Database: Embase Classic+Embase <1947 to 2021 February 04>
Search Strategy:
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1 "interventional lung assist*".mp. (138)
2 (extracorporeal adj (CO2 or "carbon dioxide") adj removal).mp. (684)
3 ILA*.mp. (8082)
4 novalung*.mp. (301)
5 PECLA*.mp. (60)
6 "percutaneous extracorporeal lung assist*".mp. (2)
7 "partial extracorporeal support*".mp. (0)
8 (("carbon dioxide" or CO2) adj dialysis*).mp. (10)
9 ECCO2R*.mp. (322)
10 "low flow ECCO2R*".mp. (25)
11 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 (8977)
12 exp Respiratory Distress Syndrome, Adult/ (41561)
13 "respiratory failure".mp. (108774)
14 "acute lung injury".mp. (25711)
15 12 or 13 or 14 (162165)
16 11 and 15 (684)
17 limit 16 to human (556)

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1.

Management of severe ARDS with low frequency positive pressure ventilation and extracorporeal CO2 removal.
Hickling K.G., Downward G., Davis F.M., A'Court G.
Anaesthesia and Intensive Care. 14 (1) (pp 79-83), 1986. Date of Publication: 1986.
AN: 16085525
PMID
3082239 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3082239]
Institution
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Link to the Ovid Full Text or citation:
Click here for full text options

2.

Ultraprotective ventilation allowed by extracorporeal CO2 removal improves the right ventricular function in acute respiratory distress syndrome patients: a quasi-experimental pilot study.
Goursaud S., Valette X., Dupeyrat J., Daubin C., du Cheyron D.
Annals of Intensive Care. 11 (1) (no pagination), 2021. Article Number: 3. Date of Publication: December 2021.
AN: 2010134220
Background: Right ventricular (RV) failure is a common complication in moderate-to-

severe acute respiratory distress syndrome (ARDS). RV failure is exacerbated by hypercapnic acidosis and overdistension induced by mechanical ventilation. Veno-venous extracorporeal CO2 removal (ECCO2R) might allow ultraprotective ventilation with lower tidal volume (VT) and plateau pressure (Pplat). This study investigated whether ECCO2R therapy could affect RV function.
Method(s): This was a quasi-experimental prospective observational pilot study performed in a French medical ICU. Patients with moderate-to-severe ARDS with PaO2/FiO2 ratio between 80 and 150 mmHg were enrolled. An ultraprotective ventilation strategy was used with VT at 4 mL/kg of predicted body weight during the 24 h following the start of a low-flow ECCO2R device. RV function was assessed by transthoracic echocardiography (TTE) during the study protocol.
Result(s): The efficacy of ECCO2R facilitated an ultraprotective strategy in all 18 patients included. We observed a significant improvement in RV systolic function parameters. Tricuspid annular plane systolic excursion (TAPSE) increased significantly under ultraprotective ventilation compared to baseline (from 22.8 to 25.4 mm; $p < 0.05$). Systolic excursion velocity (S' wave) also increased after the 1-day protocol (from 13.8 m/s to 15.1 m/s; $p < 0.05$). A significant improvement in the aortic velocity time integral (VTIAo) under ultraprotective ventilation settings was observed ($p = 0.05$). There were no significant differences in the values of systolic pulmonary arterial pressure (sPAP) and RV preload.
Conclusion(s): Low-flow ECCO2R facilitates an ultraprotective ventilation strategy thatwould improve RV function in moderate-to-severe ARDS patients. Improvement in RV contractility appears to be mainly due to a decrease in intrathoracic pressure allowed by ultraprotective ventilation, rather than a reduction of PaCO2.

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Publisher
Springer Science and Business Media Deutschland GmbH

3.

A new, minimally invasive and highly effective extracorporeal CO2 removal device combined with a continuous renal replacement therapy.
Busana M., Zanella A., De Falco S., Di Girolamo L., Scotti E., Protti I., Colombo S., Biancolilli O., Gori F., Grasselli G., Dondossola D., Gatti S., Pesenti A.
Perfusion. Conference: EuroELSO Congress 2020. United Kingdom. 35 (1 SUPPL) (pp 137), 2020. Date of Publication: May 2020.
AN: 633765032
Objective: Extracorporeal carbon dioxide Removal (ECCO2R) is used to treat patients suffering from acute respiratory failure. Its use is hampered by the high blood flow required to achieve a relevant CO2 clearance. We developed an ultra-low blood flow device to effectively remove CO2 and perform continuous renal replacement therapy (CRRT).
Method(s): Six pigs were connected to an extracorporeal circuit where 200 ml/min of

blood flowed through a hemofilter connected to a closed-loop dialysate circuit. An ion-exchange resin acidified the dialysate flow upstream a membrane lung to increase PCO2, thus enhancing CO2 removal. Different levels of acidification were tested (from 0 to 5 mEq/min). Two l/h of post-dilution CRRT were constantly performed. At each step, we decreased the respiratory rate to maintain arterial PCO2 at 50 mmHg Results: Increasing acidification increased CO2 removal of the membrane lung from 30+/-5 (0 mEq/min) up to 145+/-8 ml/min (5 mEq/min), a 483% increase, representing the 73+/-7% of the total CO2 production. Minute ventilation decreased accordingly from 6.5+/-0.7 to 1.7+/-0.5 l/min. No major side effects occurred, but transient tachycardia episodes
Conclusion(s): This new extracorporeal ion-exchange resin-based multiorgan support device, proved extremely high efficiency in CO2 removal and continuous renal support. Future evaluations of long-term efficacy and safety will be required. (Table Presented).
Institution
(Busana) Anesthesia and Critical Care Medicine, Universitatsmedizin Gottingen, Gottingen, Germany (Busana, Zanella, De Falco, Di Girolamo, Scotti, Protti, Colombo, Biancolilli, Gori, Grasselli, Dondossola, Gatti, Pesenti) Dipartimento di Scienze Biomediche per la Salute, Universita degli Studi di Milano, Milan, Italy (Zanella, Grasselli, Dondossola, Gatti, Pesenti) Anesthesia and Intensive Care Medicine, IRCCS Policlinico Ospedale Maggiore, Milan, Italy
Publisher
SAGE Publications Inc.

4.

Extracorporeal Carbon Dioxide Removal (ECCO2R) in Acute Respiratory Distress Syndrome (ARDS): A systematic review and meta-analysis.
Ho C., Choo A., Huiling R., Cove M.E., Maclaren G., Ramanathan K.
Perfusion. Conference: EuroELSO Congress 2020. United Kingdom. 35 (1 SUPPL) (pp 179), 2020. Date of Publication: May 2020.
AN: 633764916
Objective: To review peer-reviewed publications on effectiveness of ECCO2R in patients with ARDS.
Method(s): We searched MEDLINE, Embase, Ovid and Scopus using appropriate keywords from 1978 till 2019. We included randomized controlled trials (RCTs), case-control studies and case series with 10 or more patients. Our primary endpoint was mortality; we looked at hospital length of stay (HLOS), quantified CO2 removal, respiratory parameters and complications of ECCO2R in ARDS patients. Publications were reviewed for quality using the Joanna Briggs Institute checklist. Anticipating substantial heterogeneity between studies, we applied a random-effects model for all analyses.
Result(s): Of the 566 publications screened, we shortlisted 25 articles that reported on mortality, with a total of 989 patients (2RCTs and 23 observational studies). Arteriovenous ECCO2R was used in fourteen studies, venovenous in eight studies and a combination in three studies. Overall pooled hospital mortality was 45%, (CI 34% - 56%, $p < 0.01$) with pooled mean HLOS being 34.97 days. 17 studies reported a pooled mean reduction in pCO2 of 20.42mmHg (CI 12.49 - 28.35, $p < 0.01$). Respiratory parameters also improved with a pooled mean decrease in plateau pressure by 3.41 mmHg, minute volume by 3.75 L/min and tidal volume by 1.76ml/kg. Complication rates varied greatly across studies, with mechanical circuit and

bleeding (19.8% and 20.8% respectively) the most common.
Conclusion(s): Patients with ARDS who received ECCOR had a pooled hospital mortality of 45%. ECCOR helped reducing hypercapnia and improved respiratory mechanics in moderate to severe ARDS with variable complication rates. Further RCTs are needed.
Institution
(Ho, Choo, Huiling) National University of Singapore, Singapore, Singapore (Cove, Maclaren, Ramanathan) National University Hospital, Singapore, Singapore
Publisher
SAGE Publications Inc.

Link to the Ovid Full Text or citation:
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5.

Venovenous ecco2r (extracorporeal co2 removal) in moderate-severe ards: Can equipoise give way to efficacy? A systematic review.
Worku E., Brodie D., Hay K., Shekar K.
ASAIO Journal. Conference: 31st Annual Conference of the Extracorporeal Life Support Organization, ELSO 2020. United States. 66 (SUPPL 3) (pp 12), 2020. Date of Publication: 2020.
AN: 633718672
Introduction: Acute respiratory distress syndrome(ARDS) is associated with high morbidity and mortality. Conventional lung protective mechanical ventilation offers benefit through mitigation of ventilator-induced lung injury. Ultra-protective ventilation (UPV; Pplat<=25cmH20, Vt<=4ml/Kg), facilitated by venovenous extracorporeal CO2 removal (vvECCO2R), may afford additional benefit.
Objective(s): Systematically review efficacy and safety of vvECCO2R in moderate-severe ARDS.
Method(s): MEDLINE and EMBASE were interrogated for studies (January 2000-September 2019) reporting vvECCO2R [blood flow rate (BFR)<2L. min-1] use in >=10 adult patients with ARDS. Changes in mechanical ventilation after 24hrs of vvECCO2R, and safety outcomes were recorded.
Result(s): Eight studies reporting 201 patients, receiving vvECCO2R with blood flow rates (BFR) 0.4-1.5 L.min-1 were included. Driving pressure(DELTAP) fell from 10-19 (pre) to 7-14cmH20 (post) in 4 studies, tidal volume from 5.3-6.9 to 3.9-5.6ml/Kg and Pplat from 25-31 to. 21-25cmH20. Some improvements in pH (7.21-7.39 vs. 7.31-7.40) and PaCO2 (43-68 vs. 42-53mmHg) were observed. The PaO2:FiO2 ratio (83-188 to131-184mmHg); respiratory rate (20-32 vs. 20-32), and PEEP (12-14 to 11-15cmH20) remained unchanged. Random effects modelling (r=0.5), indicated a 3.9 cmH20 reduction in DELTAP (95%CI: 3.0-4.7) p<0.001. Study heterogeneity precluded further metaanalysis. Bleeding and hemolysis were the commonest complications (21% and 20%, respectively).
Conclusion(s): VvECCO2R permitted significant reductions in DELTAP in moderate-to-severe ARDS. Lack of reductions in RR and PEEP may still result in harmful mechanical power delivery to the lung. Study heterogeneity, and variable reporting calls for standardisation of core outcomes. Prospective evaluations of the optimal patient selection, operating characteristics, and anticoagulation strategies for vvECCO2R are required.
Institution
(Worku, Shekar) Prince Charles Hospital Chermside, Adult Intensive Care Services, Brisbane, Australia (Worku) University of Queensland, Brisbane, QLD, Australia (Brodie) Columbia University College of Physicians, New York Presbyterian Hospital,

New York, United States
(Hay) Qimr, Brisbane, Australia
(Shekar) University of Queensland, Brisbane, QLD, Australia
Publisher
Lippincott Williams and Wilkins

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6.

Role of veno-venous extracorporeal carbon dioxide removal in coronavirus disease 2019 associated acute respiratory distress syndrome.
Zaidi G., Fryman C., Hasan Z., Manetta F., Narasimhan M.
ASAIO Journal. Conference: 31st Annual Conference of the Extracorporeal Life Support Organization, ELSO 2020. United States. 66 (SUPPL 3) (pp 28), 2020. Date of Publication: 2020.
AN: 633718099
Introduction: Standard management for acute respiratory distress syndrome secondary to Coronavirus disease 2019 (COVID-19) includes low tidal volume lung-protective mechanical ventilation, paralytics and prone positioning. Permissive hypercapnia is allowed to reduce the risk of barotrauma. Despite stabilization of oxygenation, some patients develop progressive respiratory acidosis. This may be due to a combination of mucus plugging and microthrombi in the lungs.
Method(s): We describe the use of veno-venous extracorporeal carbon dioxide removal (ECCO2R) in three patients with COVID-19 associated severe ARDS and refractory.
Result(s): Patient 1 showed improvement in respiratory acidosis following initiation of ECCO2R, however after 24 hours of stabilization he developed progressive hypoxemia and cardiac arrest without return of spontaneous circulation. Patient 2 showed improvement in respiratory acidosis following initiation of ECCO2R and remained stable for several days before developing progressive hypoxemia requiring veno-venous extracorporeal membrane oxygenation (V-V ECMO) support. He was successfully weaned off V-V ECMO after two weeks. Patient 3 also remained stable on ECCO2R support for a week before developing refractory hypoxemia and cardiac arrest without return of spontaneous circulation.
Conclusion(s): In severe COVID-19 ARDS on optimal lung-protective ventilation, progressive hypoxemia may lag behind hypercapnia, rendering carbon dioxide removal alone insufficient. We suggest that patients who develop progressive respiratory acidosis despite maximum optimization of lung-protective ventilation should be considered for V-V ECMO support rather than ECCO2R alone.
Institution
(Zaidi, Fryman, Hasan, Narasimhan) Division of Pulmonary Critical Care and Sleep Medicine, Northwell Health System, New Hyde Park, United States (Manetta) Department of Cardiothoracic Surgery, Northwell Health System, New Hyde Park, United States
Publisher
Lippincott Williams and Wilkins

Link to the Ovid Full Text or citation:
Click here for full text options

7.

Effect of hematocrit and plasma protein concentration on CO2 removalin artificial lungs.
May A.G., Omecinski K.S., Frankowski B.J., Federspiel W.J.
ASAIO Journal. Conference: 66th Annual Conference of the American Society for Artificial Internal Organs, ASAIO 2020. United States. 66 (SUPPL 2) (pp 72), 2020. Date of Publication: June 2020.
AN: 633684547
Study: Extracorporeal CO2 removal has the potential to benefit two important patient populations, patients with acute respiratory distress syndrome (ARDS) and those with acute exacerbations of COPD (aeCOPD). In ARDS patients ECCO2R may allow the use of lung protective mechanical ventilation and in the aeCOPD population it may prevent the need for invasive mechanical ventilation altogether. As the investigation of ECCO2R clinically rises, all factors that influence the CO2 removal rate in ECCO2R should be well understood. While many factors have been explored, some have not. In this study we explored in- vitro the effect of hematocrit (HCT) and presence of plasma proteins on CO2 removal in ECCO2R.
Method(s): Bovine blood was diluted with saline or plasma to HCT levels ranging from 33% to 8%. In vitro CO2 removal was evaluated in our ambulatory artificial lung according to ISO standards at a blood flowrate of 500 ml/min, a flowrate that provides therapeutic ECCO2R in our device.
Result(s): CO2 removal rate (vCO2) decreased linearly by 42% and 32% in saline and plasma respectively from a HCT of 33% to 8%. The difference in vCO2 in plasma versus saline was not statistically significant. The effect of HCT on vCO2 is hypothesized, as is the case in the native lung, to be due to the release of fewer Bohr protons, a decreased buffering capacity of blood due to lack of red blood cells (RBC), and a reduced flux of bicarbonate ion across the RBC membrane. Thus, the HCT of blood should be accounted for when assessing the CO2 removal rate in ECCO2R.
Institution
(May, Omecinski, Frankowski, Federspiel) McGowan Institute of Regenerative Medicine, Pittsburgh, PA, United States
Publisher
Lippincott Williams and Wilkins

Link to the Ovid Full Text or citation:
Click here for full text options

8.

The successful use of extracorporeal carbon dioxide removal as a rescue therapy in a patient with severe COVID-19 pneumonitis.
Tully R.P., Hopley N., Lawrence G.
Anesthesia Reports. 8 (2) (pp 113-115), 2020. Date of Publication: July-December 2020.
AN: 2007254881
We present a patient with severe COVID-19 pneumonitis; poor respiratory compliance; dangerously high ventilator pressures; and hypercapnia refractory to conventional treatment including low tidal volume ventilation, neuromuscular blockade and prone position ventilation. Extracorporeal carbon dioxide removal was used as a rescue therapy to facilitate safer ventilator pressures and arterial partial

pressures of carbon dioxide. After 6 days of treatment, the patient had improved to the extent that the extracorporeal support was able to be weaned and the patient was decannulated from the device. Following a prolonged respiratory wean, the patient was subsequently discharged from the intensive care unit and then from the hospital to home with no adverse events related to the therapy.

Institution
(Tully) Intensive Care Medicine and Anaesthesia, Royal Oldham Hospital, Oldham, United Kingdom (Hopley) Intensive Care Medicine, Royal Oldham Hospital, Oldham, United Kingdom
(Lawrence) Royal Oldham Hospital, Oldham, United Kingdom
Publisher
John Wiley and Sons Inc

9.

Adult respiratory distress syndrome in the trauma patient.
Snider M.T.
Critical Care Clinics. 6 (1) (pp 103-110), 1990. Date of Publication: 1990.
AN: 20083800
A high mortality rate still exists for the patient with ARDS 20 years after the severe syndrome was first formally defined. Hypoxia and hypercarbia remain major clinical challenges requiring mechanical ventilation. The pulmonary vascular bed has been identified as a prime site of injury. The major working hypothesis is that cellular injury is caused by oxyradicals produced by activated neutrophils. There is no present pharmacologic therapy based on this hypothesis. Steroids have no demonstrable effect on outcome. Major advances have been made in the use of extracorporeal membrane lungs to relieve hypercarbia and hypoxia while minimizing pulmonary oxygen toxicity and barotrauma. The most promising current technique is extracorporeal CO2 removal during venovenous perfusion. Further advances must await definition of the early stages of the ARDS.
PMID
2404541 [http://www.ncbi.nlm.nih.gov/pubmed/?term=2404541]
Institution
(Snider) The Milton S. Hershey Medical Center, The Pennsylvania State University, P.O. Box 850, Hershey, PA 17033 United States

10.

Practical clinical application of an extracorporeal carbon dioxide removal system in acute respiratory distress syndrome and acute on chronic respiratory failure.
Grasselli G., Castagna L., Bottino N., Scaravilli V., Corcione N., Guzzardella A., Bonifazi M., Rossi N., Zanella A., Pesenti A.
ASAIO Journal. 66 (6) (pp 691-697), 2020. Date of Publication: 01 Jun 2020.

AN: 631966166
We retrospectively reviewed the medical records of 11 patients supported with a veno-venous low-flow extracorporeal carbon dioxide (CO2) removal (ECCO2R) device featuring a large gas exchange surface membrane lung (ML) (i.e., 1.8 m2). Seven patients suffered from exacerbation of a chronic pulmonary disease, while four subjects were affected by acute respiratory distress syndrome (ARDS). Twenty-four hours of ECCO2R treatment reduced arterial PCO2from 63 +/- 12 to 54 +/- 11 mm Hg ($p < 0.01$), increased arterial pH from 7.29 +/- 0.07 to 7.39 +/- 0.06 ($p < 0.01$), and decreased respiratory rate from 32 +/- 10 to 21 +/- 8 bpm ($p < 0.05$). Extracorporeal blood flow and CO2removal were 333 +/- 37 and 94 +/- 18 ml/min, respectively. The median duration of ECCO2R treatment was 7 days (6.5-9.5). All four ARDS patients were invasively ventilated at the time of treatment start, no one was extubated and they all died. Among the seven patients with exacerbation of chronic pulmonary diseases, four were managed with noninvasive ventilation at ECCO2R institution, while three were extubated after starting the extracorporeal treatment. No one of these seven patients was intubated or re-intubated after ECCO2R institution and five (71%) survived to hospital discharge. A low-flow ECCO2R device with a large surface ML removes a relevant amount of CO2resulting in a decreased arterial PCO2, an increased arterial pH, and in a reduced ventilatory load.

PMID
31425258 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31425258]
Institution
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Publisher
Lippincott Williams and Wilkins

11.

Extracorporeal life support for adults with acute respiratory distress syndrome.
Combes A., Schmidt M., Hodgson C.L., Fan E., Ferguson N.D., Fraser J.F., Jaber S., Pesenti A., Ranieri M., Rowan K., Shekar K., Slutsky A.S., Brodie D.
Intensive Care Medicine. 46 (12) (pp 2464-2476), 2020. Date of Publication: December 2020.
AN: 2007139287
Extracorporeal life support (ECLS) can support gas exchange in patients with the acute respiratory distress syndrome (ARDS). During ECLS, venous blood is drained from a central vein via a cannula, pumped through a semipermeable membrane that permits diffusion of oxygen and carbon dioxide, and returned via a cannula to a central vein. Two related forms of ECLS are used. Venovenous extracorporeal membrane oxygenation (ECMO), which uses high blood flow rates to both oxygenate the blood and remove carbon dioxide, may be considered in patients with severe ARDS whose oxygenation or ventilation cannot be maintained adequately with best practice conventional mechanical ventilation and adjunctive therapies, including prone positioning. Extracorporeal carbon dioxide removal (ECCO2R) uses lower blood flow rates through smaller cannulae and provides substantial CO2 elimination (~ 20-70% of total CO2 production), albeit with marginal improvement in oxygenation.

The rationale for using ECCO2R in ARDS is to facilitate lung-protective ventilation by allowing a reduction of tidal volume, respiratory rate, plateau pressure, driving pressure and mechanical power delivered by the mechanical ventilator. This narrative review summarizes physiological concepts related to ECLS, as well as the rationale and evidence supporting ECMO and ECCO2R for the treatment of ARDS. It also reviews complications, limitations, and the ethical dilemmas that can arise in treating patients with ECLS. Finally, it discusses future key research questions and challenges for this technology.

PMID
33140180 [http://www.ncbi.nlm.nih.gov/pubmed/?term=33140180]
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(Hodgson) Australian and New Zealand Intensive Care-Research Centre, Monash University, Melbourne, Australia
(Fan) Interdepartmenal Division of Critical Care Medicine, University of Toronto, Toronto, ON, Canada
(Fan) Department of Medicine, Division of Respirology, University Health Network, Toronto, ON, Canada
(Ferguson) Department of Medicine, Division of Respirology, University Health Network, Toronto, ON, Canada
(Ferguson) Interdepartmental Division of Critical Care Medicine and Department of Medicine, University of Toronto, Toronto, ON, Canada
(Fraser) Critical Care Research Group, Adult Intensive Care Services, Northside Medical School, The Prince Charles Hospital, University of Queensland, Brisbane, Australia
(Jaber) Institut National de la Sante et de la Recherche Medicale (INSERM), Centre National de la Recherche Scientifique (CNRS), From the PhyMedExp, University of Montpellier, Centre Hospitalier Universitaire (CHU) Montpellier, Montpellier, France
(Jaber) Departement d'Anesthesie-Reanimation, Hopital Saint-Eloi, Montpellier Cedex, France
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(Ranieri) Intensive Care Unit, Policlinico di Sant'Orsola, Alma Mater Studiorum University of Bologna, Bologna, Italy
(Rowan) Clinical Trials Unit, Intensive Care National Audit and Research Centre (ICNARC), London, United Kingdom
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(Brodie) Center for Acute Respiratory Failure, NewYork-Presbyterian Hospital, NY, United States
Publisher
Springer Science and Business Media Deutschland GmbH

12.

Recovery from total acute lung failure after 20 months of extracorporeal life support.
Nelson-McMillan K., Vricella L.A., Stewart F.D., Young J., Shah A.S., Hibino N., Coulson J.D.
ASAIO Journal. 66 (1) (pp e11-e14), 2020. Date of Publication: 01 Jan 2020.
AN: 631607214
Since the first successful case report in 1972, extracorporeal life support or extracorporeal membrane oxygenation (ECMO) has become a standard approach for severe respiratory failure unresponsive to other therapy. In the past, if there was no recovery by approximately 30 days or if right ventricular heart failure occurred, ECMO was discontinued and the patient died. More recently patients with severe lung disease have been maintained for months, as opposed to days, with eventual decannulation and recovery. We report the case of a child, 7 years old, with severe inhalational burn injury and rapid progression to multisystem organ failure. She was supported by ECMO with no lung function for almost 2 years. Central nervous system function remained normal and lung function recovered. This is the longest successful case of ECMO to date and prompts further discussion regarding "irreversible" lung injury.

PMID
30908288 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30908288]
Institution
(Nelson-McMillan, Vricella, Stewart, Hibino, Coulson) Johns Hopkins University School of Medicine, Baltimore, MD, United States (Nelson-McMillan) Department of Anesthesiology and Critical Care Medicine, Division of Pediatric Critical Care, Johns Hopkins University School of Medicine, Baltimore, MD, United States
(Nelson-McMillan, Coulson) Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, MD, United States
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(Vricella, Stewart, Hibino) Department of Surgery, Hopkins University School of Medicine, Baltimore, MD, United States
(Stewart) Division of Pediatric General Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States
(Hibino) Division of Pediatric Cardiothoracic Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States
(Young) Department of Pediatric ECMO and VAD Program, Johns Hopkins Hospital, Baltimore, MD, United States
(Shah) Department of Cardiac Surgery, Vanderbilt University Medical Center, Nashville, TN, United States
Publisher
Lippincott Williams and Wilkins

Link to the Ovid Full Text or citation:
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13.

Extracorporeal Carbon Dioxide Removal Using a Renal Replacement Therapy Platform to Enhance Lung-Protective Ventilation in Hypercapnic Patients With Coronavirus Disease 2019-Associated Acute Respiratory Distress Syndrome.
Husain-Syed F., Birk H.-W., Wilhelm J., Ronco C., Ranieri V.M., Karle B., Kuhnert S., Tello K., Hecker M., Morty R.E., Herold S., Kehl O., Walmrath H.-D., Seeger W., Vadasz I.
Frontiers in Medicine. 7 (no pagination), 2020. Article Number: 598379. Date of Publication: 12 Nov 2020.
AN: 633491403
Coronavirus disease 2019 (COVID-19)-associated acute respiratory distress syndrome (ARDS) is associated with high mortality. Lung-protective ventilation is the current standard of care in patients with ARDS, but it might lead to hypercapnia, which is independently associated with worse outcomes. Extracorporeal carbon dioxide removal (ECCO2R) has been proposed as an adjuvant therapy to avoid progression of clinical severity and limit further ventilator-induced lung injury, but its use in COVID-19 has not been described yet. Acute kidney injury requiring renal replacement therapy (RRT) is common among critically ill COVID-19 patients. In centers with available dialysis, low-flow ECCO2R (<500 mL/min) using RRT platforms could be carried out by dialysis specialists and might be an option to efficiently allocate resources during the COVID-19 pandemic for patients with hypercapnia as the main indication. Here, we report the feasibility, safety, and efficacy of ECCO2R using an RRT platform to provide either standalone ECCO2R or ECCO2R combined with RRT in four hypercapnic patients with moderate ARDS. A randomized clinical trial is required to assess the overall benefit and harm. Clinical Trial Registration: ClinicalTrials.gov. Unique identifier: NCT04351906.

Institution
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(Husain-Syed, Ronco) International Renal Research Institute of Vicenza, San Bortolo Hospital, Vicenza, Italy
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(Wilhelm, Tello, Morty, Herold, Seeger, Vadasz) The Cardio-Pulmonary Institute, Giessen, Germany
(Wilhelm, Seeger) Institute for Lung Health, Justus Liebig University Giessen, Giessen, Germany
(Ronco) Department of Medicine (DIMED), Universita di Padova, Padua, Italy
(Ranieri) Department of Medical and Surgical Sciences (DIMEC), Anaesthesia and Intensive Care Medicine, Sant'Orsola-Malpighi Hospital, Alma Mater Studiorum University of Bologna, Bologna, Italy
(Morty, Seeger) Department of Lung Development and Remodelling, Max Planck Institute for Heart and Lung Research, Bad Nauheim, Germany
Publisher
Frontiers Media S.A.

14.

Intraoperative extracorporeal carbon dioxide removal support for minimally invasive surgical treatment of vanishing lung syndrome.
Dell'Amore A., Monaci N., Boschetto G., Bellini A., Pangoni A., Schiavon M., Serra E., Rea F.
General Thoracic and Cardiovascular Surgery. 68 (12) (pp 1517-1522), 2020. Date of Publication: December 2020.
AN: 2003841534
Vanishing lung syndrome is a rare disease that could be treated successfully in selected cases with bullectomy. Protective ventilation is very important during surgery to achieve optimal post-operative results and to prevent complications. Hypercapnia and respiratory acidosis are the main disadvantages of this ventilator strategy. The use of extracorporeal CO2 removal device has been introduced to support protective and ultra-protective ventilation during respiratory failure in complex cases. In thoracic surgery the intraoperative use of this device is still not widespread. We report a successful case of a giant left lung bullectomy with intraoperative support with Pro-Lung CO2 removal device for the management of hypercapnia during single lung ventilation.

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31828519 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31828519]
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Publisher
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15.

Multi organ support with extracorporeal carbon dioxide removal (ECCO2R) and continuous renal replacement therapy (CRRT) with citrate anticoagulation in the clinical setting of difficult weaning from mechanical ventilation.
Ricci D., Sagliocchi A., Siniscalchi A., Ranieri M., Mancini E.
Nephrology Dialysis Transplantation. Conference: 57th Annual Congress of the European Renal Association-European Dialysis and Transplant Association, ERA-EDTA 2020. Italy. 35 (SUPPL 3) (pp iii1438), 2020. Date of Publication: June 2020.
AN: 633422308
Background and Aims: Prolonged mechanical ventilation is associated with the risk of difficult weaning due to the onset of muscle weakness. A disproportion occurs between the respiratory workload and the muscular force, which leads to failure of the ventilatory pump and hypercapnia. Some early experiences suggest that ECCO2R facilitates weaning from the ventilator in patients with a high risk of failure. Method(s): Clinical case: a 49 year-old man with a) recent orthotopic liver transplantation (cryptogenic cirrhosis), b) acute renal injury (AKI) on continuous

veno-venous hemofiltration (CVVH) and c) acute respiratory distress syndrome (ARDS) requiring prolonged mechanical ventilation. After unsuccessful attempts at weaning from the ventilator, a lung membrane was inserted in series, before the hemofilter, on the CRRT circuit in order to remove CO2 and so reduce the workload of the respiratory muscles (Fig. 1). The patient was then extubated. We used citrate anticoagulation due to the presence of contraindications to systemic heparin (high bleeding risk, thrombocytopenia).
Result(s): ECCO2R + CRRT treatment requires a relatively high blood flow (300-350 ml / min) in order to extract a significant amount of CO2, but, the more the blood flow increases, the more citrate must be infused, and the more the metabolic load increases. The patient developed mild alkalosis as an initial sign of citrate accumulation (Table 1), but it was self-limiting. During ECCO2R we actually obtained the desired decrease in respiratory muscle effort (decrease in respiratory rate from 24 to 18 per minute and a maximum negative value of esophageal pressure from -8 to -4 cmH2O) and the treatment was interrupted after 36 hours. Mechanical ventilation was restored due to a complication independent of ECCO2R (massive pneumothorax). The patient tolerated the treatment for 36 hours.
Conclusion(s): ECCO2R proved an efficient and relatively simple technology helping respiratory function recovery. Due to the very frequent association of AKI and ARDS, leading to a high mortality rate, nephrological care in intensive care units should include this new treatment. Moreover, reduction of the inflammatory pathway secondary to mechanical ventilation could also benefit the evolution of AKI.
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Publisher
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16.

Extracorporeal CO2 removal and the alveolar gas equation.
Dickstein M.L.
American Journal of Respiratory and Critical Care Medicine. 202 (7) (pp 1057-1058), 2020. Date of Publication: 01 Oct 2020.
AN: 2008018886
PMID
32502357 [http://www.ncbi.nlm.nih.gov/pubmed/?term=32502357]
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Publisher
American Thoracic Society

17.

Early signs of right ventricular systolic and diastolic dysfunction in acute severe respiratory failure: the importance of diastolic restrictive pattern.
Tavazzi G., Bergsland N., Alcada J., Price S.
European Heart Journal: Acute Cardiovascular Care. 9 (6) (pp 649-656), 2020. Date of Publication: September 2020.
AN: 2003736038
Background: The incidence and pathophysiology of right ventricular failure in patients with severe respiratory insufficiency has been largely investigated. However, there is a lack of early signs suggesting right ventricular systolic and diastolic dysfunction prior to acute cor pulmonale development.
Method(s): We conducted a retrospective analytical cohort study of patients for acute respiratory distress syndrome undertaking an echocardiography during admission in the cardiothoracic intensive care unit. Patients were divided according to treatment: conventional protective ventilation (38 patients, 38%); interventional lung assist (23 patients, 23%); veno-venous extracorporeal membrane oxygenation (37 patients, 37%). Systolic and diastolic function was studied assessing, respectively: right ventricular systolic longitudinal function (tricuspid annular plane systolic excursion) and systolic contraction duration (tricuspid annular plane systolic excursion length); right ventricular diastolic filling time and right ventricular diastolic restrictive pattern (presence of pulmonary valve presystolic ejection wave). Correlation between the respiratory mechanics and systo-diastolic parameters were analysed.
Result(s): In 98 patients studied, systolic dysfunction (tricuspid annular plane systolic excursion <16 mm) was present in 33.6% while diastolic restrictive pattern was present in 64%. A negative correlation was found between tricuspid annular plane systolic excursion and tricuspid annular plane systolic excursion length (P<0.0001; r -0.42). Tricuspid annular plane systolic excursion and tricuspid annular plane systolic excursion length correlated with right ventricular diastolic filling time (P<0.001; r -0.39). Pulmonary valve presystolic ejection wave was associated with tricuspid annular plane systolic excursion (P<0.0001), tricuspid annular plane systolic excursion length (P<0.0001), right ventricular diastolic filling time (P<0.0001), positive end-expiratory pressure (P<0.0001) and peak inspiratory pressure (P<0.0001).
Conclusion(s): Diastolic restrictive pattern is present in a remarkable percentage of patients with respiratory distress syndrome. Bedside echocardiography allows a mechanistic evaluation of systolic and diastolic interaction of the right ventricle.

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SAGE Publications Inc.

18.

Low flow veno-venous extracorporeal CO2 removal for acute hypercapnic respiratory failure.
Hilty M.P., Riva T., Cottini S.R., Kleinert E.-M., Maggiorini A., Maggiorini M.
Minerva Anestesiologica. 83 (8) (pp 812-823), 2017. Date of Publication: August 2017.
AN: 617550227
BACKGROUND: Ventilation with low tidal volume and airway pressure results in a survival benefit in ARDS patients. Previous research suggests that avoiding mechanical ventilation altogether may be beneficial in some cases of respiratory failure. Our hypothesis was that low flow veno-venous extracorporeal CO2 removal (ECCO2R) enables maintenance of a lung protective ventilation strategy or awake spontaneous ventilation despite severe hypercapnic respiratory failure (HRF).
METHOD(S): Twenty patients with HRF were investigated while mechanically ventilated (N.=14) or breathing spontaneously close to respiratory exhaustion (N.=6). Low flow ECCO2R was performed using a hemoperfusion device with a polypropylene gas-exchanger. RESULTS : Causes of HRF were severe ARDS (N.=11), COPD (N.=4), chronic lung transplant rejection (N.=3) and cystic fibrosis (N.=2). During the first 8h of ECCO2R, PaCO2 decreased from 10.6 (9.3-12.9) to 7.9 (7.3-9.3) kPa (P<0.001) and pH increased from 7.23 (7.09-7.40) to 7.36 (7.27-7.41) (P<0.05). Thereafter, steady state was achieved while maintaining lung protective tidal volume (4.7 (3.8-6.5) mL/kg) and peak ventilator pressure (28 (27-30) mbar at 24 h). During the first 48 h, thrombocyte count decreased by 52% (P<0.01), Fibrinogen by 38% (P<0.05). Intubation could be avoided in all spontaneously breathing patients. In 4/6 high blood flow extracorporeal circulation was required due to increased oxygen demand. 6/14 mechanically ventilated patients recovered from respiratory support.
CONCLUSION(S): Our results suggest that in mechanically ventilated patients with HRF, low flow ECCO2R supports the maintenance of lung protective tidal volume and peak ventilator pressure. In selected awake patients with acute HRF, it may be a novel treatment approach to avoid mechanical ventilation, hence preventing ventilator- and sedation-associated morbidity and mortality.

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19.

ECCO2R therapy in the ICU: Consensus of a European round table meeting.
Combes A., Auzinger G., Capellier G., Du Cheyron D., Clement I., Consales G., Dabrowski W., De Bels D., De Molina Ortiz F.J.G., Gottschalk A., Hilty M.P., Pestana D., Sousa E., Tully R., Goldstein J., Harenski K.

Critical Care. 24 (1) (no pagination), 2020. Article Number: 490. Date of Publication: 07 Aug 2020.
AN: 632556786
Background: With recent advances in technology, patients with acute respiratory distress syndrome (ARDS) and severe acute exacerbations of chronic obstructive pulmonary disease (ae-COPD) could benefit from extracorporeal CO2 removal (ECCO2R). However, current evidence in these indications is limited. A European ECCO2R Expert Round Table Meeting was convened to further explore the potential for this treatment approach.
Method(s): A modified Delphi-based method was used to collate European experts' views to better understand how ECCO2R therapy is applied, identify how patients are selected and how treatment decisions are made, as well as to identify any points of consensus.
Result(s): Fourteen participants were selected based on known clinical expertise in critical care and in providing respiratory support with ECCO2R or extracorporeal membrane oxygenation. ARDS was considered the primary indication for ECCO2R therapy (n = 7), while 3 participants considered ae-COPD the primary indication. The group agreed that the primary treatment goal of ECCO2R therapy in patients with ARDS was to apply ultra-protective lung ventilation via managing CO2 levels. Driving pressure (>= 14 cmH2O) followed by plateau pressure (P plat; >= 25 cmH2O) was considered the most important criteria for ECCO2R initiation. Key treatment targets for patients with ARDS undergoing ECCO2R included pH (> 7.30), respiratory rate (< 25 or < 20 breaths/min), driving pressure (< 14 cmH2O) and P plat (< 25 cmH2O). In ae-COPD, there was consensus that, in patients at risk of non-invasive ventilation (NIV) failure, no decrease in PaCO2 and no decrease in respiratory rate were key criteria for initiating ECCO2R therapy. Key treatment targets in ae-COPD were patient comfort, pH (> 7.30-7.35), respiratory rate (< 20-25 breaths/min), decrease of PaCO2 (by 10-20%), weaning from NIV, decrease in HCO3- and maintaining haemodynamic stability. Consensus was reached on weaning protocols for both indications. Anticoagulation with intravenous unfractionated heparin was the strategy preferred by the group.
Conclusion(s): Insights from this group of experienced physicians suggest that ECCO2R therapy may be an effective supportive treatment for adults with ARDS or ae-COPD. Further evidence from randomised clinical trials and/or high-quality prospective studies is needed to better guide decision making.

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20.

Validity of empirical estimates of physiological dead space in acute respiratory distress syndrome.
Dianti J.D., Goligher E.G., Slutsky A.S.
Critical Care. Conference: 40th International Symposium on Intensive Care and Emergency Medicine. Belgium. 24 (Supplement 1) (no pagination), 2020. Date of Publication: 2020.
AN: 633285625
Introduction: Increased physiological dead space fraction (VD/VT) is a hallmark of the acute respiratory distress syndrome (ARDS) and has been shown to predict ARDS mortality. VD/VT is also important in estimating the reduction in tidal volume (VT) and driving pressure (DELTAP) with extracorporeal CO2 removal (ECCO2R). VD/VT can be measured with volumetric capnography but empirical formulae using the patient's age, weight, height, gender and PaCO2 have been proposed to estimate VD/VT based on estimates of CO2 production (VCO2). The accuracy of this approach in critically ill patients, however, is not clear.
Method(s): Secondary analysis of a previously published trial [1] in which VD/VT and VCO2 were measured in ARDS patients. Estimated dead space fraction (VD,est/VT) was calculated using standard formulae. Agreement between methods was evaluated by Bland-Altman analysis. The predicted change in DELTAP with ECCO2R was evaluated using both measured and estimated alveolar dead space fraction (VDalv/VT).

Result(s): VD,est/VT was higher than measured VD/VT, with a low correlation between the 2 (R2= 0.21). VCO2 was underestimated by the predicted approach (Table 1), accounting for 57% of the error in estimating VD/VT. The expected reduction in DELTAP with ECCO2R using VDalv/ VT was in reasonable agreement with the expected reduction using Fig. 1 (abstract P090). Mechanical power as a function of RR and VT for varying ECCO2R and deadspace VDalv,est /VT (Bias= -0.7, Level of agreement (LOA) = -1.87 to 0.47). Measured VD/VT was the only variable associated with increased risk of mortality in univariate and multivariate logistic regressions, after adjusting for, age, SOFA score, respiratory system compliance and PaO2/FiO2 (OR 1.9, [95%CI 1.08-3.3], p= 0.02).
Conclusion(s): VD/VT and VD,est/VT showed low LOA and should not be used interchangeably. The predicted decrease in DELTAP from ECCO2R was similar when using both approaches.
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Publisher
BioMed Central Ltd

21.

Efficiency and safety of a system CRRT plus ECCO2R to allow ultraprotective ventilation protocol in patients with acute renal failure.
Maldarelli F., Alessandri F.A., D'Albo R.D., Pugliese F.P., Ranieri M.V.
Critical Care. Conference: 40th International Symposium on Intensive Care and Emergency Medicine. Belgium. 24 (Supplement 1) (no pagination), 2020. Date of Publication: 2020.
AN: 633285603
Introduction: Despite renal function replacement techniques (CRRT), a patient who develops acute renal failure(AKI) in intensive care unit (ICU) has a mortality rate of 5-80%. This risk is partly due to the adverse effect of AKI on other organs than the kidney. Respiratory complications are frequently associated with the development of AKI. New machines combining CRRT with a carbon dioxide removal membrane (ECCO2R) allows the setting up of an ultra-protective ventilation (4 ml/kg of predicted boby weight (PBW)) to reduce any lung damage from mechanical ventilation (MV). The reduction in tidal volume (Vt) is associated with a decrease in lung damage partly triggered by AKI. We evaluated the efficacy of a combined system CRRT+ECCO2R to reduce the Vt to ultraprotective values in patients with acute respiratory failure and AKI. (Figure Presented) Methods: Five patients with acute respiratory failure invasively mechanically ventilated for at least 48 that develop AKI needing CRRT were recruited in our ICU. CRRT + ECCO2R was performed with OMNI system (B.Braun Avitum, Melsungen, Germany). The Vt was progressively reduced to 4 ml/kg/PBW according to a predefined ventilation protocol and therapy was set as follows: CVVHDF, blood flow up to 400 ml/min, dialysis dose 25-35 ml/kg/h, sweep gas:10 L/min. Hemodynamic, respiratory and biochemical clinical parameters were recorded: before the start of treatment (T0) and at the end of each 12-hour interval. Adverse events during treatment have been reported.
Result(s): Within an hour, patients treated with CRRT+ECCO2R have achieved and maintained an ultra-protective ventilation protocol. The pH and PaCO2 values did not show statistically significant differences from T0 throughout the treatment. In treated patients no complications were recorded.

Conclusion(s): The combined system CRRT+ECCO2R was safe and effective in allowing a reduction of the Vt up to 4 ml/kg of PBW. Further studies are needed to extend the result of our pilot study.
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22.

Validity of Empirical Estimates of the Ratio of Dead Space to Tidal Volume in ARDS.
Dianti J., Slutsky A.S., Goligher E.C.
Respiratory care. (no pagination), 2020. Date of Publication: 20 Oct 2020.
AN: 633225163
BACKGROUND: The ratio of dead space to tidal volume (VD/VT) is a clinically relevant parameter in ARDS; it has been shown to predict mortality, and it determines the extent to which extracorporeal CO2 removal reduces tidal volume (VT) and driving pressure (DELTAP). VD/VT can be estimated with volumetric capnography, but empirical formulas using demographic and physiological information have been proposed to estimate VD/VT without the need of additional equipment. It is unknown whether estimated and measured VD/VT produce similar estimates of the predicted effect of extracorporeal CO2 removal on DELTAP.
METHOD(S): We performed a secondary analysis of data from a previous clinical trial including subjects with ARDS in whom VD/VT and CO2 production (VCO2) were measured with volumetric capnography. The estimated ratio of dead space to tidal volume (VD,est/VT) was calculated using standard empiric formulas. Agreement between measured and estimated values was evaluated with Bland-Altman analysis. Agreement between the predicted change in DELTAP with extracorporeal CO2 removal as computed using the measured ratio of alveolar dead space to tidal volume (VDalv/VT) or estimated VDalv/VT (VDalv,est/VT) was also evaluated.
RESULT(S): VD,est/VT was higher than measured VD/VT, and agreement between them was low (bias 0.05, limits of agreement -0.21 to 0.31). Differences between measured and estimated VCO2 accounted for 57% of the error in VD,est/VT. The predicted reduction in DELTAP with extracorporeal CO2 removal computed using VDalv,est/VT was in reasonable agreement with the expected reduction using VDalv/VT (bias -0.7 cm H2O, limits of agreement -1.87 to 0.47 cm H2O). In multivariable regression, measured VD/VT was associated with mortality (odds ratio 1.9, 95% CI 1.2-3.1, P = .01), but VD,est/VT was not (odds ratio 1.2, 95% CI 0.8-1.8, P = .3).
CONCLUSION(S): VD/VT and VD,est/VT showed low levels of agreement and cannot be used interchangeably in clinical practice. Nevertheless, the predicted decrease in DELTAP due to extracorporeal CO2 removal was similar when computed from either estimated or measured VDalv/VT.

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33082218 [http://www.ncbi.nlm.nih.gov/pubmed/?term=33082218]
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Publisher
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23.

Prognostic factors associated with mortality risk and disease progression in 639 critically ill patients with COVID-19 in Europe: Initial report of the international RISC-19-ICU prospective observational cohort.
Wendel Garcia P.D., Fumeaux T., Guerci P., Heuberger D.M., Montomoli J., Roche-Campo F., Schuepbach R.A., Hilty M.P.
EClinicalMedicine. 25 (no pagination), 2020. Article Number: 100449. Date of Publication: August 2020.
AN: 2006974970
Background: Coronavirus disease 2019 (COVID-19) is associated with a high disease burden with 10% of confirmed cases progressing towards critical illness. Nevertheless, the disease course and predictors of mortality in critically ill patients are poorly understood.
Method(s): Following the critical developments in ICUs in regions experiencing early inception of the pandemic, the European-based, international RIsk Stratification in COVID-19 patients in the Intensive Care Unit (RISC-19-ICU) registry was created to provide near real-time assessment of patients developing critical illness due to COVID-19.
Finding(s): As of April 22, 2020, 639 critically ill patients with confirmed SARS-CoV-2 infection were included in the RISC-19-ICU registry. Of these, 398 had deceased or been discharged from the ICU. ICU-mortality was 24%, median length of stay 12 (IQR, 5-21) days. ARDS was diagnosed in 74%, with a minimum P/F-ratio of 110 (IQR, 80-148). Prone positioning, ECCO2R, or ECMO were applied in 57%. Off-label therapies were prescribed in 265 (67%) patients, and 89% of all bloodstream infections were observed in this subgroup (n = 66; RR=3.2, 95% CI [1.7-6.0]). While PCT and IL-6 levels remained similar in ICU survivors and non-survivors throughout the ICU stay (p = 0.35, 0.34), CRP, creatinine, troponin, D-dimer, lactate, neutrophil count, P/F-ratio diverged within the first seven days (p<0.01). On a multivariable Cox proportional-hazard regression model at admission, creatinine, D-dimer, lactate, potassium, P/F-ratio, alveolar-arterial gradient, and ischemic heart disease were independently associated with ICU-mortality.
Interpretation(s): The European RISC-19-ICU cohort demonstrates a moderate mortality of 24% in critically ill patients with COVID-19. Despite high ARDS severity, mechanical ventilation incidence was low and associated with more rescue therapies. In contrast to risk factors in hospitalized patients reported in other studies, the main mortality predictors in these critically ill patients were markers of oxygenation deficit, renal and microvascular dysfunction, and coagulatory activation. Elevated risk of bloodstream infections underscores the need to exercise caution with off-label therapies.

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24.

European respiratory society international congress 2018: Highlights from Assembly 2 on respiratory intensive care.
Fisser C., Spoletini G., Soe A.K., Livesey A., Schreiber A., Swingwood E., Bos L.D., Dreher M., Schultz M.J., Heunks L., Scala R.
ERJ Open Research. 5 (1) (no pagination), 2019. Article Number: 00198-2018. Date of Publication: February 2019.
AN: 2001960856
The respiratory intensive care Assembly of the European Respiratory Society is proud to present a summary of several important sessions held at the International Congress in Paris in 2018. For the highly esteemed reader who may have missed the Congress, a concise review was written on three topics: the state-of-the-art session on respiratory critical care, hot topics in weaning and the best abstracts in noninvasive ventilation.

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Publisher
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25.

EXTRA-CORPOREAL CARBON DIOXIDE REMOVAL IN COVID-19 ARDS.
Boparai S., Keith Scott L., Conrad S., Motayar N.
Chest. Conference: CHEST 2020 Annual Meeting. 158 (4 Supplement) (pp A1029), 2020. Date of Publication: October 2020.
AN: 2008025525
SESSION TITLE: Medical Student/Resident Critical Care Posters SESSION TYPE: Med Student/Res Case Rep Postr PRESENTED ON: October 18-21, 2020 INTRODUCTION: Management of Acute Respiratory Distress Syndrome (ARDS) involves lung-protective mechanical ventilation with an emphasis on low pressure and low tidal volume ventilation(LTVV). Permissive hypercapnia is a known consequence of LTVV, the progression of which can lead to hemodynamic instability and death. Management of hypercapnia in such cases may require ventilator settings which may exceed known lung protective strategies. The incidence of ARDS in SARS-coV-2 is approximately 30% which has increased emphasis on ventilator management. Extracorporeal carbon dioxide removal (ECCO2R) utilizes a gas exchange membrane to remove carbon dioxide from the blood and control hypercapnia while still allowing lung-protective mechanical ventilation. We report the first case of ECCO2R safely and successfully utilized to manage life-threatening hypercapnia in severe ARDS related to COVID-19. CASE PRESENTATION: A 57-year-old male with a history of hypertension presented to our hospital with severe ARDS secondary to COVID19. He was intubated at an outside institution 7 days prior and transferred for management of refractory hypercapnia. ABG revealed pH:6.9, CO2:188 mmHg,O2:93 on 100% FiO2. ECCO2R was emergently initiated using a 15.5 Fr catheter in the right internal jugular vein. The sweep was initially set at 3L/min, the blood flow at 500ml/min. Repeat ABG improved to a pH of 7.17 and CO2 of 80mmHg. Ventilator requirements were weaned to achieve acceptable pressures (Pressure control: pressure support:5, PEEP:18). His pH and pCO2 gradually normalized. On day 5, ABG showed a pH:7.27, CO2:55 sweep was turned to 0 and he was able to maintain a pCO2 of 52 for 24 hours, after which a decision was made to decannulate. His hospital course was prolonged due to hypoxemic respiratory failure, transient renal failure requiring dialysis, and difficulty with sedation. A tracheostomy was performed on day 31. The patient was successfully weaned off the ventilator on day 37 and discharged home after 41 days in the ICU. DISCUSSION: ECCO2R has been utilized in ARDS to facilitate "ultra-low" volume mechanical

ventilation in cases with refractory respiratory acidosis and facilitate weaning from assisted mechanical ventilation. This case demonstrates the successful utilization of ECCO2R in a patient with COVID19. Despite significantly elevated d-dimer levels the patient did not experience complications related to circuit thrombosis or bleeding and was maintained on full-dose anticoagulation throughout his hospital stay.
CONCLUSION(S): This case highlights the use of ECCO2R in severe ARDS and refractory hypercapnia related to COVID19. ECCO2R may be more advantageous and an acceptable alternative in comparison to other rescue modalities in this population. Future studies are required to further investigate its safety and efficacy.
Reference #1: 19 Registry. COVID. https://sccmcovid19.org/. Published May 30, 2020. Accessed May 30, 2020 Reference #2: Staudinger T. Update on extracorporeal carbon dioxide removal: a comprehensive review on principles, indications, efficiency, and complications [published online ahead of print, 2020 Mar 10]. Perfusion. 2020;267659120906048. doi:10.1177/0267659120906048 Reference #3: Jacobs JP, Stammers AH, St Louis J, et al. Extracorporeal Membrane Oxygenation in the Treatment of Severe Pulmonary and Cardiac Compromise in COVID-19: Experience with 32 patients [published online ahead of print, 2020 Apr 17]. ASAIO J. 2020;10.1097/MAT.0000000000001185. doi:10.1097/MAT.0000000000001185
DISCLOSURES: No relevant relationships by Sukhmani Boparai, source=Web Response Scientific Medical Advisor relationship with ALung Technologies, Inc. Please note: $5001 - $20000 Added 06/01/2020 by Steven Conrad, source=Web Response, value=Consulting fee No relevant relationships by Nasim Motayar, source=Web Response No relevant relationships by L. Keith Scott, source=Web Response

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26.

Spontaneous breathing patterns during maximum extracorporeal co2 removal in subjects with early severe ards.
Spinelli E., Mauri T., Lissoni A., Crotti S., Langer T., Albanese M., Volta C.A., Fornari C., Tagliabue P., Grasselli G.
Respiratory Care. 65 (7) (pp 911-919), 2020. Date of Publication: 01 Jul 2020.
AN: 2005048812
BACKGROUND: Switching patients affected by early severe ARDS and undergoing extracorporeal membrane oxygenation (ECMO) from controlled ventilation to spontaneous breathing can be either beneficial or harmful, depending on how effectively the breathing pattern is controlled with ECMO. Identifying the factors associated with ineffective control of spontaneous breathing with ECMO may advance our pathophysiologic understanding of this syndrome.
METHOD(S): We conducted a prospective study in subjects with severe ARDS who were on ECMO support <= 7 d. Subjects were switched to minimal sedation and pressure-support ventilation while extracorporeal CO2 removal was increased to approximate the subject's total CO2 production (_VCO2). We calculated the rapid shallow breathing index (RSBI) as breathing frequency divided by tidal volume. We explored the correlation between certain characteristics recorded during pretest controlled ventilation and the development of apnea (ie, expiratory pause lasting > 10 s; n 5 3), normal breathing pattern (ie, apnea to RSBI <= 105 breaths/ min/L; n 5 6), and rapid shallow breathing (RSBI > 105 breaths/min/L; n 5 6) that occurred during

the test study.
RESULT(S): The ratio of extracorporeal CO2 removal to the subjects' _VCO2 was >90% in all 15 subjects, and arterial blood gases remained within normal ranges. Baseline pretest Sequential Organ Failure Assessment score, total _VCO2 and ventilatory ratio increased steadily, whereas PaO2 /FIO2 was higher in subjects with apnea compared to intermediate RSBI <=105 breaths/min/L and elevated RSBI >105 breaths/min/L. In subjects with rapid shallow breathing, baseline lung weight measured with quantitative computed tomography scored higher, as well.
CONCLUSION(S): In early severe ARDS, the factors associated with rapid shallow breathing despite maximum extracorporeal CO2 extraction include less efficient CO2 and O2 exchange by the natural lung, higher severity of organ failure, and greater magnitude of lung edema.

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27.

Extracorporeal multiorgan support including CO2-removal with the ADVanced Organ Support (ADVOS) system for COVID-19: A case report.
Huber W., Lorenz G., Heilmaier M., Bottcher K., Sahm P., Middelhoff M., Ritzer B., Schulz D., Bekka E., Hesse F., Poszler A., Geisler F., Spinner C., Schmid R.M., Lahmer T.
International Journal of Artificial Organs. (no pagination), 2020. Date of Publication: 2020.
AN: 2006814937
A substantial part of COVID-19-patients suffers from multi-organ failure (MOF). We report on an 80-year old patient with pulmonary, renal, circulatory, and hepatic failure. We decided against the use of extracorporeal membrane oxygenation (ECMO) due to old age and a SOFA-score of 13. However, the patient was continuously treated with the extracorporeal multi-organ- "ADVanced Organ Support" (ADVOS) device (ADVITOS GmbH, Munich, Germany). During eight 24h-treatment-sessions blood flow (100-300 mL/min), dialysate flow (160-320 mL/min) and dialysate pH (7.6-9.0) were adapted to optimize arterial PaCO2 and pH. Effective CO2 removal and correction of acidosis could be demonstrated by mean arterial- versus post-dialyzer values of pCO2 (68.7 +/- 13.8 vs. 26.9 +/- 11.6 mmHg; p < 0.001). The CO2-elimination rate was 48 +/- 23mL/min. The initial vasopressor requirement could be reduced in parallel to pH-normalization. Interruptions of ADVOS-treatment repeatedly resulted in reversible deteriorations of paCO2 and pH. After 95 h of continuous extracorporeal decarboxylating therapy the patient had markedly improved circulatory

parameters compared to baseline. In the context of secondary pulmonary infection and progressive liver failure, the patient had a sudden cardiac arrest. In accordance with the presumed patient will, we decided against mechanical resuscitation. Irrespective of the outcome we conclude that extracorporeal CO2 removal and multiorgan-support were feasible in this COVID-19-patient. Combined and less invasive approaches such as ADVOS might be considered in old-age-COVID-19 patients with MOF.

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28.

Ventilator support and oxygen therapy in palliative and end-of-life care in the elderly.
Scala R., Ciarleglio G., Maccari U., Granese V., Salerno L., Madioni C.
Turkish Thoracic Journal. 21 (1) (pp 54-60), 2020. Date of Publication: 2020.
AN: 2004308538
Elderly patients suffering from chronic cardio-pulmonary diseases commonly experience acute respiratory failure. As in younger patients, a well-known therapeutic approach of noninvasive mechanical ventilation is able to prevent orotracheal intubation in a large number of severe scenarios in elderly patients. In addition, this type of ventilation is frequently applied in elderly patients who refuse intubation for invasive mechanical ventilation. The rate of failure of noninvasive ventilation may be reduced by means of the integration of new technological devices (i.e., high-flow nasal cannula, extracorporeal CO2 removal, cough assistance and high-frequency chest wall oscillation, and fiberoptic bronchoscopy). Ethical issues with end-of-life decisions and the choice of the environment are not clearly defined in the treatment of elderly with acute respiratory insufficiency.

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Publisher
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29.

Extracorporeal carbon dioxide removal may prevent the need for extracorporeal membrane oxygenation in severe respiratory failure: A cohort study.
Pestana D., Gomis A., de Pablo R., Tenorio M.T.
European journal of anaesthesiology. 37 (10) (pp 950-952), 2020. Date of Publication: 01 Oct 2020.
AN: 632871340
PMID
32925440 [http://www.ncbi.nlm.nih.gov/pubmed/?term=32925440]
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Publisher
NLM (Medline)

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30.

The role of IL-6 and other mediators in the cytokine storm associated with SARS-CoV-2 infection.
Copaescu A., Smibert O., Gibson A., Phillips E.J., Trubiano J.A.
Journal of Allergy and Clinical Immunology. 146 (3) (pp 518-534.e1), 2020. Date of Publication: September 2020.
AN: 2007619660
The coronavirus disease 2019 pandemic caused by severe acute respiratory syndrome coronavirus 2 presents with a spectrum of clinical manifestations from asymptomatic or mild, self-limited constitutional symptoms to a hyperinflammatory state ("cytokine storm") followed by acute respiratory distress syndrome and death. The objective of this study was to provide an evidence-based review of the associated pathways and potential treatment of the hyperinflammatory state associated with severe acute respiratory syndrome coronavirus 2 infection. Dysregulated immune responses have been reported to occur in a smaller subset of those infected with severe acute respiratory syndrome coronavirus 2, leading to clinical deterioration 7 to 10 days after initial presentation. A hyperinflammatory state referred to as cytokine storm in its severest form has been marked by elevation of IL-6, IL-10, TNF-alpha, and other cytokines and severe CD4+ and CD8+ T-cell lymphopenia and coagulopathy. Recognition of at-risk patients could permit early institution of aggressive intensive care and antiviral and immune treatment to reduce the complications related to this proinflammatory state. Several reports and ongoing clinical trials provide hope that available immunomodulatory therapies could have therapeutic potential in these severe cases. This review highlights our current state of knowledge of immune mechanisms and targeted immunomodulatory treatment options for the current coronavirus disease 2019 pandemic.

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31.

Update on extracorporeal carbon dioxide removal: a comprehensive review on principles, indications, efficiency, and complications.
Staudinger T.
Perfusion (United Kingdom). 35 (6) (pp 492-508), 2020. Date of Publication: 01 Sep 2020.
AN: 2004453275
Technology: Extracorporeal carbon dioxide removal means the removal of carbon dioxide from the blood across a gas exchange membrane without substantially improving oxygenation. Carbon dioxide removal is possible with substantially less extracorporeal blood flow than needed for oxygenation. Techniques for extracorporeal carbon dioxide removal include (1) pumpless arterio-venous circuits, (2) low-flow venovenous circuits based on the technology of continuous renal replacement therapy, and (3) venovenous circuits based on extracorporeal membrane oxygenation technology. Indications: Extracorporeal carbon dioxide removal has been shown to enable more protective ventilation in acute respiratory distress syndrome patients, even beyond the so-called "protective" level. Although experimental data suggest a benefit on ventilator induced lung injury, no hard clinical evidence with respect to improved outcome exists. In addition, extracorporeal carbon dioxide removal is a tool to avoid intubation and mechanical ventilation in patients with acute exacerbated chronic obstructive pulmonary disease failing non-invasive ventilation. This concept has been shown to be effective in 56-90% of patients. Extracorporeal carbon dioxide removal has also been used in ventilated patients with hypercapnic respiratory failure to correct acidosis, unload respiratory muscle burden, and facilitate weaning. In patients suffering from terminal fibrosis awaiting lung transplantation, extracorporeal carbon dioxide removal is able to correct acidosis and enable spontaneous breathing during bridging. Keeping these patients awake, ambulatory, and breathing spontaneously is associated with favorable outcome. Complications: Complications of extracorporeal carbon dioxide removal are mostly associated with vascular access and deranged hemostasis leading to bleeding. Although the spectrum of complications may differ, no technology offers advantages with respect to rate and severity of complications. So called "high-extraction systems"

working with higher blood flows and larger membranes may be more effective with respect to clinical goals.

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32.

Transpulmonary thermodilution before and during veno-venous extra-corporeal membrane oxygenation ECMO: an observational study on a potential loss of indicator into the extra-corporeal circuit.
Herner A., Lahmer T., Mayr U., Rasch S., Schneider J., Schmid R.M., Huber W.
Journal of Clinical Monitoring and Computing. 34 (5) (pp 923-936), 2020. Date of Publication: 01 Oct 2020.
AN: 2003544875
Haemodynamic monitoring before extra-corporeal membrane oxygenation (ECMO) might help to optimize the effectiveness of ECMO. However, there are concerns that pulmonary arterial and trans-pulmonary thermodilution (TPTD) might be confounded by a loss of indicator into the ECMO-circuit, resulting in an overestimation of volumetric parameters. Since there is a lack of data on indicator dilution techniques during ECMO, we compared TPTD-measurements before and during ECMO. TPTD-derived parameters before and after initiation of ECMO were compared in 14 intensive care unit-patients with veno-venous ECMO and TPTD-monitoring (PiCCO). Eight patients had a jugular and six patients a femoral central venous catheter (CVC). Cardiac index, global end-diastolic volume index (GEDVI) and extra-vascular lung water index (EVLWI) before ECMO as well as the ECMO-flow were comparable in patients with jugular and femoral CVC. Pre-ECMO, cardiac index (CI) was not significantly different compared to values during ECMO (4.5 +/- 1.7 vs. 4.4 +/- 2.1 L/min/m2; p = 0.43). By contrast, GEDVI (791 +/- 179 vs. 974 +/- 384 mL/m2; p = 0.04) and EVLWI (21 +/- 9 vs. 28 +/- 11 mL/kg; p < 0.01) were higher during ECMO than before. Increases in GEDVI (36 +/- 210 vs. 378 +/- 247 mL/m2; p = 0.02) and EVLWI (3 +/- 2 vs. 11 +/- 8 mL/kg; p = 0.06) were substantially more pronounced in patients with femoral compared to jugular indicator injection. In multivariate analysis, femoral indicator injection was independently associated with larger increases in GEDVI (p < 0.01) and EVLWI (p = 0.04) during ECMO. However, CI and haemodynamic parameters not derived from TPTD, but from pulse contour analysis (systolic and diastolic arterial pressure, stroke volume variation and pulse pressure variation) were not affected by the start of ECMO. Our study demonstrates marked increases in GEDVI and EVLWI after the onset of ECMO. These increases were more pronounced for femoral compared to jugular indicator injection. CI and haemodynamic parameters not derived from TPTD were not affected by the extra-corporeal circuit.

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31691149 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31691149]
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33.

Outcomes of the NHS England National Extracorporeal Membrane Oxygenation Service for adults with respiratory failure: a multicentre observational cohort study.
Warren A., Chiu Y.-D., Villar S.S., Fowles J.-A., Symes N., Barker J., Camporota L., Harvey C., Ledot S., Scott I., Vuylsteke A.
British Journal of Anaesthesia. 125 (3) (pp 259-266), 2020. Date of Publication: September 2020.
AN: 2007255373
Background: Extracorporeal membrane oxygenation (ECMO) is increasingly used to support adults with severe respiratory failure refractory to conventional measures. In 2011, NHS England commissioned a national service to provide ECMO to adults with refractory acute respiratory failure. Our aims were to characterise the patients admitted to the service, report their outcomes, and highlight characteristics potentially associated with survival.
Method(s): An observational cohort study was conducted of all patients treated by the NHS England commissioned ECMO service between December 1, 2011 and December 31, 2017. Analysis was conducted according to a prespecified protocol (NCT: 03979222). Data are presented as median [inter-quartile range, IQR].
Result(s): A total of 1205 patients were supported with ECMO during the study period; the majority (n=1150; 95%) had veno-venous ECMO alone. The survival rate at ECMO ICU discharge was 74% (n=887). Survivors had a lower median age (43 yr [32-52]), compared with non-survivors (49 y [39-60]). Increased severity of hypoxaemia at time of decision-to-cannulate was associated with a lower probability of survival: survivors had a median SaO2 of 90% (84-93%; median PaO2/FiO2, 9.4 kPa [7.7-12.6]), compared with non-survivors (SaO2 88% [80-92%]; PaO2/FiO2 ratio: 8.5 kPa [7.1-11.5]). Patients requiring ECMO because of asthma were more likely to survive (95% survival rate (95% CI, 91-99%), compared with a survival of 71% (95% CI, 69-74%) in patients with respiratory failure attributable to other diagnoses.
Conclusion(s): A national ECMO service can achieve good short-term outcomes for patients with undifferentiated respiratory failure refractory to conventional management. Clinical trial registration: NCT 03979222.

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34.

Management of acute respiratory failure.
Slattery M., Vasques F., Srivastava S., Camporota L.
Medicine (United Kingdom). 48 (6) (pp 397-403), 2020. Date of Publication: June 2020.
AN: 2005845539
Acute respiratory failure is the most common indication for admission to critical care. Appropriate management requires: early recognition and identification of precipitating factors; understanding of the pathophysiology and a systematic approach to assessing disease severity. Finally, if necessary, respiratory support can be non-invasive or invasive mechanical ventilation, and adjunctive therapies, including the timely use of extracorporeal respiratory support.

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35.

Lung dialysis: Are we there yet?.
Surani S., Varon J.
Current Respiratory Medicine Reviews. 10 (4) (pp 195-196), 2015. Date of Publication: 2015.
AN: 604782199
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36.

Extracorporeal membrane oxygenation (ECMO) - state of the art. Extrakorporale Membranoxygenierung (ECMO) - State of the Art <Extrakorporale Membranoxygenierung (ECMO) - State of the Art.>
Sattler P.B., Schafer S., Karagiannidis C.
Pneumologe. 17 (4) (pp 249-255), 2020. Date of Publication: 01 Jul 2020.
AN: 2004454281
The use of temporary extracorporeal membrane oxygenation (ECMO) as a circulatory or respiratory support has increased significantly in the last two decades: in 2007 there were approximately 1 veno-venous (VV) ECMO procedure per 100,000 citizens in Germany and in 2014 already 2.4 per 100,000. This was mainly due to the major technical advances that have been made in recent years; therefore, the current systems (and in contrast to the predecessors) are small, portable, percutaneously implantable, effective, much safer and sometimes also suitable for use over a longer period. The area of application has also expanded accordingly: in addition to veno-arterial (VA) ECMO for cardiac support, VV-ECMO is now applied as high-flow variation for severe acute respiratory distress syndrome (ARDS) and as low-flow variation for hypercapnic respiratory failure (VV-ECCO2R [venovenous-extracorporeal CO2-removal]). According to the second large randomized study on the use of VV-ECMO in severe ARDS (EOLIA), there is now sufficient evidence for its use under these circumstances. The evidence for hypercapnic respiratory failure or further protection of the lungs in moderate to severe ARDS is still lacking, so that as many patients as possible should be treated in clinical trials. Despite the high probability that VV-ECMO can improve the prognosis for severe ARDS, it is an invasive treatment measure that can be associated with serious complications and requires a high degree of specialist expertise.

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37.

Treatment options for acute respiratory distress syndrome in neurointensive care. Individual management due to enhanced neuromonitoring?: A case report series.
Therapieoptionen des akuten Atemnotsyndroms in der Neurointensivmedizin. Individuelles Management dank erweitertem Neuromonitoring?: Eine Fallberichtserie
<Therapieoptionen des akuten Atemnotsyndroms in der Neurointensivmedizin. Individuelles Management dank erweitertem Neuromonitoring?: Eine Fallberichtserie.>
Klocker E., Pietsch C., Pietsch U.
Anaesthesist. 69 (6) (pp 421-431), 2020. Date of Publication: 01 Jun 2020.
AN: 2004728456
Severe pulmonary impairment can occur after traumatic brain injury or stroke. The resulting brain-lung interactions represent key points for the treatment and the subsequent outcome of the patient. Established treatment approaches, such as permissive hypercapnia and prone positioning, present the intensive care physician with divergent treatment goals in these patients with partially increased intracranial pressure. This case report series shows the instrument-based and noninstrument-based options for the treatment of acute respiratory distress syndrome (ARDS) in the simultaneous presence of intracranial pathologies. This includes equipment based therapies using extracorporeal CO2 elimination, special positioning maneuvers in specially designed hospital beds and positional maneuvers, such as prone positioning. With enhanced neuromonitoring it is possible to optimally adapt treatment measures focused on the lungs early and before secondary damage to the brain.

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38.

Outcome predictors of prone position ventilation in severe ARDS.
Jog S., Kalyani P., Jai M., Arpit G., Prasad R.
Intensive Care Medicine Experimental. Conference: 32nd European Society of Intensive Care Medicine Annual Congress, ESICM 2019. Germany. 7 (Supplement 3) (no pagination), 2019. Date of Publication: September 2019.
AN: 631812055
INTRODUCTION. Prone ventilation (PV) is a standard of care for severe ARDS . Factors associated with outcome of PV are not well studied. OBJECTIVES. This retrospective analysis aims at finding the factors associated with survival as an

outcome in patients who received PV in severe ARDS. METHODS. Single center retrospective observational study. Patients with severe ARDS who received lung protective ventilation as per the ARDSnet protocol and received prone ventilation(PV) were considered for the analysis. Inclusion criteria - 1)PO2/FiO2 ratio < 100 2)Plateau Pressure > 28 cm 3)PEEP > 12 cm 4) Received at least 1 session of PV for consecutive 14 hours. Exclusion criteria -i)Patients who received ECMO or ECCO2R Extended prone session was defined as a prone ventilation session continued for more than 24 hours consecutively. Multivariable regression analysis used as a statistical method. RESULTS. Data of 44 patients was analysed. Mortality was 54.44%(24/44). Average days of mechanical ventilation were 14.84 days. ICU length of stay was 18.72 days. Average days of mechanical ventilation were 14.84 days. ICU length of stay was 18.72 days . In univariate analysis, we analysed 32 clinical, organ function, gas exchange and lung mechanics parameters of each patient. Survival as an outcome was significantly associated with Extended Prone Session (P<0.005) and number of Extended Prone Sessions (P < 0.05) while following factors were significantly associated with death as an outcome: 1)pH < 7.15 at the end of first prone session (P = 0.000) 2)Presence of shock needing vasopressors (OR 9.86 ; CI 1.07 to 90.7) 3)Need for Renal Replacement Therapy (OR 5.4;CI 1 to 28.93) 4)PCO2 > 55 mm Hg at the end of first prone session (OR 4.46; CI 1.24 to 17.41) In multiple regression analysis, 2 factors were independently associated with outcome. pH < 7.15 at the end of first prone session(1.25 +/- 0.57;P=0.03) was associated with Mortality and number of extended prone position sessions (0.10 +/- 0.04;P=0.02) was associated with Survival CONCLUSION. Extended sessions of prone position are associated with survival and persistent respiratory acidosis at the end of first prone session is associated with death in patients of severe ARDS treated with prone position.
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39.

Ultra-protective ventilation without extracorporeal circulation in moderately severe and severe ARDS patients (for the REVA research network).
Richard J.C., Marque S., Gros A., Muller M., Prat G., Beduneau G., Quenot J.P., Dellamonica J., Tapponnier R., Soum E., Bitker L., Richecoeur J.
Intensive Care Medicine Experimental. Conference: 32nd European Society of Intensive Care Medicine Annual Congress, ESICM 2019. Germany. 7 (Supplement 3) (no pagination), 2019. Date of Publication: September 2019.
AN: 631813206
INTRODUCTION. Ultra-protective ventilation with tidal volume (VT) reduction below 6 ml/kg predicted body weight (PBW) in severe ARDS may reduce alveolar strain, driving pressure and hence ventilator-induced lung injury, with main drawback of worsening respiratory acidosis. We hypothesized that VT could be reduced down to 4 ml/kg PBW, with clinically significant decrease in driving pressure, without the need for extracorporeal CO2 removal, while maintaining pH in the range targeted in recent randomized controlled trials on ARDS. METHODS. We conducted a non-experimental before-and-after multicenter study on 35 ARDS patients with

PaO2/FiO2 <= 150 mm Hg, within 24 hours of ARDS diagnosis. After inclusion (H0), VT was reduced to 4 ml/kg PBW and further adjusted to maintain pH >= 7.20, respiratory rate was increased up to 40/min and PEEP was set using the PEEP-FiO2 table of the high PEEP arm of the ALVEOLI trial. This strategy was applied until positivity of a PEEP weaning trial. The primary judgment criterion was the driving pressure on day 2 of the study, as compared to study inclusion. Data are presented as median [1st quartile-3rd quartile]. RESULTS. One patient's next of kin withdrew consent leaving 34 analyzable patients. Patients' age was 67 [53-73] year, SAPS II amounted to 50 [35-58], 29 patients (85%) had pneumonia as ARDS risk factor, SOFA at inclusion was 13 [11-14], and PaO2/FiO2 at inclusion was 101 [78-132] mm Hg under a PEEP of 10 [8-12] cmH2O. From inclusion to day 2, driving pressure decreased significantly from 12 [9-15] to 8 [6-11] cmH2O, while VT decreased from 6.0 [5.9-6.1] to 4.1 [4.0-4.7] ml/kg PBW. On day 2 of the study, VT was below 4.2 ml/kg in 22 patients (65% [IC95% 48%-79%]), and below 5.25 ml.kg-1 in 30 patients (88 % CI95% [73%-95%]). Time with VT below 4.2 ml/kg and 5.25 ml/kg averaged 2 [0.5-2.0] days and 2 [1-4] days, respectively. Respiratory rate increased significantly from 28 [23-30] /min to 40 [35-40]/min and 37 [30-40]/min on day 2 and 3 of the study, respectively. PEEP was significantly increased from hour 4 to day 3 after inclusion as compared to baseline, while intrinsic PEEP was not significantly modified during the first four days of the study. PaO2/FiO2 and PaCO2 increased significantly from baseline values as early as hour 4 up to day 3 after inclusion, while pH was significantly lower than baseline only at hour 4 and hour 10. Sedation drugs were not significantly modified. Regarding safety, 2 patients (6%) presented with acute cor pulmonale after inclusion. Right ventricle/left ventricle ratio increased nonsignificantly from 0.50 [0.50-0.72] at H0 to 0.66 [0.60-0.76] on day 2. Eleven patients (32%) presented with severe mixed acidosis with pH < 7.15. Multivariate analysis identified renal SOFA at inclusion (OR: 1.91 [CI95% : 1.08-3.71] per 1 unit increase) and pH at inclusion (OR: 0.91 [CI95% : 0.80-0.99] per 0.01 unit increase) as variables independently associated with occurrence of any episode of severe mixed acidosis during the study. Fourteen patients (41%) died before day 90 with median delay between inclusion and death amounting to 16 [9-22] days. CONCLUSION. Ultraprotective ventilation may be applied in approximately 2/3 of moderately severe to severe ARDS patients, with a 4 cmH2O median reduction of driving pressure, at the price of severe mixed acidosis in approximately 1/3 of the patients.

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40.

Validation of RESP and PRESERVE score for ARDS patients with pumpless extracorporeal lung assist (pECLA).
Petran J., Muelly T., Dembinski R., Steuer N., Arens J., Marx G., Kopp R.
BMC Anesthesiology. 20 (1) (no pagination), 2020. Article Number: 102. Date of Publication: 02 May 2020.
AN: 631626352
Background: RESP score and PRESERVE score have been validated for veno-venous Extracorporeal Membrane Oxygenation in severe ARDS to assume individual mortality risk. ARDS patients with low-flow Extracorporeal Carbon Dioxide Removal, especially pumpless Extracorporeal Lung Assist, have also a high mortality rate, but there are no validated specific or general outcome scores. This retrospective study tested whether these established specific risk scores can be validated for pumpless Extracorporeal Lung Assist in ARDS patients in comparison to a general organ dysfunction score, the SOFA score.
Method(s): In a retrospective single center cohort study we calculated and evaluated RESP, PRESERVE, and SOFA score for 73 ARDS patients with pumpless Extracorporeal Lung Assist treated between 2002 and 2016 using the XENIOS iLA Membrane Ventilator. Six patients had a mild, 40 a moderate and 27 a severe ARDS according to the Berlin criteria. Demographic data and hospital mortality as well as ventilator settings, hemodynamic parameters, and blood gas measurement before and during extracorporeal therapy were recorded.
Result(s): Pumpless Extracorporeal Lung Assist of mechanical ventilated ARDS patients resulted in an optimized lung protective ventilation, significant reduction of PaCO2, and compensation of acidosis. Scoring showed a mean score of alive versus deceased patients of 3 +/- 1 versus - 1 +/- 1 for RESP ($p < 0.01$), 3 +/- 0 versus 6 +/- 0 for PRESERVE ($p < 0.05$) and 8 +/- 1 versus 10 +/- 1 for SOFA ($p < 0.05$). Using receiver operating characteristic curves, area under the curve (AUC) was 0.78 (95% confidence interval (CI) 0.67-0.89, $p < 0.01$) for RESP score, 0.80 (95% CI 0.70-0.90, $p < 0.0001$) for PRESERVE score and 0.66 (95% CI 0.53-0.79, $p < 0.05$) for SOFA score.
Conclusion(s): RESP and PRESERVE scores were superior to SOFA, as non-specific critical care score. Although scores were developed for veno-venous ECMO, we could validate RESP and PRESERVE score for pumpless Extracorporeal Lung Assist. In conclusion, RESP and PRESERVE score are suitable to estimate mortality risk of ARDS patients with an arterio-venous pumpless Extracorporeal Carbon Dioxide Removal.

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41.

New approaches to respiratory assist: Bioengineering an ambulatory, miniaturized bioartificial lung.
Novosel E., Borchers K., Kluger P.J., Mantalaris A., Matheis G., Pistolesi M., Schneider J., Wenz A., Lelkes P.I.
ASAIO Journal. 65 (5) (pp 422-429), 2019. Date of Publication: 2019.
AN: 631561107
Although state-of-the-art treatments of respiratory failure clearly have made some progress in terms of survival in patients suffering from severe respiratory system disorders, such as acute respiratory distress syndrome (ARDS), they failed to significantly improve the quality of life in patients with acute or chronic lung failure, including severe acute exacerbations of chronic obstructive pulmonary disease or ARDS as well. Limitations of standard treatment modalities, which largely rely on conventional mechanical ventilation, emphasize the urgent, unmet clinical need for developing novel (bio)artificial respiratory assist devices that provide extracorporeal gas exchange with a focus on direct extracorporeal CO2 removal from the blood. In this review, we discuss some of the novel concepts and critical prerequisites for such respiratory lung assist devices that can be used with an adequate safety profile, in the intensive care setting, as well as for long-term domiciliary therapy in patients with chronic ventilatory failure. Specifically, we describe some of the pivotal steps, such as device miniaturization, passivation of the blood-contacting surfaces by chemical surface modifications, or endothelial cell seeding, all of which are required for converting current lung assist devices into ambulatory lung assist device for long-term use in critically ill patients. Finally, we also discuss some of the risks and challenges for the long-term use of ambulatory miniaturized bioartificial lungs.

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42.

Recent advances in understanding and treating acute respiratory distress syndrome.
Nanchal R.S., Truwit J.D.
F1000Research. 7 (no pagination), 2018. Article Number: 1322. Date of Publication: 2018.
AN: 623683454
Acute respiratory distress syndrome (ARDS) is a clinically and biologically heterogeneous disorder associated with many disease processes that injure the lung, culminating in increased non-hydrostatic extravascular lung water, reduced compliance, and severe hypoxemia. Despite enhanced understanding of molecular mechanisms, advances in ventilatory strategies, and general care of the critically ill patient, mortality remains unacceptably high. The Berlin definition of ARDS has now replaced the American-European Consensus Conference definition. The recently concluded Large Observational Study to Understand the Global Impact of Severe Acute Respiratory Failure (LUNG-SAFE) provided worldwide epidemiological data of ARDS including prevalence, geographic variability, mortality, and patterns of mechanical ventilation use. Failure of clinical therapeutic trials prompted the investigation and subsequent discovery of two distinct phenotypes of ARDS (hyper-inflammatory and hypo-inflammatory) that have different biomarker profiles and clinical courses and respond differently to the random application of positive end expiratory pressure (PEEP) and fluid management strategies. Low tidal volume ventilation remains the predominant mainstay of the ventilatory strategy in ARDS. High-frequency oscillatory ventilation, application of recruitment maneuvers, higher PEEP, extracorporeal membrane oxygenation, and alternate modes of mechanical ventilation have failed to show benefit. Similarly, most pharmacological therapies including keratinocyte growth factor, beta-2 agonists, and aspirin did not improve outcomes. Prone positioning and early neuromuscular blockade have demonstrated mortality benefit, and clinical guidelines now recommend their use. Current ongoing trials include the use of mesenchymal stem cells, vitamin C, re-evaluation of neuromuscular blockade, and extracorporeal carbon dioxide removal. In this article, we describe advances in the diagnosis, epidemiology, and treatment of ARDS over the past decade.

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43.

Extracorporeal Membrane Oxygenation for Respiratory Failure.
Quintel M., Bartlett R.H., Grocott M.P.W., Combes A., Ranieri M.V., Baiocchi M., Nava S., Brodie D., Camporota L., Vasques F., Busana M., Marini J.J., Gattinoni L.
Anesthesiology. (pp 1257-1276), 2020. Date of Publication: 2020.
AN: 631619790
This review focuses on the use of veno-venous extracorporeal membrane

oxygenation for respiratory failure across all blood flow ranges. Starting with a short overview of historical development, aspects of the physiology of gas exchange (i.e., oxygenation and decarboxylation) during extracorporeal circulation are discussed. The mechanisms of phenomena such as recirculation and shunt playing an important role in daily clinical practice are explained. Treatment of refractory and symptomatic hypoxemic respiratory failure (e.g., acute respiratory distress syndrome [ARDS]) currently represents the main indication for high-flow veno-venous-extracorporeal membrane oxygenation. On the other hand, lower-flow extracorporeal carbon dioxide removal might potentially help to avoid or attenuate ventilator-induced lung injury by allowing reduction of the energy load (i.e., driving pressure, mechanical power) transmitted to the lungs during mechanical ventilation or spontaneous ventilation. In the latter context, extracorporeal carbon dioxide removal plays an emerging role in the treatment of chronic obstructive pulmonary disease patients during acute exacerbations. Both applications of extracorporeal lung support raise important ethical considerations, such as likelihood of ultimate futility and end-of-life decision-making. The review concludes with a brief overview of potential technical developments and persistent challenges.

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44.

Extracorporeal carbon dioxide removal requirements for ultraprotective mechanical ventilation: Mathematical model predictions.

Leypoldt J.K., Goldstein J., Pouchoulin D., Harenski K.
Artificial Organs. 44 (5) (pp 488-496), 2020. Date of Publication: 01 May 2020.
AN: 2003895419
Extracorporeal carbon dioxide (CO2) removal (ECCO2R) facilitates the use of low tidal volumes during protective or ultraprotective mechanical ventilation when managing patients with acute respiratory distress syndrome (ARDS); however, the rate of ECCO2R required to avoid hypercapnia remains unclear. We calculated ECCO2R rate requirements to maintain arterial partial pressure of CO2 (PaCO2) at clinically desirable levels in mechanically ventilated ARDS patients using a six-compartment mathematical model of CO2 and oxygen (O2) biochemistry and whole-body transport with the inclusion of an ECCO2R device for extracorporeal veno-venous removal of CO2. The model assumes steady state conditions. Model compartments were lung capillary blood, arterial blood, venous blood, post-ECCO2R venous blood, interstitial fluid and tissue cells, with CO2 and O2 distribution within each compartment; biochemistry included equilibrium among bicarbonate and non-bicarbonate buffers and CO2 and O2 binding to hemoglobin to elucidate Bohr and Haldane effects. O2 consumption and CO2 production rates were assumed proportional to predicted body weight (PBW) and adjusted to achieve reported arterial partial pressure of O2 and a PaCO2 level of 46 mmHg at a tidal volume of 7.6 mL/kg PBW in the absence of an ECCO2R device based on average data from LUNG SAFE. Model calculations showed that ECCO2R rates required to achieve mild permissive hypercapnia (PaCO2 of 46 mmHg) at a ventilation frequency or respiratory rate of 20.8/min during mechanical ventilation increased when tidal volumes decreased from 7.6 to 3 mL/kg PBW. Higher ECCO2R rates were required to achieve normocapnia (PaCO2 of 40 mmHg). Model calculations also showed that required ECCO2R rates were lower when ventilation frequencies were increased from 20.8/min to 26/min. The current mathematical model predicts that ECCO2R rates resulting in clinically desirable PaCO2 levels at tidal volumes of 5-6 mL/kg PBW can likely be achieved in mechanically ventilated ARDS patients with current technologies; use of ultraprotective tidal volumes (3-4 mL/kg PBW) may be challenging unless high mechanical ventilation frequencies are used.

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45.

Efect of extracorporeal CO2 removal on right ventricular function in patients with acute respiratory distress syndrome: The ECCO2Rea pilot study.
Goursaud S., Valette X., Dupeyrat J., Daubin C., Cheyron D.D.

Annals of Intensive Care. Conference: French Intensive Care Society International Congress, 2020. France. 10 (Supplement 1) (no pagination), 2020. Date of Publication: 2020.
AN: 631514336
Rationale: Right ventricular (RV) failure is a common complication in moderate to severe acute respiratory distress syndrome (ARDS). RV failure is exacerbated by hypercapnic acidosis and overdistension induced by mechanical ventilation. Veno-venous extracorporeal CO2 removal (ECCO2R) might allow ultraprotective mechanical ventilation strategy with a low tidal volume (VT) and plateau pressure (Pplat). This study investigated if ECCO2R therapy could have benefcial effects on RV function.
Patients and Methods: This prospective monocentric pilot study was conducted in a French ICU from January 2017 to March 2019. Patients with moderate to severe ARDS with PaO2/FiO2 ratio between 80 to 150 mmHg were enrolled. Ventilation parameters, arterial blood gases, echocardiographic parameters performed by transthoracic echocar-diography (TTE), low-fow ECCO2R system operational characteristics, outcomes and adverse events were collected during the protocol. Primary end point was evolution of RV echocardiographic parameters with ultraprotective ventilation strategy at 4 mL/Kg PBW during the 24-h following the start of ECCO2R.
Result(s): Eighteen patients were included. Effcacy of ECCO2R allowed an ultraprotective strategy in all patients. We observed a signifcant improvement of RV systolic function parameters assessed by TTE (Fig. 1). Tricuspid annular plane systolic excursion (TAPSE) increased signifcantly under ultraprotective ventilation compared to baseline (from 22.8 to 25.4 mm; $p < 0.05$). Systolic excursion velocity (S') also increased after 1-day protocol (from 13.8 m/s to 15.1 m/s; $p < 0.05$). A signifcant improvement of aortic velocity time integral (VTIAo) under ultraprotective ventilation settings was observed. There were no sig-nifcant differences in the values of systolic pulmonary arterial pressure (sPAP). When patients were separated in two groups according to baseline PaCO2 level above or under 50 mmHg, we showed the deleterious effect of hypercapnia on RV function, and observed in both groups a benefcial impact of an ultraprotective ventilation strategy on TAPSE. No severe adverse events directly related to ECCO2R were observed in our small cohort.
Conclusion(s): The low-fow ECCO2R allows ultraprotective ventilation strategy and improve RV function in moderate to severe ARDS patients. Similarly to prone positioning, ECCO2R could become a strategy that enables to reconcile lung protective approach with RV protective approach in ARDS patients. Large-scale clinical studies, including patients with severe RV dysfunction, will be required to confrm these results and to assess the overall benefts, in particular the best timing of beginning ECCO2R in ARDS patients.
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46.

Increased respiratory morbidity in individuals with interstitial lung abnormalities.
Hoyer N., Thomsen L.H., Wille M.M.W., Wilcke T., Dirksen A., Pedersen J.H., Saghir Z., Ashraf H., Shaker S.B.

BMC Pulmonary Medicine. 20 (1) (no pagination), 2020. Article Number: 67. Date of Publication: 19 Mar 2020.
AN: 631434210
Background: Interstitial lung abnormalities (ILA) are common in participants of lung cancer screening trials and broad population-based cohorts. They are associated with increased mortality, but less is known about disease specific morbidity and healthcare utilisation in individuals with ILA.
Method(s): We included all participants from the screening arm of the Danish Lung Cancer Screening Trial with available baseline CT scan data (n = 1990) in this cohort study. The baseline scan was scored for the presence of ILA and patients were followed for up to 12 years. Data about all hospital admissions, primary healthcare visits and medicine prescriptions were collected from the Danish National Health Registries and used to determine the participants' disease specific morbidity and healthcare utilisation using Cox proportional hazards models.
Result(s): The 332 (16.7%) participants with ILA were more likely to be diagnosed with one of several respiratory diseases, including interstitial lung disease (HR: 4.9, 95% CI: 1.8-13.3, p = 0.008), COPD (HR: 1.7, 95% CI: 1.2-2.3, p = 0.01), pneumonia (HR: 2.0, 95% CI: 1.4-2.7, p < 0.001), lung cancer (HR: 2.7, 95% CI: 1.8-4.0, p < 0.001) and respiratory failure (HR: 1.8, 95% CI: 1.1-3.0, p = 0.03) compared with participants without ILA. These findings were confirmed by increased hospital admission rates with these diagnoses and more frequent prescriptions for inhalation medicine and antibiotics in participants with ILA.
Conclusion(s): Individuals with ILA are more likely to receive a diagnosis and treatment for several respiratory diseases, including interstitial lung disease, COPD, pneumonia, lung cancer and respiratory failure during long-term follow-up.

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47.

Extracorporeal Carbon Dioxide Removal in the Management of Complex Bilateral Flail Chest Injury.
Wells A.H., Oswald T.J., Samra N., Scott L.K., Conrad S.A.
ASAIO Journal. 65 (7) (pp E75-E77), 2019. Date of Publication: 01 Sep 2019.

AN: 630983329
Flail chest is an uncommon consequence of traumatic injury. Medical management includes mechanical ventilation for internal pneumatic stabilization. Control of respiratory drive is necessary to avoid paradoxical movement and impairment of recovery. Traditional approaches include sedation and neuromuscular blockade, but these measures are at odds with current trends of keeping patients awake and implementing active rehabilitation. We hypothesized that extracorporeal carbon dioxide removal (ECCO2R) would suppress the respiratory drive sufficiently to permit synchronous mechanical ventilation, allowing rib fracture healing in an awake patient with extensive bilateral flail chest. A patient with 21 fractures underwent ECCO2R for 6 weeks to permit internal pneumatic stabilization with mechanical ventilation, targeting a partial pressure of carbon dioxide in arterial blood (PaCO2) of 25-30 mm Hg. The first 2 weeks were performed with extracorporeal membrane oxygenation (ECMO) for bilateral pulmonary contusions and acute respiratory distress syndrome. The last 4 weeks was with low-flow ECCO2R. Respiratory drive was suppressed during both ECMO and ECCO2R phases when the targeted hypocapnia range of 25-30 mm Hg was achieved, permitting synchronous positive pressure ventilation in an awake and cooperative patient undergoing active rehabilitation. Extracorporeal carbon dioxide removal targeting hypocapnia is a potential adjunct in extensive flail chest injury undergoing nonsurgical management.

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48.

Mechanical ventilation for acute respiratory distress syndrome during extracorporeal life support research and practice.
Abrams D., Schmidt M., Pham T., Beitler J.R., Fan E., Goligher E.C., McNamee J.J., Patroniti N., Wilcox M.E., Combes A., Ferguson N.D., McAuley D.F., Pesenti A., Quintel M., Fraser J., Hodgson C.L., Hough C.L., Mercat A., Mueller T., Pellegrino V., Ranieri V.M., Rowan K., Shekar K., Brochard L., Brodie D.
American Journal of Respiratory and Critical Care Medicine. 201 (5) (pp 514-525), 2020. Date of Publication: 01 Mar 2020.
AN: 2005094886
Ventilator-induced lung injury remains a key contributor to the morbidity and mortality of acute respiratory distress syndrome (ARDS). Efforts tominimize this injury are typically limited by the need to preserve adequate gas exchange. In the most severe forms of the syndrome, extracorporeal life support is increasingly being deployed for severe hypoxemia or hypercapnic acidosis refractory to conventional ventilator management strategies. Data from a recent randomized controlled trial, a post hoc analysis of that trial, a meta-analysis, and a large international multicenter observational study suggest that extracorporeal life support, when combined with

lower VT and airway pressures than the current standard of care, may improve outcomes compared with conventional management in patients with the most severe forms of ARDS. These findings raise important questions not only about the optimal ventilation strategies for patients receiving extracorporeal support but also regarding how various mechanisms of lung injury in ARDS may potentially be mitigated by ultra-lung-protective ventilation strategies when gas exchange is sufficiently managed with the extracorporeal circuit. Additional studies are needed to more precisely delineate the best strategies for optimizing invasive mechanical ventilation in this patient population.

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31726013 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31726013]
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Publisher
American Thoracic Society (E-mail: malexander@thoracic.org)

49.

A New Percutaneous Approach to Treat Combined Right Ventricular and Respiratory Failure: The "aachen Cannula".
Hima F., Gummer M., Prescher A., Altarawneh B., Zayat R., Hatam N., Ernst L., Kalverkamp S., Spillner J., Arias-Pinilla J.
European Surgical Research. 60 (5-6) (pp 229-238), 2020. Date of Publication: 01 Feb 2020.
AN: 629980193
Introduction: Right ventricular failure (RVF) on its own is a life-threatening condition. Often it manifests as a two-organ failure in the final phase of several lung diseases. Mechanical circulatory support is a proven treatment of RVF but remains challenging. Our objective is to develop a novel, simplified, and minimally invasive cannula approach to treat both RVF and respiratory failure.
Method(s): We conceptualized a dual lumen cannula approach to allow oxygenated right-to-left shunting at an atrial level to decompress right-sided circulation. A minimally invasive approach through percutaneous, transjugular insertion and transseptal placement should enable patients to be non-sedated and even ambulatory. In an iterative design, pre-prototyping, prototyping, and anatomic fitting process, such a cannula was generated and tested in both cadaveric and fluid dynamic studies.
Result(s): After various modifications and improvements, a 27-Fr 255-mm-long double-lumen cannula with an inner line (oxygenated blood return to patient into the left atrium) of 18 Fr and an inflatable balloon (with a volume of approximately 1 mL) at the outflow tip was produced - one version with a straight head and another one with a curved head. In our anatomic studies, the "Aachen Cannula" allowed an easy transjugular introduction and advancement into the right atrium by Seldinger technique. Transseptal placement was achieved by puncture (Brockenbrough needle) in combination with dilatation and was then secured in place with the stabilizing balloon, even under slight tension. The cannula prototype enabled a flow of up to 3.5 L/min, at which common pressure drops were observed.
Conclusion(s): In conclusion, we successfully conceptualized, designed, and verified a minimally invasive one-cannula approach for the treatment of either isolated right heart failure and even combined RVF and respiratory failure through our transseptal Aachen Cannula. This concept may also be carried out in ambulatory conditions. Moreover, this approach completely avoids recirculation issues and ensures reliable oxygenated coronary as well as cerebral perfusion.

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(Ernst) Institute of Laboratory Animal Science, University Hospital RWTH Aachen, Aachen, Germany
Publisher
S. Karger AG

50.

What Can We Apply to Manage Acute Exacerbation of Chronic Obstructive Pulmonary Disease with Acute Respiratory Failure?.
Kim D.K., Lee J., Park J.-H., Yoo K.H.
Tuberculosis and Respiratory Diseases. 81 (2) (pp 99-105), 2018. Date of Publication: April 2018.
AN: 621866842
Acute exacerbation(s) of chronic obstructive pulmonary disease (AECOPD) tend to be critical and debilitating events leading to poorer outcomes in relation to chronic obstructive pulmonary disease (COPD) treatment modalities, and contribute to a higher and earlier mortality rate in COPD patients. Besides pro-active preventative measures intended to obviate acquisition of AECOPD, early recovery from severe AECOPD is an important issue in determining the long-term prognosis of patients diagnosed with COPD. Updated GOLD guidelines and recently published American Thoracic Society/European Respiratory Society clinical recommendations emphasize the importance of use of pharmacologic treatment including bronchodilators, systemic steroids and/or antibiotics. As a non-pharmacologic strategy to combat the effects of AECOPD, noninvasive ventilation (NIV) is recommended as the treatment of choice as this therapy is thought to be most effective in reducing intubation risk in patients diagnosed with AECOPD with acute respiratory failure. Recently, a few adjunctive modalities, including NIV with helmet and helium-oxygen mixture, have been tried in cases of AECOPD with respiratory failure. As yet, insufficient documentation exists to permit recommendation of this therapy without qualification. Although there are too few findings, as yet, to allow for regular andr routine application of those modalities in AECOPD, there is anecdotal evidence to indicate both mechanical and physiological benefits connected with this therapy. High-flow nasal cannula oxygen therapy is another supportive strategy which serves to improve the symptoms of hypoxic respiratory failure. The therapy also produced improvement in ventilatory variables, and it may be successfully applied in cases of hypercapnic respiratory failure. Extracorporeal carbon dioxide removal has been successfully attempted in cases of adult respiratory distress syndrome, with protective hypercapnic ventilatory strategy. Nowadays, it is reported that it was also effective in reducing intubation in AECOPD with hypercapnic respiratory failure. Despite the apparent need for more supporting evidence, efforts to improve efficacy of NIV have continued unabated. It is anticipated that these efforts will, over time, serve toprogressively decrease the risk of intubation and invasive mechanical ventilation in cases of AECOPD with acute respiratory failure.

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Publisher
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51.

Avoiding invasive mechanical ventilation by extracorporeal carbon dioxide removal in patients failing noninvasive ventilation.
Kluge S., Braune S.A., Engel M., Nierhaus A., Frings D., Ebelt H., Uhrig A., Metschke M., Wegscheider K., Suttorp N., Rousseau S.
Intensive Care Medicine. (pp 1-8), 2012. Date of Publication: 2012.
AN: 52133438
Purpose: To evaluate whether extracorporeal carbon dioxide removal by means of a pumpless extracorporeal lung-assist (PECLA) device could be an effective and safe alternative to invasive mechanical ventilation in patients with chronic pulmonary disease and acute hypercapnic ventilatory failure not responding to noninvasive ventilation (NIV).
Method(s): In this multicentre, retrospective study, 21 PECLA patients were compared with respect to survival and procedural outcomes to 21 matched controls with conventional invasive mechanical ventilation. Matching criteria were underlying diagnosis, age, Simplified Acute Physiology Score II and pH at ICU admission.
Result(s): Of the 21 patients treated with PECLA, 19 (90 %) did not require intubation. Median PaCO2 levels and pH in arterial blood prior to PECLA were 84.0 mmHg (54.2-131.0) and 7.28 (7.10-7.41), respectively. Within 24 h, median PaCO2 levels and pH had significantly improved to 52.1 (33.0-70.1; $p < 0.001$) and 7.44 (7.27-7.56; $p < 0.001$), respectively. Two major and seven minor bleeding complications related to the device occurred. Further complications were one pseudoaneurysm and one heparin-induced thrombocytopenia type 2. Compared to the matched control group, there was a trend toward a shorter hospital length of stay in the PECLA group (adjusted $p = 0.056$). There was no group difference in the 28-day (24 % vs. 19 %, adjusted $p = 0.845$) or 6-month mortality (33 % vs. 33 %).
Conclusion(s): In this study the use of extracorporeal carbon dioxide removal allowed avoiding intubation and invasive mechanical ventilation in the majority of patients with acute on chronic respiratory failure not responding to NIV. Compared to conventional invasive ventilation, short- and long-term survivals were similar.
Institution
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Publisher
Springer-Verlag

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52.

Primary lung transplantation after bridge with extracorporeal membrane oxygenation: A plea for a shift in our paradigms for indications.
Lang G., Taghavi S., Aigner C., Renyi-Vamos F., Jaksch P., Augustin V., Nagayama K., Ghanim B., Klepetko W.
Transplantation. (no pagination), 2012. Date of Publication: 12 Mar 2012.
AN: 51907954
BACKGROUND: The introduction of the lung allocation score has brought lung transplantation (LTX) of patients on extracorporeal membrane oxygenation (ECMO) bridge into the focus of interest. We reviewed our institutional experience with ECMO as a bridge to LTX.
METHOD(S): Between 1998 and 2011, 38 patients (median age 30.1 years, range 13-66 years) underwent ECMO support with intention to bridge to primary LTX. The underlying diagnosis was cystic fibrosis (n=17), pulmonary hypertension (n=4), idiopathic pulmonary fibrosis (n=9), adult respiratory distress syndrome (n=4), hemosiderosis (n=1), bronchiolitis obliterans (n=1), sarcoidosis (n=1), and bronchiectasis (n=1). The type of extracorporeal bridge was venovenous (n=18), venoarterial (n=15), interventional lung assist (n=1), or a stepwise combination of them (n=4). The median bridging time was 5.5 days (range 1-63) days. The type of transplantation was double LTX (n=7), size-reduced double LTX (n=8), lobar LTX (n=16), split LTX (n=2), and lobar LTX after ex vivo lung perfusion (n=1).
RESULT(S): Four patients died before transplantation. Thirty-four patients underwent LTX, of them eight patients died in the hospital after a median stay of 24.5 days (range 1-180 days). Twenty-six patients left the hospital and returned to normal life (median hospital stay=47.5 days; range 21-90 days). The 1-, 3-, and 5-year survival for all transplanted patients was 60%, 60%, and 48%, respectively. The 1-, 3-, and 5-year survival conditional on 3-month survival for patients bridged with ECMO to LTX (78%, 78%, and 63%) was not worse than for other LTX patients within the same period of time (90%, 80%, and 72%, respectively, P=0.09, 0.505, and 0.344).
CONCLUSION(S): Transplantation of patients bridged on ECMO to LTX is feasible and results in acceptable outcome.
Publisher
Lippincott Williams & Wilkins, Inc.

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53.

Role and potentials of low-flow CO2 removal system in mechanical ventilation.
Terragni P., Maiolo G., Marco Ranieri V.M.
Current Opinion in Critical Care. (no pagination), 2011. Date of Publication: 18 Dec 2011.
AN: 51777256
PURPOSE OF REVIEW: An analysis of the technological implementation of extracorporeal CO2 removal (ECCO2R) techniques and of its clinical application. A new classification of ECCO2R, based on technological aspects, clinical properties and physiological performance, is proposed. RECENT FINDINGS: The use of a

ventilation with lower tidal volumes has been proved successful in acute respiratory distress syndrome (ARDS) patients but can be extremely problematic, especially when dealing with respiratory acidosis. The implementation of ECCO2R devices can represent the missing link between the prevention of ventilator-induced lung injury and pH control. ECCO2R has attracted increasing interest because of new less-invasive approaches allowing an easier management of ARDS patients. Recent studies have also shown that ECCO2R can also be used in patients with exacerbation of chronic obstructive pulmonary disease (COPD) and as a bridge to lung transplantation. SUMMARY: The future ventilatory management of patients with acute respiratory failure may include a minimally invasive extracorporeal carbon dioxide removal circuit associated with the least amount of ventilatory support (noninvasive in COPD and/or invasive in ARDS) to minimize sedation, prevent ventilator-induced acute lung injury and nosocomial infections. Randomized clinical trials in the pipeline will confirm this fascinating hypothesis.
Publisher
Lippincott Williams & Wilkins, Inc.

54.

Physiologic Effect and Safety of the Pumpless Extracorporeal Interventional Lung Assist System in Patients With Acute Respiratory Failure-A Pilot Study.
Cho W.H., Lee K., Huh J.W., Lim C.-M., Koh Y., Hong S.-B.
Artificial Organs. (no pagination)
AN: 51698244
Interventional lung assist (iLA) effectively reduces CO2 tension and permits protective lung ventilation in patients with acute respiratory distress syndrome. However, there is little experience in using iLA in acute respiratory failure from various causes and no experience for small body sizes such as Asian patients. We evaluated the physiologic effect and safety of the iLA device in patients with acute respiratory failure from various causes. We enrolled 11 consecutive patients with severe respiratory failure from various causes. Wire-enforced cannulae (13-15 Fr) were inserted under ultrasound guidance and connected to iLA. Arterial blood gas analysis, ventilator parameters, hemodynamic parameter, and adverse events were recorded serially. During the first 24h of iLA use, mean blood flow was 1.08+/-0.15L/min, PaCO2 decreased from 83.9+/-23.4mmHg to 40.7+/-10.2mmHg, and PaO2/FiO2 ratio increased from 110+/-37 to 141+/-74. Minute ventilation decreased from 9.4+/-2.5 to 6.3+/-1.5L/min, and peak inspiratory pressure decreased from 30.3+/- 7.1cm H2O to 28.8+/-9.4cm H2O. No serious adverse events were observed during iLA use. iLA showed effective CO2 removal, allowed for reducing the invasiveness of mechanical ventilation in patients with severe respiratory failure from various causes even using a small-sized catheter and was safe in small body-sized patients.
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55.

A new treatment algorithm for acute exacerbation of IPF: A retrospective cohort study.
Vianello A., Ferrarese S., Molena B., Arcaro G., Braccioni F., Paladini L., Gallan F.
European Respiratory Journal. Conference: 29th International Congress of the European Respiratory Society, ERS. Spain. 54 (Supplement 63) (no pagination), 2019. Date of Publication: September 2019.
AN: 630918175
Background: Some patients with Idiopathic Pulmonary Fibrosis (IPF) develop acute exacerbation (AE-IPF) leading to severe Acute Respiratory Failure (ARF); despite conventional supportive therapy, the mortality rate remains extremely high. Aims and Objectives: To assess how a treatment algorithm incorporating High Flow Nasal Cannula (HNFC) oxygen therapy and Extracorporeal CO2 Removal (ECCO2R) may affect the short-term mortality of patients with AE-IPF who develop ARF.
Method(s): Seventeen AE-IPF patients admitted to a Respiratory Intensive Care Unit (RICU) for ARF were managed using a treatment algorithm incorporating HFNC and ECCO2R. Mortality rate during their stay in the RICU and shortterm survival rates were recorded.
Result(s): The implementation of the treatment algorithm led to a successful outcome in 9 patients (52.9%). 8 patients (47.1%) died within 39 days of being admitted to the RICU. The survival rate was 70.6% (+/-0.1 %) at 15 days, 52.9% (+/-0.1%) at 30 days, 35.3% (+/-0.1%) at 90 days, and 15.6% (+/-9.73 %) at 365 days. Four/10 patients who did not respond to conventional oxygen therapy showed a satisfactory response to HFNC.
Conclusion(s): Short-term mortality fell to below 50 per cent when a treatment algorithm incorporating HFNC and ECCO2R was implemented in a group of AE-IPF patients admitted to a RICU for ARF. Subjects not responding to conventional oxygen therapy seemed to benefit from HFNC. (Figure Presented) .
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Publisher
European Respiratory Society

Link to the Ovid Full Text or citation:
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56.

O2 as sweep gas shows slightly more effective decarboxylation compared to air in an in-vitro ECCO2R test setup.
Schwaerzel L., Jungmann A., Schmoll N., Schenk J., Dinh T., Bals R., Lepper P., Omlor A.
European Respiratory Journal. Conference: 29th International Congress of the European Respiratory Society, ERS. Spain. 54 (Supplement 63) (no pagination), 2019. Date of Publication: September 2019.

AN: 630918138
Extracorporeal carbon dioxide elimination is a method to counteract hypercapnic respiratory failure. One ambition of current research is to create more portable ECCO2R devices. Herein, we present an 'in vitro' model that can simulate a human body connected to an ECCO2R as an alternative to animal experiments. This model was used to examine the relation of sweep flow and CO2 clearance. Different flow rates of air and pure oxygen (0.25-7 liters per minute) were tested to find the sweet spot and to assess the possibility of a potential gas cylinder free ECCO2Rsetup.
Method(s): In our ECCO2R simulation we use two interconnected circuits filled with fresh pig blood. The main circuit is supposed to simulate the vena cava and creates a hypoxic and hypercapnic (venous) environment by applying a N2 and CO2 gas flow to a Quadrox PLS. The test circuit which contains the actual ECCO2R-system consists of a second Rotaflow and a pediatric Quadrox membrane. The decarboxylation rate of the system was determined from the sweep flow rate and the carbon dioxide content in the sweep outflow of the test membrane.
Result(s): We were able to create a simple yet effective ECCO2R test setup. Our experiments revealed a slight but statistically significant disadvantage of air as sweep gas compared to pure oxygen regarding CO2 clearance. Moreover, a linear relationship in the reciprocal plots of CO2 transfer rate and sweep flow was observed. This linear relationship could be deduced from a simplified mathematical model. Although the CO2 transfer rate of pure oxygen was slightly higher than using air, we still think that portable ECCO2R-system should use air as sweep gas in order to be gas cylinder free.
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Publisher
European Respiratory Society

57.

Extracorporeal carbon dioxide removal in heart-beating donor with acute severe asthma: A case report.
De Rosa S., Golino G., Ronco C.
Respiratory Medicine Case Reports. 29 (no pagination), 2020. Article Number: 101010. Date of Publication: 2020.
AN: 2004791998
Status asthmaticus is a life-threatening disorder that can manifest in dangerous levels of hypercapnia and acidosis. The use of extracorporeal carbon dioxide removal (ECCO2R) has been used successfully to control pH and PaCO2 in patients with acute severe asthma. The present report describes the use of this technology in near-fatal asthma with brain death, and awaiting organ harvest. The ProLUNG system consists of a veno-venous hemoperfusion circuit with an artificial lung polymethylpentene membrane coated with phosphorylcholine with a surface of 1.81 m2. The system can reach a blood flow of 450 ml/min trough a double-lumen central venous catheter (13.0 Fr) placed in femoral, subclavian or jugular vein. The platform is provided with automated management of airflow and VCO2 monitoring during

treatment. The patient was maintained on extracorporeal treatment ensuring stable arterial pH control and PaCO2 control. In acute status asthmaticus, complicated with cardiac arrest, mini-invasive ECCO2R was an effective method of controlling pH and PaCO2, for optimizing hemodynamic and aerobic metabolism and for performing protective ventilation for an optimal organ donor preservation until the organ harvest occurs.

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(Ronco) Department of Medicine, University of Padova, Padova, Italy
Publisher
W.B. Saunders Ltd

58.

Effectiveness of using pre-hospital aspirin and anti-inflammatory drugs on mortality and morbidity in acute respiratory distress syndrome patients. Yogun bakim unitesinde takip edilen akut respiratuar distress sendromu hastalarinda yatis oncesi kullanilan antienflamatuvar ilac ve aspirinin mortalite ve morbiditeye etkisi <Yogun bakim unitesinde takip edilen akut respiratuar distress sendromu hastalarinda yatis oncesi kullanilan antienflamatuvar ilac ve aspirinin mortalite ve morbiditeye etkisi.>
Sahin A.S., Derbent A., Salihoglu E.
Nobel Medicus. 15 (3) (pp 12-15), 2019. Date of Publication: 2019.
AN: 2003470608
Objective: In this study, we aimed to investigate the efficacy of pre-hospital use of aspirin and anti-inflammatory agents in patients with Acute Respiratory Distress Syndrome (ARDS) and mortality in critically ill patients, by retrospectively screening ARDS patients treated in intensive care unit (ICU).
Material(s) and Method(s): Demographic data, duration time of ICU, intensive care unit Apache-II score, presence of comorbidity and mortality, procalcitonin and C-Reactive Protein (CRP) levels, neutrophil/lymphocyte (N/L) rates, Berlin Criteria, the use of aspirin and anti-inflammatory drugs, and the presence of infection findings from the files of ARDS patients followed from January 2016 to January 2017.
Result(s): Forty of the 43 ARDS patients were included in the study. Eighteen patients (90%) had worsening in the first week, 14 (70%) had chest X-ray pathology, 15 had (75%) pulmonary edema and 12 had (60%) needed oxygen. Statistically significant difference was found in these Berlin Criteria ($p<0.05$). There were significant differences between last procalcitonin values, the first and last CRP, N/L ratios values, hospitalization times and APACHE II scores ($p<0.05$). There were no statistically significant differences between first and last leukocyte levels ($p>=0.05$).
Conclusion(s): Pre-hospital aspirin and anti-inflammatory drugs seemed to decrease morbidity in terms of Berlin Criteria but there were no significant differences between mortality in ARDS patients in intensive care unit. However, further research is needed to confirm the results.

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Publisher
Nobelmedicus (Inkilap Mah. Akcakoca Sok. No: 10, Umraniye Istanbul 34768, Turkey)

59.

Extracorporeal CO2 removal in a case of respiratory distress syndrome by sepsis.
Eliminacion extracorporea de CO2 en un caso de sindrome de distres respiratorio por sepsis <Eliminacion extracorporea de CO2 en un caso de sindrome de distres respiratorio por sepsis.>
Mendez Hernandez R., Ramasco Rueda F., Planas Roca A.
Revista espanola de anestesiologia y reanimacion. 67 (1) (pp 35-38), 2020. Date of Publication: 01 Jan 2020.
AN: 630015051
PMID
31780048 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31780048]
Institution
(Mendez Hernandez, Ramasco Rueda, Planas Roca) Servicio de Anestesiologia y Reanimacion, Hospital Universitario de La Princesa, Madrid, Spain
Publisher
NLM (Medline)

60.

Respiratory drive of ARDS patients on ECMO is correlated to dead space and lung edema.
Spinelli E., Mauri T., Tubiolo D., Lissoni A., Tagliabue P., Abbruzzese C., Grasselli G., Pesenti A.
American Journal of Respiratory and Critical Care Medicine. Conference: 2019 International Conference of the American Thoracic Society , ATS 2019. United States. 199 (9) (no pagination), 2019. Date of Publication: May 2019.
AN: 630352523
Rationale: A significant proportion of patients with early severe ARDS maintain a high respiratory drive despite a substantial amount of CO2 production removed by ECMO.

The relationship between respiratory drive response to extracorporeal CO2 removal and severity of lung injury in mechanically ventilated ARDS patients on ECMO has not been elucidated. We investigated the association between respiratory drive and indexes of ARDS severity during a short spontaneous breathing test under maximal extracorporeal CO2 removal by ECMO.
Method(s): Fifteen mechanically ventilated patients with severe ARDS on ECMO since 2-7 days were included. Before performing the spontaneous breathing test, respiratory system compliance, pulmonary shunt fraction and physiologic dead space (calculated with standard equations) were measured during controlled mechanical ventilation, with clinical ventilation and ECMO settings. Ventilatory ratio was calculated as (minute ventilation+sweep gas flow) x PaCO2/predicted body weight x 100 x 37.5. After awakening, patients were switched to pressure support ventilation. CO2 excretion from the native lung was continuously monitored by volumetric capnography. Sweep gas flow was increased so that extracorporeal CO2 removal (VCO2-ECMO) corresponded to nearly total CO2 elimination (VCO2-tot). Respiratory rate was recorded after stabilization. Lung computed tomography scans performed for clinical reasons were analyzed for quantification of lung weight.
Result(s): Nearly total extracorporeal CO2 removal (VCO2-ECMO = 98.2 +/- 3.3 % of total VCO2) was obtained in all the patients, together with levels of PaCO2, pH and PaO2 within the normal range (PaCO2 44 +/- 6 mmHg, pH 7.42 +/- 0.05, PaO2 81 +/- 22 mmHg). Respiratory rate response was highly heterogeneous (median 15 bpm, range 0-38 bpm). Patients with respiratory rate higher than the median value had greater dead space (0.92 +/- 0.11 vs 0.64 +/- 0.13, p = 0.002), higher ventilatory ratio (2.14 +/- 0.31 vs 1.38 +/- 0.37, p < 0.001) and higher lung weight (2837 +/- 770 g vs 1943 +/- 603 g, p = 0.03). No differences were found in more "classic" indexes ARDS severity, such as respiratory system compliance, driving pressure, intrapulmonary shunt and SOFA score.
Conclusion(s): In early severe ARDS patients on ECMO undergoing a spontaneous breathing test high respiratory rate despite maximal extracorporeal CO2 removal was associated with greater dead space, higher ventilatory ratio and higher lung weight.
Institution
(Spinelli, Mauri, Tubiolo, Lissoni, Tagliabue, Abbruzzese, Grasselli, Pesenti) Anesthesia and Critical Care, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy
Publisher
American Thoracic Society

61.

Current techniques for extracorporeal decarboxylation. Moderne Decarboxylierungssysteme <Moderne Decarboxylierungssysteme.>
Nentwich J., John S.
Medizinische Klinik - Intensivmedizin und Notfallmedizin. 114 (8) (pp 733-740), 2019.
Date of Publication: 01 Nov 2019.
AN: 627428262
The widespread use of extracorporeal lung assist (ECLA) in recent years has led to the introduction of different decarboxylation systems into clinical practice. Due to the large CO2 transport capacity of the blood such systems require considerably lower extracorporeal blood flows and therefore allow for effective decarboxylation with reduced invasiveness and complexity. While systems derived from classical lung assist are mainly used to control severe acute hypercapnic respiratory failure,

recently a growing number of therapies based on renal replacement platforms have become available ("respiratory dialysis"). Such low-flow systems still allow for effective partial CO2 elimination and can control respiratory acidosis as well as facilitate or even enable protective and ultraprotective ventilation strategies in acute lung failure (ARDS). While the use of extracorporeal CO2 elimination (ECCO2R) has been shown to decrease ventilator-induced lung injury (VILI), positive effects on hard clinical endpoints such as mortality or duration of mechanical ventilation are still unproven. In light of limited evidence, ECCO2R must be regarded as an experimental procedure. Its use should therefore at present be restricted to centers with appropriate experience.

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31020339 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31020339]
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62.

Risk factors for critical limb ischemia in patients undergoing femoral cannulation for venoarterial extracorporeal membrane oxygenation: Is distal limb perfusion a mandatory approach?.
Kaufeld T., Beckmann E., Ius F., Koigeldiev N., Sommer W., Mashaqi B., Fleissner F.N., Siemeni T., Puntigam J.O., Kaufeld J., Haverich A., Kuehn C.
Perfusion (United Kingdom). 34 (6) (pp 453-459), 2019. Date of Publication: 01 Sep 2019.
AN: 626412123
Background: Venoarterial extracorporeal membrane oxygenation support is a well-established tool in the care of severe refractory cardiac and respiratory failure. The application of this support may serve as a bridge to transplant, recovery or to implantation of a ventricular assist device. Venoarterial extracorporeal membrane oxygenation support can be administered through an open surgical access via the common femoral or axillary artery or a percutaneous approach using Seldinger technique. Both techniques may obstruct the blood flow to the lower limb and may cause a significant ischemia with possible limb loss. Malperfusion of the distal limb can be avoided using an ipsilateral distal limb perfusion, which may be established by adding a single-lumen catheter during venoarterial extracorporeal membrane oxygenation treatment to overcome the obstruction. The aim of this study is to distinguish the presence or absence of a distal limb perfusion regarding the incidence of distal limb ischemia. Furthermore, expected risk factors of open and percutaneous femoral venoarterial extracorporeal membrane oxygenation installation were evaluated for the development of distal limb ischemia.
Method(s): Between January 2012 and September 2015, 489 patients received venoarterial extracorporeal membrane oxygenation support at our institution. In total, 307 patients (204 male, 103 female) with femoral cannulation were included in the analysis. The cohort was distinguished by the presence (group A; n = 237) or absence (group B; n = 70) of a distal limb perfusion during peripheral venoarterial extracorporeal membrane oxygenation treatment. Furthermore, a risk factor analysis

for the development of distal limb ischemia was performed.
Result(s): The main indications for venoarterial extracorporeal membrane oxygenation therapy were a low cardiac output syndrome (LCOS) (53%) and failed weaning of extracorporeal circulation (23%). A total of 23 patients (7.49%) under venoarterial extracorporeal membrane oxygenation support developed severe distal limb malperfusion (3.38% in group A vs 21.42% in group B). Preemptive installation of distal limb perfusion extended the intervention-free intervals to 7.8 +/- 19.3 days in group A and 6.3 +/- 12.5 in group B. A missing distal limb perfusion (p = 0.001) was identified as a main risk factor for critical limb ischemia. Other comorbidities such as arterial occlusion disease (p = 0.738) were not statistically significantly associated. Surgical intervention due to vascular complications after extracorporeal membrane oxygenation explantation was needed in 14 cases (4.22% in group A and 5.71% in group B).
Conclusion(s): We were able to identify the absence of distal limb perfusion as an independent risk factor for the development of critical distal limb ischemia during femoral venoarterial extracorporeal membrane oxygenation treatment. The application of a distal limb perfusion should be considered as a mandatory approach in the context of femoral venoarterial extracorporeal membrane oxygenation treatment regardless of the implantation technique.

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30736721 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30736721]
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63.

Extracorporeal life support for adults with respiratory failure and related indications: A review.
Brodie D., Slutsky A.S., Combes A.
JAMA - Journal of the American Medical Association. 322 (6) (pp 557-568), 2019.
Date of Publication: 13 Aug 2019.
AN: 628891240
Importance: The substantial growth over the last decade in the use of extracorporeal life support for adults with acute respiratory failure reveals an enthusiasm for the technology not always consistent with the evidence. However, recent high-quality data, primarily in patients with acute respiratory distress syndrome, have made extracorporeal life support more widely accepted in clinical practice. Observations: Clinical trials of extracorporeal life support for acute respiratory failure in adults in the 1970s and 1990s failed to demonstrate benefit, reducing use of the intervention for decades and relegating it to a small number of centers. Nonetheless, technological improvements in extracorporeal support made it safer to use. Interest in extracorporeal life support increased with the confluence of 2 events in 2009: (1) the

publication of a randomized clinical trial of extracorporeal life support for acute respiratory failure and (2) the use of extracorporeal life support in patients with severe acute respiratory distress syndrome during the influenza A(H1N1) pandemic. In 2018, a randomized clinical trial in patients with very severe acute respiratory distress syndrome demonstrated a seemingly large decrease in mortality from 46% to 35%, but this difference was not statistically significant. However, a Bayesian post hoc analysis of this trial and a subsequent meta-analysis together suggested that extracorporeal life support was beneficial for patients with very severe acute respiratory distress syndrome. As the evidence supporting the use of extracorporeal life support increases, its indications are expanding to being a bridge to lung transplantation and the management of patients with pulmonary vascular disease who have right-sided heart failure. Extracorporeal life support is now an acceptable form of organ support in clinical practice.
Conclusions and Relevance: The role of extracorporeal life support in the management of adults with acute respiratory failure is being redefined by advances in technology and increasing evidence of its effectiveness. Future developments in the field will result from technological advances, an increased understanding of the physiology and biology of extracorporeal support, and increased knowledge of how it might benefit the treatment of a variety of clinical conditions.

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31408142 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31408142]
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Publisher
American Medical Association (E-mail: smcleod@itsa.ucsf.edu)

64.

Prevalence of and risk factors for pulmonary complications after curative resection in otherwise healthy elderly patients with early stage lung cancer.
Im Y., Park H.Y., Shin S., Shin S.H., Lee H., Ahn J.H., Sohn I., Cho J.H., Kim H.K., Zo J.I., Shim Y.M., Lee H.Y., Kim J.
Respiratory Research. 20 (1) (no pagination), 2019. Article Number: 136. Date of Publication: 04 Jul 2019.
AN: 628388677
Background and objective: The prevalence of lung cancer has been increasing in healthy elderly patients with preserved pulmonary function and without underlying lung diseases. We aimed to determine the prevalence of and risk factors for

postoperative pulmonary complications (PPCs) in healthy elderly patients with non-small cell lung cancer (NSCLC) to select optimal candidates for surgical resection in this subpopulation.
Method(s): We included 488 patients older than 70 years with normal spirometry results who underwent curative resection for NSCLC (stage IA-IIB) between 2012 and 2016.
Result(s): The median (interquartile range) age of our cohort was 73 (71-76) years. Fifty-two patients (10.7%) had PPCs. Severe PPCs like acute respiratory distress syndrome, pneumonia, and respiratory failure had prevalences of 3.7, 3.7, and 1.4%, respectively. Compared to patients without PPCs, those with PPCs were more likely to be male and current smokers; have a lower body mass index (BMI), higher American Society of Anesthesiologists (ASA) classification, more interstitial lung abnormalities (ILAs), and higher emphysema index on computed tomography (CT); and have undergone pneumonectomy or bilobectomy (all $p < 0.05$). On multivariate analysis, ASA classification >=3, lower BMI, ILA, and extent of resection were independently associated with PPC risk. The short-term all-cause mortality was significantly higher in patients with PPCs.
Conclusion(s): Curative resection for NSCLC in healthy elderly patients appeared feasible with 10% PPCs. ASA classification >=3, lower BMI, presence of ILA on CT, and larger extent of resection are predictors of PPC development, which guide treatment decision-making in these patients.

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65.

Regional anticoagulation with heparin of an extracorporeal CO2 removal circuit: A case report.
Tramarin J., Cortegiani A., Gregoretti C., Vitale F., Palmeri C., Iozzo P., Forfori F., Giarratano A.
Journal of Medical Case Reports. 13 (1) (no pagination), 2019. Article Number: 123.

Date of Publication: 03 May 2019.
AN: 627460934
Background: Extracorporeal carbon dioxide removal is an increasingly used respiratory support technique. As is true of all extracorporeal techniques, extracorporeal carbon dioxide removal needs proper anticoagulation. We report a case of a patient at risk of bleeding complications who was treated with extracorporeal carbon dioxide removal and anticoagulated with a regional technique.
Case presentation: A 56-year-old Caucasian man with a history of chronic obstructive pulmonary disease exacerbation required extracorporeal carbon dioxide removal for severe hypercapnia and acidosis despite mechanical ventilation. The extracorporeal circuit was anticoagulated using a regional heparin technique to limit the patient's risk of bleeding due to a low platelet count. The patient underwent 96 h of effective extracorporeal carbon dioxide removal without any adverse events. He was successfully weaned from extracorporeal carbon dioxide removal. During the treatment, no bleeding complications or unexpected circuit clotting was observed.
Conclusion(s): The use of regional heparin anticoagulation technique seems to be feasible and safe during extracorporeal carbon dioxide removal.

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31046832 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31046832]
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66.

Feasibility and safety of extracorporeal CO2 removal to enhance protective ventilation in acute respiratory distress syndrome: the SUPERNOVA study.
Combes A., Fanelli V., Pham T., Ranieri V.M., Goligher E.C., Brodie D., Pesenti A., Beale R., Brochard L., Chiche J.-D., Fan E., de Backer D., Francois G., Ferguson N., Laffey J., Mercat A., Mc Auley D.F., Muller T., Quintel M., Vincent J.-L., Taccone F.S., Peperstraete H., Morimont P., Schmidt M., Levy B., Diehl J.-L., Guervilly C., Capelier G., Vieillard-Baron A., Messika J., Karagiannidis C., Moerer O., Urbino R., Antonelli M., Mojoli F., Alessandri F., Grasselli G., Donker D., Ferrer R., Slutsky J.M.A.S.
Intensive Care Medicine. 45 (5) (pp 592-600), 2019. Date of Publication: 01 May 2019.
AN: 627345587
Purpose: We assessed feasibility and safety of extracorporeal carbon dioxide removal (ECCO2R) to facilitate ultra-protective ventilation (VT 4 mL/kg and PPLAT <= 25 cmH2O) in patients with moderate acute respiratory distress syndrome (ARDS).
Method(s): Prospective multicenter international phase 2 study. Primary endpoint was the proportion of patients achieving ultra-protective ventilation with PaCO2 not increasing more than 20% from baseline, and arterial pH > 7.30. Severe adverse

events (SAE) and ECCO2R-related adverse events (ECCO2R-AE) were reported to an independent data and safety monitoring board. We used lower CO2 extraction and higher CO2 extraction devices (membrane lung cross-sectional area 0.59 vs. 1.30 m2; flow 300-500 mL/min vs. 800-1000 mL/min, respectively).
Result(s): Ninety-five patients were enrolled. The proportion of patients who achieved ultra-protective settings by 8 h and 24 h was 78% (74 out of 95 patients; 95% confidence interval 68-89%) and 82% (78 out of 95 patients; 95% confidence interval 76-88%), respectively. ECCO2R was maintained for 5 [3-8] days. Six SAEs were reported; two of them were attributed to ECCO2R (brain hemorrhage and pneumothorax). ECCO2R-AEs were reported in 39% of the patients. A total of 69 patients (73%) were alive at day 28. Fifty-nine patients (62%) were alive at hospital discharge.
Conclusion(s): Use of ECCO2R to facilitate ultra-protective ventilation was feasible. A randomized clinical trial is required to assess the overall benefits and harms. Clinicaltrials.gov: NCT02282657.

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67.

Update: acute hypercapnic respiratory failure. Update: akute hyperkapnische respiratorische Insuffizienz <Update: akute hyperkapnische respiratorische Insuffizienz.>
Seiler F., Trudzinski F.C., Kredel M., Lotz C., Lepper P.M., Muellenbach R.M.
Medizinische Klinik - Intensivmedizin und Notfallmedizin. 114 (3) (pp 234-239), 2019.
Date of Publication: 01 Apr 2019.
AN: 617341166
Background: Hypercapnic respiratory failure is a frequent problem in critical care and mainly affects patients with acute exacerbation of COPD (AECOPD) and acute respiratory distress syndrome (ARDS). In recent years, the usage of extracorporeal CO2 removal (ECCO2R) has been increasing.
Objective(s): Summarizing the state of the art in the management of hypercapnic respiratory failure with special regard to the role of ECCO2R.
Method(s): Review based on a selective literature search and the clinical and

scientific experience of the authors.
Result(s): Noninvasive ventilation (NIV) is the therapy of choice in hypercapnic respiratory failure due to AECOPD, enabling stabilization in the majority of cases and generally improving prognosis. Patients in whom NIV fails have an increased mortality. In these patients, ECCO2R may be sufficient to avoid intubation or to shorten time on invasive ventilation; however, corresponding evidence is sparse or even missing when it comes to hard endpoints. Lung-protective ventilation according to the ARDS network is the standard therapy of ARDS. In severe ARDS, low tidal volume ventilation may result in critical hypercapnia. ECCO2R facilitates compensation of respiratory acidosis even under "ultra-protective" ventilator settings. Yet, no positive prognostic effects could be demonstrated so far.
Conclusion(s): Optimized use of NIV and lung-protective ventilation remains standard of care in the management of hypercapnic respiratory failure. Currently, ECCO2R has to be considered an experimental approach, which should only be provided by experienced centers or in the context of clinical trials.

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28707030 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28707030]
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68.

Importance of carbon dioxide in the critical patient: Implications at the cellular and clinical levels. Importancia del dioxido de carbono en el paciente critico: implicaciones a nivel celular y clinico <Importancia del dioxido de carbono en el paciente critico: implicaciones a nivel celular y clinico.>
Morales Quinteros L., Bringue Roque J., Kaufman D., Artigas Raventos A.
Medicina Intensiva. 43 (4) (pp 234-242), 2019. Date of Publication: May 2019.
AN: 2000468152
Important recent insights have emerged regarding the cellular and molecular role of carbon dioxide (CO2) and the effects of hypercapnia. The latter may have beneficial effects in patients with acute lung injury, affording reductions in pulmonary inflammation, lessened oxidative alveolar damage, and the regulation of innate immunity and host defenses by inhibiting the expression of inflammatory cytokines. However, other studies suggest that CO2 can have deleterious effects upon the lung, reducing alveolar wound repair in lung injury, decreasing the rate of reabsorption of alveolar fluid, and inhibiting alveolar cell proliferation. Clearly, hypercapnia has both beneficial and harmful consequences, and it is important to determine the net effect under specific conditions. The purpose of this review is to describe the immunological and physiological effects of carbon dioxide, considering their potential consequences in patients with acute respiratory failure.

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29486904 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29486904]
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Publisher
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69.

The use of ECMO in ICU. Recommendations of the Spanish Society of Critical Care Medicine and Coronary Units. Empleo de ECMO en UCI. Recomendaciones de la Sociedad Espanola de Medicina Intensiva Critica y Unidades Coronarias <Empleo de ECMO en UCI. Recomendaciones de la Sociedad Espanola de Medicina Intensiva Critica y Unidades Coronarias.>
Fernandez-Mondejar E., Fuset-Cabanes M.P., Grau-Carmona T., Lopez-Sanchez M., Penuelas O., Perez-Vela J.L., Perez-Villares J.M., Rubio-Munoz J.J., Solla-Buceta M.
Medicina Intensiva. 43 (2) (pp 108-120), 2019. Date of Publication: March 2019.
AN: 2001318555
The use of extracorporeal membrane oxygenation systems has increased significantly in recent years; given this reality, the Spanish Society of Critical Intensive Care Medicine and Coronary Units (SEMICYUC) has decided to draw up a series of recommendations that serve as a framework for the use of this technique in intensive care units. The three most frequent areas of extracorporeal membrane oxygenation systems use in our setting are: as a cardiocirculatory support, as a respiratory support and for the maintenance of the abdominal organs in donors. The SEMICYUC appointed a series of experts belonging to the three working groups involved (Cardiological Intensive Care and CPR, Acute Respiratory Failure and Transplant work group) that, after reviewing the existing literature until March 2018, developed a series of recommendations. These recommendations were posted on the SEMICYUC website to receive suggestions from the intensivists and finally approved by the Scientific Committee of the Society. The recommendations, based on current knowledge, are about which patients may be candidates for the technique, when to start it and the necessary infrastructure conditions of the hospital centers or, the conditions for transfer to centers with experience. Although from a physiopathological point of view, there are clear arguments for the use of extracorporeal membrane oxygenation systems, the current scientific evidence is weak, so studies are needed that define more precisely which patients benefit most from the technique and when they should start.

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30482406 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30482406]
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Publisher
Ediciones Doyma, S.L.

70.

Acute Respiratory Failure Due to Acute Exacerbation of Chronic Obstructive Pulmonary Disease: The Spectrum of Ventilator Strategies.
Ghazala L., Hanks J., Abhijit D., Hatipoglu U., Stoller J.K.
Clinical Pulmonary Medicine. 26 (5) (pp 154-160), 2019. Date of Publication: 01 Sep 2019.
AN: 629661845
Chronic obstructive pulmonary disease (COPD) is the third leading cause of death in the United States. Acute exacerbation of COPD is associated with a faster decline in lung function, lower quality of life, and increased mortality. Management of acute exacerbation of COPD in the intensive care unit includes pharmacotherapy and mechanical ventilatory support. Noninvasive mechanical ventilation has led to significant improvement in outcomes of COPD and reduced morbidity and mortality compared with invasive mechanical ventilation. An emerging modality, extracorporeal carbon dioxide removal is now being studied to reduce the need for ventilatory assistance in acute ventilatory failure due to COPD exacerbation.

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Publisher
Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

71.

Efficacy and safety of lower versus higher CO 2 extraction devices to allow ultraprotective ventilation: Secondary analysis of the SUPERNOVA study.
Combes A., Tonetti T., Fanelli V., Pham T., Pesenti A., Mancebo J., Brodie D., Ranieri V.M.
Thorax. 74 (12) (pp 1179-1181), 2019. Date of Publication: 01 Dec 2019.
AN: 628934099
Retrospective analysis of the SUPERNOVA trial exploring the hypothesis that efficacy and safety of extracorporeal carbon dioxide removal (ECCO 2 R) to facilitate reduction of tidal volume (V T) to 4 mL/kg in patients with acute respiratory distress syndrome (ARDS) may differ between systems with lower (area of membrane length 0.59 m 2; blood flow 300-500 mL/min) and higher (membrane area 1.30 m 2; blood flow between 800 and 1000 mL/min) CO 2 extraction capacity. Ninety-five patients with moderate ARDS were included (33 patients treated with lower and 62 patients treated with higher CO 2 extraction devices). We found that (1) V T of 4 mL/kg was reached by 55% and 64% of patients with the lower extraction versus 90% and 92% of patients with higher extraction devices at 8 and 24 hours from baseline, respectively (p<0.001), and (2) percentage of patients experiencing episodes of ECCO 2 R-related haemolysis and bleeding was higher with lower than with higher extraction devices (21% vs 6%, p=0.045% and 27% vs 6%, p=0.010, respectively). Although V T of 4 mL/kg could have been obtained with all devices, this was achieved frequently and with a lower rate of adverse events by devices with higher CO 2 extraction capacity.

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31409646 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31409646]
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72.

Extracorporeal CO2 Removal - A Solution in Search of a Problem?.

Fan E.
Critical Care Medicine. 47 (1) (pp 124-126), 2019. Date of Publication: 01 Jan 2019.
AN: 627432397
PMID
30557243 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30557243]
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Click here for full text options

73.

Electrical impedance tomography: Just another tool or a real advance towards precision-medicine in mechanical ventilation?.
Grasso S., Spadaro S.
Minerva Anestesiologica. 85 (11) (pp 1157-1158), 2019. Date of Publication: 2019.
AN: 2004088842
PMID
31334621 [http://www.ncbi.nlm.nih.gov/pubmed/?term=31334621]
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74.

Feasibility and safety of ultra-low tidal volume ventilation without extracorporeal circulation in moderately severe and severe ARDS patients.
Richard J.C., Marque S., Gros A., Muller M., Prat G., Beduneau G., Quenot J.P., Dellamonica J., Tapponnier R., Soum E., Bitker L., Richecoeur J., Andreu P., Bodenes L., Cavelot S., Chebib N., Dargent A., Ferriere N., Le Bouar G., Legriel S., Mercier R., Mezidi M., Verrier N.
Intensive Care Medicine. 45 (11) (pp 1590-1598), 2019. Date of Publication: 01 Nov 2019.
AN: 2003480588
Purpose: Mechanical ventilation with ultra-low tidal volume (VT) during ARDS may reduce alveolar strain, driving pressure and hence ventilator-induced lung injury, with the main drawback of worsening respiratory acidosis. We hypothesized that VT could

be reduced down to 4 ml/kg, with clinically significant decrease in driving pressure, without the need for extracorporeal CO2 removal, while maintaining pH > 7.20.
Method(s): We conducted a non-experimental before-and-after multicenter study on 35 ARDS patients with PaO2/FiO2 <= 150 mmHg, within 24 h of ARDS diagnosis. After inclusion, VT was reduced to 4 ml/kg and further adjusted to maintain pH >= 7.20, respiratory rate was increased up to 40 min-1 and PEEP was set using a PEEP-FiO2 table. The primary judgment criterion was driving pressure on day 2 of the study, as compared to inclusion.
Result(s): From inclusion to day 2, driving pressure decreased significantly from 12 [9-15] to 8 [6-11] cmH2O, while VT decreased from 6.0 [5.9-6.1] to 4.1 [4.0-4.7] ml/kg. On day 2, VT was below 4.2 ml/kg in 65% [CI95% 48%-79%], and below 5.25 ml/kg in 88% [CI95% 74%-95%] of the patients. 2 patients (6%) developed acute cor pulmonale after inclusion. Eleven patients (32%) developed transient severe acidosis with pH < 7.15. Fourteen patients (41%) died before day 90.
Conclusion(s): Ultra-low tidal volume ventilation may be applied in approximately 2/3 of moderately severe-to-severe ARDS patients, with a 4 cmH2O median reduction in driving pressure, at the price of transient episodes of severe acidosis in approximately 1/3 of the patients.

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75.

Extracorporeal Life Support: The Next Step in Moderate to Severe ARDS - A Review and Meta-Analysis of the Literature.
Aretha D., Fligou F., Kiekkas P., Karamouzos V., Voyagis G.
BioMed Research International. 2019 (no pagination), 2019. Article Number: 1035730. Date of Publication: 2019.
AN: 2003397942
Despite the use of lung protective ventilation (LPV) strategies, a severe form of acute respiratory distress syndrome (ARDS) is unfortunately associated with high mortality rates, which sometimes exceed 60%. Recently, major technical improvements have been applied in extracorporeal life support (ECLS) systems, but as these techniques are costly and associated with very serious adverse events, high-quality evidence is needed before these techniques can become the "cornerstone" in the management of moderate to severe ARDS. Unfortunately, evaluation of previous randomized controlled and observational trials revealed major methodological issues. In this review, we focused on the most important clinical trials aiming at a final conclusion about the effectiveness of ECLS in moderate to severe ARDS patients. Totally, 20 published clinical studies were included in this review. Most studies have important limitations with regard to quality and design. In the 20 included studies (2,956 patients), 1,185 patients received ECLS. Of them, 976 patients received extracorporeal membrane oxygenation (ECMO) and 209 patients received extracorporeal carbon dioxide removal (ECCO2R). According to our results, ECLS use was not associated with a benefit in mortality rate in patients with ARDS. However, when restricted to higher quality studies, ECMO was associated with a significant benefit in mortality rate. Furthermore, in patients with H1N1, a potential benefit of ECLS in mortality rate was apparent. Until more high-quality data are derived, ECLS should be an option as a salvage therapy in severe hypoxemic ARDS patients.

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Publisher
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76.

Extracorporeal carbon dioxide removal for acute hypercapnic exacerbations of chronic obstructive pulmonary disease: Study protocol for a randomised controlled trial.
Barrett N.A., Kostakou E., Hart N., Douiri A., Camporota L.
Trials. 20 (1) (no pagination), 2019. Article Number: 465. Date of Publication: 30 Jul 2019.

AN: 629196178
Background: Chronic obstructive pulmonary disease (COPD) is a common cause of chronic respiratory failure and its course is punctuated by a series of acute exacerbations which commonly lead to hospital admission. Exacerbations are managed through the application of non-invasive ventilation and, when this fails, tracheal intubation and mechanical ventilation. The need for mechanical ventilation significantly increases the risk of death. An alternative therapy, extracorporeal carbon dioxide removal (ECCO2R), has been shown to be efficacious in removing carbon dioxide from the blood; however, its impact on respiratory physiology and patient outcomes has not been explored. Methods/design: A randomised controlled open label trial of patients (12 in each arm) with acute exacerbations of COPD at risk of failing conventional therapy (NIV) randomised to either remaining on NIV or having ECCO2R added to NIV with a primary endpoint of time to cessation of NIV. The change in respiratory physiology following the application of ECCO2R and/or NIV will be measured using electrical impedance tomography, oesophageal pressure and parasternal electromyography. Additional outcomes, including patient tolerance, outcomes, need for readmission, changes in blood gases and biochemistry and procedural complications, will be measured. Physiological changes will be compared within one patient over time and between the two groups. Healthcare costs in the UK system will also be compared between the two groups.
Discussion(s): COPD is a common disease and exacerbations are a leading cause of hospital admission in the UK and worldwide, with a sizeable mortality. The management of patients with COPD consumes significant hospital and financial resources. This study seeks to understand the feasibility of a novel approach to the management of patients with acute exacerbations of COPD as well as to understand the underlying physiological changes to explain why the approach does or does not assist this patient cohort. Detailed respiratory physiology has not been previously undertaken using this technique and there are no other randomised controlled trials currently in the literature. Trial registration: ClinicalTrials.gov, NCT02086084.

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77.

A 2-year multicenter, observational, prospective, cohort study on extracorporeal CO2 removal in a large metropolis area.
Augy J.L., Aissaoui N., Richard C., Maury E., Fartoukh M., Mekontso-Dessap A., Paulet R., Anguel N., Blayau C., Cohen Y., Chiche J.D., Gaudry S., Voicu S., Demoule A., Combes A., Megarbane B., Charpentier E., Haghighat S., Panczer M., Diehl J.L.
Journal of Intensive Care. 7 (1) (no pagination), 2019. Article Number: 45. Date of Publication: 20 Aug 2019.
AN: 628949561
Background: Extracorporeal carbon dioxide removal (ECCO2R) is a promising technique for the management of acute respiratory failure, but with a limited level of evidence to support its use outside clinical trials and/or data collection initiatives. We report a collaborative initiative in a large metropolis.
Method(s): To assess on a structural basis the rate of utilization as well as efficacy and safety parameters of 2 ECCO2R devices in 10 intensive care units (ICU) during a 2-year period.
Result(s): Seventy patients were recruited in 10 voluntary and specifically trained centers. The median utilization rate was 0.19 patient/month/center (min 0.04; max 1.20). ECCO2R was started under invasive mechanical ventilation (IMV) in 59 patients and non-invasive ventilation in 11 patients. The Hemolung Respiratory Assist System (Alung) was used in 53 patients and the iLA Activve iLA kit (Xenios Novalung) in 17 patients. Main indications were ultraprotective ventilation for ARDS patients (n = 24), shortening the duration of IMV in COPD patients (n = 21), preventing intubation in COPD patients (n = 9), and controlling hypercapnia and dynamic hyperinflation in mechanically ventilated patients with severe acute asthma (n = 6). A reduction in median V T was observed in ARDS patients from 5.9 to 4.1 ml/kg (p <0.001). A reduction in PaCO2 values was observed in AE-COPD patients from 67.5 to 51 mmHg (p< 0.001). Median duration of ECCO2R was 5 days (IQR 3-8). Reasons for ECCO2R discontinuation were improvement (n = 33), ECCO2R-related complications (n = 18), limitation of life-sustaining therapies or measures decision (n = 10), and death (n = 9). Main adverse events were hemolysis (n = 21), bleeding (n = 17), and lung membrane clotting (n = 11), with different profiles between the devices. Thirty-five deaths occurred during the ICU stay, 3 of which being ECCO2R-related.
Conclusion(s): Based on a registry, we report a low rate of ECCO2R device utilization, mainly in severe COPD and ARDS patients. Physiological efficacy was confirmed in these two populations. We confirmed safety concerns such as hemolysis, bleeding, and thrombosis, with different profiles between the devices. Such results could help to design future studies aiming to enhance safety, to demonstrate a still-lacking strong clinical benefit of ECCO2R, and to guide the choice between different devices. Trial registration: ClinicalTrials.gov: Identifier: NCT02965079 retrospectively registered https://clinicaltrials.gov/ct2/show/NCT02965079

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78.

ARDS in Obese Patients: Specificities and Management.
De Jong A., Verzilli D., Jaber S.
Critical Care. 23 (1) (no pagination), 2019. Article Number: 74. Date of Publication: 09 Mar 2019.
AN: 626673977
This article is one of ten reviews selected from the Annual Update in Intensive Care and Emergency Medicine 2019. Other selected articles can be found online at https://www.biomedcentral.com/collections/annualupdate2019. Further information about the Annual Update in Intensive Care and Emergency Medicine is available from http://www.springer.com/series/8901.

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79.

Extracorporeal life support and systemic inflammation.
Al-Fares A., Pettenuzzo T., Del Sorbo L.
Intensive Care Medicine Experimental. 7 (Supplement 1) (no pagination), 2019.
Article Number: 46. Date of Publication: 01 Jul 2019.
AN: 2002332477
Extracorporeal life support (ECLS) encompasses a wide range of extracorporeal modalities that offer short- and intermediate-term mechanical support to the failing heart or lung. Apart from the daily use of cardiopulmonary bypass (CPB) in the operating room, there has been a resurgence of interest and utilization of veno-arterial and veno-venous extracorporeal membrane oxygenation (VA- and VV-ECMO, respectively) and extracorporeal carbon dioxide removal (ECCO2R) in recent years. This might be attributed to the advancement in technology, nonetheless the morbidity and mortality associated with the clinical application of this technology is still significant. The initiation of ECLS triggers a systemic inflammatory response, which involves the activation of the coagulation cascade, complement systems, endothelial cells, leukocytes, and platelets, thus potentially contributing to morbidity and mortality. This is due to the release of cytokines and other biomarkers of inflammation, which have been associated with multiorgan dysfunction. On the other hand, ECLS can be utilized as a therapy to halt the inflammatory response associated with critical illness and ICU therapeutic intervention, such as facilitating ultra-protective mechanical ventilation. In addition to addressing the impact on outcome of the relationship between inflammation and ECLS, two different but complementary pathophysiological perspectives will be developed in this review: ECLS as the cause of inflammation and ECLS as the treatment of inflammation. This framework may be useful in guiding the development of novel therapeutic strategies to improve the outcome of critical illness.

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80.

The role of hypercapnia in acute respiratory failure.
Morales-Quinteros L., Camprubi-Rimblas M., Bringue J., Bos L.D., Schultz M.J., Artigas A.
Intensive Care Medicine Experimental. 7 (Supplement 1) (no pagination), 2019.

Article Number: 39. Date of Publication: 01 Jul 2019.
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The biological effects and physiological consequences of hypercapnia are increasingly understood. The literature on hypercapnia is confusing, and at times contradictory. On the one hand, it may have protective effects through attenuation of pulmonary inflammation and oxidative stress. On the other hand, it may also have deleterious effects through inhibition of alveolar wound repair, reabsorption of alveolar fluid, and alveolar cell proliferation. Besides, hypercapnia has meaningful effects on lung physiology such as airway resistance, lung oxygenation, diaphragm function, and pulmonary vascular tree. In acute respiratory distress syndrome, lung-protective ventilation strategies using low tidal volume and low airway pressure are strongly advocated as these have strong potential to improve outcome. These strategies may come at a price of hypercapnia and hypercapnic acidosis. One approach is to accept it (permissive hypercapnia); another approach is to treat it through extracorporeal means. At present, it remains uncertain what the best approach is.

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81.

Guidelines on the management of acute respiratory distress syndrome.
Griffiths M.J.D., McAuley D.F., Perkins G.D., Barrett N., Blackwood B., Boyle A., Chee N., Connolly B., Dark P., Finney S., Salam A., Silversides J., Tarmey N., Wise M.P., Baudouin S.V.
BMJ Open Respiratory Research. 6 (1) (no pagination), 2019. Article Number: e000420. Date of Publication: 01 May 2019.
AN: 627799656

The Faculty of Intensive Care Medicine and Intensive Care Society Guideline Development Group have used GRADE methodology to make the following recommendations for the management of adult patients with acute respiratory distress syndrome (ARDS). The British Thoracic Society supports the recommendations in this guideline. Where mechanical ventilation is required, the use of low tidal volumes (<6 ml/kg ideal body weight) and airway pressures (plateau pressure <30 cmH 2 O) was recommended. For patients with moderate/severe ARDS (PF ratio<20 kPa), prone positioning was recommended for at least 12 hours per day. By contrast, high frequency oscillation was not recommended and it was suggested that inhaled nitric oxide is not used. The use of a conservative fluid management strategy was suggested for all patients, whereas mechanical ventilation with high positive end-expiratory pressure and the use of the neuromuscular blocking agent cisatracurium for 48 hours was suggested for patients with ARDS with ratio of arterial oxygen partial pressure to fractional inspired oxygen (PF) ratios less than or equal to 27 and 20 kPa, respectively. Extracorporeal membrane oxygenation was suggested as an adjunct to protective mechanical ventilation for patients with very severe ARDS. In the absence of adequate evidence, research recommendations were made for the use of corticosteroids and extracorporeal carbon dioxide removal.

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82.

Extracorporeal Strategies in Acute Respiratory Distress Syndrome.
Cavayas Y.A., Thakore A., Fan E.
Seminars in Respiratory and Critical Care Medicine. 40 (1) (pp 114-128), 2019. Date of Publication: 2019.
AN: 627607192
Despite the breadth of life-sustaining interventions available, mortality in patients with acute respiratory distress syndrome (ARDS) remains high. A greater appreciation of the potential iatrogenic injury associated with the use of mechanical ventilation has led clinicians and researchers to seek alternatives. Extracorporeal life support

(ECLS) may be used to rescue patients with severely impaired gas exchange and provide time for injured lungs to recover while treating the underlying disease. In patients with ARDS, venovenous (VV) ECLS is commonly used, where venous blood is drained into a circuit that passes through a membrane lung, which provides gas exchange, and then returned to the venous system. VV-ECLS can be configured as a system that uses higher blood flows with extracorporeal membrane oxygenation (VV-ECMO) or as one that uses lower blood flows for extracorporeal carbon dioxide removal (VV-ECCO 2 R). Recent studies support the use of VV-ECMO in patients with severe ARDS who present with refractory gas exchange despite the use of lung-protective mechanical ventilation, positive end-expiratory pressure optimization, neuromuscular blockade, and prone positioning. The optimal management of patients during ECLS (i.e., anticoagulation, transfusions, mechanical ventilation) and the role of ECCO 2 R in the management of ARDS remain to be determined.

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Publisher
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83.

Extracorporeal carbon dioxide removal for acute hypercapnic respiratory failure.
Morales-Quinteros L., Del Sorbo L., Artigas A.
Annals of Intensive Care. 9 (1) (no pagination), 2019. Article Number: 79. Date of Publication: 01 Dec 2019.
AN: 2002259250
In the past, the only treatment of acute exacerbations of obstructive diseases with hypercapnic respiratory failure refractory to medical treatment was invasive mechanical ventilation (IMV). Considerable technical improvements transformed extracorporeal techniques for carbon dioxide removal in an attractive option to avoid worsening respiratory failure and respiratory acidosis, and to potentially prevent or shorten the duration of IMV in patients with exacerbation of COPD and asthma. In this review, we will present a summary of the pathophysiological rationale and evidence of ECCO2R in patients with severe exacerbations of these pathologies.

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84.

Noninvasive ventilation (Advanced): Course report.
Kumar R., Fadieieva H., Chipev P.M., Simonds A.
Breathe. 15 (2) (pp 104-107), 2019. Date of Publication: June 2019.
AN: 2002085020
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Publisher
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85.

Uses and mechanisms of apnoeic oxygenation: a narrative review.
Lyons C., Callaghan M.
Anaesthesia. 74 (4) (pp 497-507), 2019. Date of Publication: April 2019.
AN: 626474136
Apnoeic oxygenation refers to oxygenation in the absence of spontaneous respiration or mechanical ventilation. It has been described in humans for over half a century and has seen a resurgence in interest given its potential to delay oxygen desaturation during airway management, especially with the advent of high-flow nasal cannulae. This narrative review summarises our current understanding of the mechanisms of gas exchange during apnoeic oxygenation and its diverse range of clinical applications, including its use at induction of anaesthesia and for the facilitation of 'tubeless anaesthesia'. Additional discussion covers use in critical care, obese, obstetric and paediatric sub-populations. The article also highlights current research efforts aiming to enhance the evidence base for the use of this technique.

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30784037 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30784037]
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86.

Reply to Kredel et al.
Araos J., Bruhn A.
American Journal of Respiratory and Critical Care Medicine. 199 (7) (pp 931-932), 2019. Date of Publication: 01 Apr 2019.
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87.

Acute respiratory distress syndrome - Extracorporeal therapy. Extrakorporale Therapie des akuten Lungenversagens <Extrakorporale Therapie des akuten Lungenversagens.>
Seiler F., Horsch S.I., Becker A., Lepper P.M.
Atemwegs- und Lungenkrankheiten. 45 (3) (pp 142-148), 2019. Date of Publication: March 2019.
AN: 2001714830
The acute respiratory distress syndrome (ARDS) is associated with variable impairment of gas exchange. In severe ARDS, hypoxic or hypercapnic lung failure can occur despite optimized conventional therapy; these conditions can be addressed by extracorporeal lung replacement. Even though few high quality evidence regarding mortality exists, extracorporeal therapy is clinically approved and therefore recommended by the current national guidelines as a rescue therapy in refractory hypoxic lung failure. The role of extracorporeal therapy in hypercapnic lung failure is less clear; however, it can be considered as rescue therapy as well. Therefore, ARDS patients at risk for refractory lung failure should be considered for referral to an ARDS/ECMO center with appropriate expertise and structure.

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88.

Understanding hypoxemia on ECCO2R: back to the alveolar gas equation.
Diehl J.-L., Mercat A., Pesenti A.
Intensive Care Medicine. 45 (2) (pp 255-256), 2019. Date of Publication: 27 Feb 2019.
AN: 626272456
PMID
30324288 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30324288]
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Publisher
Springer Verlag (E-mail: service@springer.de)

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89.

Further options and survival results after failure following extracorporeal life support implantation.
Rupprecht L., Camboni D., Philipp A., Lunz D., Muller T., Schmid C., Keyser A.
Journal of Cardiovascular Surgery. 60 (1) (pp 128-135), 2019. Date of Publication: February 2019.
AN: 626018347
BACKGROUND: A retrospective study was designed to analyze the outcome of patients with extracorporeal life support (ECLS) who needed a consecutive cardiac or pulmonary support system.
METHOD(S): From 2006 to 2016, 93 out of 587 patients with their age ranging from 2.4 to 77.3 years required an exchange of an ECLS by another mechanical support system. Sixty-one patients were inhospital cases, 39 patients were referred with ECLS from other institutions by ambulance car (N.=15) or helicopter (N.=24). Sixty-five patients came from internal medicine wards, of which 38 patients had CPR, whereas 24 patients suffered postcardiotomy failure with CPR in 11 cases. Ten

patients were referred from other hospitals for failure to wean from ECLS.
RESULT(S): Leading symptoms were continuing cardiac failure in 43 patients (46%) and ongoing respiratory failure after cardiac recovery in 50 patients (54%). Patients with cardiac failure underwent implantation of a ventricular assist device (N.=36) or remained on long-term ECLS (N.=7) until a donor organ for heart transplantation was available (mean waiting time 43 days). Respiratory failure was treated by veno-venous ECMO (N.=34) or vav-ECMO (N.=16). Overall inhouse survival was 50.5% (N.=47). Only 22.6% of patients (N.=21) died during ongoing support. In contrast, 26.9% of patients (N.=25) deceased 35+/-51 days after weaning from vv-or vav-ECMO. Major reasons of death were multi-organ failure in 16 patients, cerebral hypoxia in 12 patients, sepsis in 10 patients, and intractable ow output in 5 patients.
CON CLUSIONS: Despite a switch from ECLS to another mechanical support system, survival remains limited as irreversible multi-organ failure and sepsis still jeopardize the patients' life.

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29616522 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29616522]
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Publisher
Edizioni Minerva Medica (E-mail: subscriptions.dept@minervamedica.it)

90.

Low-flow CO2 removal in combination with renal replacement therapy effectively reduces ventilation requirements in hypercapnic patients: a pilot study.
Nentwich J., Wichmann D., Kluge S., Lindau S., Mutlak H., John S.
Annals of Intensive Care. 9 (1) (no pagination), 2019. Article Number: 3. Date of Publication: 01 Dec 2019.
AN: 625818819
Background: Lung-protective strategies are the cornerstone of mechanical ventilation in critically ill patients with both ARDS and other disorders. Extracorporeal CO2 removal (ECCO2R) may enhance lung protection by allowing even further reductions in tidal volumes and is effective in low-flow settings commonly used for renal replacement therapy. In this study, we describe for the first time the effects of a labeled and certified system combining ECCO2R and renal replacement therapy on pulmonary stress and strain in hypercapnic patients with renal failure.
Method(s): Twenty patients were treated with the combined system which incorporates a membrane lung (0.32 m2) in a conventional renal replacement circuit. After changes in blood gases under ECCO2R were recorded, baseline hypercapnia was reestablished and the impact on ventilation parameters such as tidal volume and driving pressure was recorded.
Result(s): The system delivered ECCO2R at rate of 43.4 +/- 14.1 ml/min, PaCO2 decreased from 68.3 +/- 11.8 to 61.8 +/- 11.5 mmHg ($p < 0.05$) and pH increased from 7.18 +/- 0.09 to 7.22 +/- 0.08 ($p < 0.05$). There was a significant reduction in ventilation requirements with a decrease in tidal volume from 6.2 +/- 0.9 to 5.4 +/- 1.1 ml/kg PBW ($p < 0.05$) corresponding to a decrease in plateau pressure from 30.6 +/- 4.6 to 27.7 +/- 4.1 cmH2O ($p < 0.05$) and a decrease in driving pressure from 18.3 +/- 4.3 to 15.6 +/- 3.9 cmH2O ($p < 0.05$), indicating reduced pulmonary stress and strain.

No complications related to the procedure were observed.
Conclusion(s): The investigated low-flow ECCO2R and renal replacement system can ameliorate respiratory acidosis and decrease ventilation requirements in hypercapnic patients with concomitant renal failure. Trial registration NCT02590575, registered 10/23/2015.

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Publisher
Springer Verlag (E-mail: service@springer.de)

91.

Ultra-protective mechanical ventilation without extra-corporeal carbon dioxide removal for acute respiratory distress syndrome.
Regunath H., Moulton N., Woolery D., Alnijoumi M., Whitacre T., Collins J.
Journal of the Intensive Care Society. 20 (1) (pp 40-45), 2019. Date of Publication: 01 Feb 2019.
AN: 622110259
Background: Tidal hyperinflation can still occur with mechanical ventilation using low tidal volume (LVT) (6 mL/kg predicted body weight (PBW)) in acute respiratory distress syndrome (ARDS), despite a well-demonstrated reduction in mortality.
Method(s): Retrospective chart review from August 2012 to October 2014. Inclusion: Age >18years, PaO2/FiO2<200 with bilateral pulmonary infiltrates, absent heart failure, and ultra-protective mechanical ventilation (UPMV) defined as tidal volume (VT) <6 mL/kg PBW. Exclusion: UPMV use for <24 h. Demographics, admission Acute Physiology and Chronic Health Evaluation II (APACHE II) scores, arterial blood gas, serum bicarbonate, ventilator parameters for pre-, during, and post-UPMV periods including modes, VT, peak inspiratory pressure (PIP), plateau pressure (Pplat), driving pressure, etc. were gathered. We compared lab and ventilator data for pre-, during, and post-UPMV periods.
Result(s): Fifteen patients (male:female = 7:8, age 42.13 +/- 11.29 years) satisfied criteria, APACHEII 20.6 +/- 7.1, mean days in intensive care unit and hospitalization were 18.5 +/- 8.85 and 20.81 +/- 9.78 days, 9 (60%) received paralysis and 7 (46.67%) required inotropes. Eleven patients had echocardiogram, 7 (63.64%) demonstrated right ventricular volume or pressure overload. Eleven patients (73.33%) survived. During-UPMV, VT ranged 2-5 mL/kg PBW(3.99 +/- 0.73), the arterial partial pressure of carbon dioxide (PaCO2) was higher than pre-UPMV values (84.81 +/- 18.95 cmH2O vs. 69.16 +/- 33.09 cmH2O), but pH was comparable and none received extracorporeal carbon dioxide removal (ECCO2-R). The positive end-expiratory pressure (14.18 +/- 7.56 vs. 12.31 +/- 6.84 cmH2O), PIP (38.21 +/- 12.89 vs. 32.59 +/- 9.88), and mean airway pressures (19.98 +/- 7.61 vs. 17.48 +/- 6.7 cm H2O) were higher during UPMV, but Pplat and PaO2/FiO2 were comparable during- and pre-UPMV. Driving pressure was observed to be higher in those who died than who survived (24.18 +/- 12.36 vs. 13.42 +/- 3.25).
Conclusion(s): UPMV alone may be a safe alternative option for ARDS patients in

centers without ECCO2-R.

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Publisher
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92.

The advantages of next-generation sequencing technology in the detection of different sources of abscess.
Guo L.-Y., Feng W.-Y., Guo X., Liu B., Liu G., Dong J.
Journal of Infection. 78 (1) (pp 75-86), 2019. Date of Publication: January 2019.
AN: 2001042213
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Publisher
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93.

Can ECCO2R be the rising sun for respiratory failure?.
Sablon A., Jacobs R., Diltoer M., Troubleyn J., Malbrain M.L.N.G.
Anaesthesiology Intensive Therapy. Conference: 6th International Fluid Academy Days. Belgium. 51 (Supplement 1) (pp 56-57), 2019. Date of Publication: 2019.
AN: 627804990
Background: Extracorporeal carbon dioxide removal (ECCO2R) devices have been proposed as an adjunctive therapy in patients with acute exacerbations of chronic obstructive pulmonary disease (AECOPD) to avoid intubation or reduce the length of invasive ventilation [1-3]. In acute respiratory distress syndrome (ARDS) patients it is

used to allow ultra-protective ventilation. In cases of severe ARDS, veno-venous extracorporeal membrane oxygenation (VV-ECMO) proves to be a life-sustaining rescue strategy; however, complications associated with VV-ECMO are common and potentially life-threatening [1-3].
Objective(s): We performed a single-center retrospective observational study where we investigated the benefts of ECCO2R, complications encountered and mortality. We were also interested to know for patients who have contraindications for VV-ECMO if they could beneft from an ECCO2R.
Method(s): We performed a single-center retrospective observational cohort analysis in a tertiary University Intensive Care Unit (ICU). Over a 34-month period, 59 patients were treated with arterio-venous (AV)-ECCO2R for ARDS or AECOPD. We used a Novalung iLA Membrane Ventilator (Xenios, Heilbronn, Germany) which is a pumpless device.
Result(s): In total, 59 subjects were analyzed. In the ARDS group 35 patients were included, consisting of 16 male and 19 female patients with a mean age of 57 years (54-59) and a mean APACHE score of 25 (23-27). In the AECOPD group 24 patients were included, consisting of 12 male, and 12 female patients with a mean age of 64 years (63-65) and a mean APACHE score of 24 (21-27). Mortality for patients treated with AV-ECCO2R for ARDS or AECOPD was respectively 48.6% and 40.9%. In the ARDS group the mean duration of ventilation during ECCO2R was 5.7 days (5.1-6.3), the mean length of ICU and hospital stay was 23.9 days (20.9-26.8) and 44.1 days (37.5-50.9) respectively. Mean arterial blood pH obtained at initiation of ECCO2R treatment was 7.2 mm Hg (7.04-7.36) and 7.36 mm Hg (7.22-7.50) at termination of ECCO2R therapy. Mean PaCO2 value was 65.8 mm Hg (63.3-68.4) at initiation of ECCO2R therapy and 48.1 mm Hg (46-50.2) at termination of the ECCO2R treatment. In the AECOPD group the mean duration of ventilation during ECCO2R was 2.4 days (1.8-3.0), the mean length of ICU and hospital stay was 10.8 days (9.2-12.4) and 23.2 days (19.9-26.5) respectively. Mean arterial blood pH obtained at initiation of ECCO2R treatment was 7.24 (7.22-7.26) and 7.42 (7.41-7.43) at termination of ECCO2R therapy. Mean PaCO2 value was 80.3 mm Hg (77.0-83.6) at initiation of ECCO2R therapy and 56 mm Hg (53.3-58.7) at termination of the ECCO2R treatment. Complications due to AV-ECCO2R had no signifcant impact upon outcome in both groups.
Conclusion(s): ECCO-R is a feasible, rapidly evolving technology and is an efcient treatment that allows lung protective ventilation. However, evidence for a mortality beneft with ECCOR is lacking and complications are frequent. Well-designed adequately powered randomized controlled trials (RCTs) are required to better elucidate risk-beneft balance.
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Publisher
Via Medica

94.

Prone position is feasible with an extracorporeal decarboxylation during adult's acute respiratory distress syndrome. Analysis of 58 sessions.
Boquillon N., Georger J.F.

Annals of Intensive Care. Conference: French Intensive Care Society International Congress - Reanimation 2019. France. 9 (Supplement 1) (no pagination), 2019. Date of Publication: March 2019.
AN: 630114077
Introduction: Toxicity of mechanical ventilation during acute respiratory distress syndrome (ARDS) can possibly be prevented by using 'ultra-protective' ventilation which favors hypercapnia. An extracorporeal removal of CO2 (ECCO2R) can correct it. The issue of hypoxemia remains for which prone positioning (PP) is known to be effective. We therefore studied PP feasibility with ECCO2R.
Patients and Methods: We conducted a retrospective analysis from August 2014 to December 2017 in our center. Indication for ECCO2R was a pH < 7.20 with an arterial partial pressure of CO2 > 50 mmHg with 'protective ventilation'. Indication for PP was a PaO2 FiO2 ratio (arterial partial pressure of O2 fraction of inspired O2) < 150. Primary endpoint was discontinuation before 15 h of PP. Patients with ARDS (Berlin's criteria) and ECCO2R were compared to patients without ECCO2R with Fischer's exact test.
Result(s): 23 patients with ECCO2R underwent 58 PP procedures whose 56 lasted more than 15 h. 38 patients without ECCO2R underwent 53 PP procedures whose 47 lasted more than 15 h. There was no difference for early discontinuation of PP (p = 0.15).
Discussion(s): Our results were in accordance with scientific evidence and did not advocate for a change of practice.
Conclusion(s): It was possible to safely conduct 58 PP sessions with ECCO2R and 'ultra-protective' ventilation during ARDS.
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Publisher
Springer

95.

Acquired von Willebrand syndrome in patients with extracorporeal CO2 removal.
Couteau-Chardon A., Rivet N., Augy J.-L., Vimpere D., Lancelot A., Commereuc M., Bailleul C., Aissaoui N., Puymirat E., Guerot E., Novara A., Smadja D., Gaussem P., Diehl J.-L.
Annals of Intensive Care. Conference: French Intensive Care Society International Congress - Reanimation 2019. France. 9 (Supplement 1) (no pagination), 2019. Date of Publication: March 2019.
AN: 630113780
Introduction: Acquired von Willebrand syndrome (AVWS) is a hemostasis disorder widely described with different extracorporeal circulatory assistances. Conversely, very few data are available in the field of extracorporeal CO2 removal (ECCO2R). We report the results of a prospective monocentric study focusing on von Willebrand disorders induced by ECCO2R devices.
Patients and Methods: Prospective study performed in 20 consecutive patients treated with ECCO2R (either Hemolung or iLA activve device). Biological testing included-platelet function analyzer-adenosine diphosphate (PFA-ADP) and -epinephrine (PFAEPI), von Willebrand factor antigen (VWF-Ag) and activity (VWF-RCo), and multimeric profile (Hydrasys 2 system). Measurements were performed prior to ECCO2R initiation, then at 5, 30, 60 and 180 min, daily during ECCO2R from

D1 to D7, and 24 h after stopping ECCO2R. Bleeding and thrombotic events were recorded.
Result(s): Hemolung was used in 8 patients, and iLA activve in 12 between January 2017 and July 2018. The indications for ECCO2R were acute exacerbation of chronic obstructive pulmonary disease (n = 16), acute respiratory distress syndrome (n = 3), and severe acute asthma (n = 1). Significant prolonged PFA-ADP (151 s of median time at D1 versus 82 s at D0, p = 0.0001) and PFA-EPI (214 s at D1 versus 106 at D0, p = 0.0017) were observed in 19 patients (one patient with missing data) during ECCO2R, and normalized in respectively 11 and 10 among the 14 patients tested 24 h after stopping ECCO2R. The VWF-RCo VWF-Ag ratio decreased for all patients between 60 min and D1 (0.65 of median ratio at D1 versus 0.93 at D0, Figure 1A, 1B). The ratio was normalized 24 h after ECCO2R cessation in 8 of the 10 patients tested. Loss of high molecular weight multimers occured in all patients tested (n = 14) as early as 60 min (0.48 of median ratio at D1, versus 1.05 at D0) and was associated with an increase in low molecular weight multimers (Figure 1C, 1D). Fourteen bleeding events were reported. Nine thrombotic events were reported (6 at the right internal jugular cannulation site, 3 device's thrombosis). There was a trend to a more pronounced decrease in high molecular weight multimers in patients with bleeding events.
Conclusion(s): Von Willebrand disorders were observed in all ECCO2R patients. They may contribute at least in part to the frequency and severity of bleeding complications observed in this population.
Institution
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96.

Ultra-protective ventilation without extracorporeal circulation in moderately severe and severe ARDS patients.
Richard J.-C., Marque S., Gros A., Muller M., Prat G., Beduneau G., Quenot J.-P., Dellamonica J., Tapponnier R., Soum E., Laurent B., Richecoeur J.
Annals of Intensive Care. Conference: French Intensive Care Society International Congress - Reanimation 2019. France. 9 (Supplement 1) (no pagination), 2019. Date of Publication: March 2019.
AN: 630113525
Introduction: Ultraprotective ventilation with tidal volume (VT) reduction below 6 ml kg predicted body weight (PBW) in severe ARDS may reduce alveolar strain, driving pressure and hence ventilatorinduced lung injury, with main drawback of worsening respiratory acidosis. We hypothesized that VT could be reduced up to 4 ml kg, with clinically significant decrease in driving pressure (DeltaP), without the need for extracorporeal CO2 removal, while maintaining pH in the range targeted in recent ARDS trials.
Patients and Methods: We conducted a non-experimental beforeand-after multi-center study on 35 ARDS patients with PaO2 FiO2 <= 150 mm Hg, within 24 h of

ARDS diagnosis. After inclusion (H0), VT was reduced to 4 ml kg PBW and further adjusted to maintain pH > = 7.20, respiratory rate was increased up to 40 min and PEEP was set using a PEEP-FiO2 table favoring high PEEP. This strategy was applied until positivity of a PEEP weaning trial. The primary judgment criterion was DeltaP on day 2, as compared to study inclusion.
Result(s): Patients' age was 62 +/- 14 year, SAPS II amounted to 47 +/- 15, 29 patients (85%) had pneumonia as ARDS risk factor, SOFA at inclusion was 13 +/- 3, and PaO2 FiO2 at inclusion was 107 +/- 35 mm Hg under a PEEP of 10 +/- 4 cmH2O. From inclusion to day 2, DeltaP decreased significantly from 12.1 +/- 4.3 to 8.6 +/- 3.1 cmH2O, while VT decreased from 6.1 +/- 0.6 to 4.4 +/- 0.7 ml kg. On day 2 of the study (table 1), VT was below 4.2 ml kg in 22 patients (65% [IC95% 48%-79%]), and below 5.25 ml kg in 30 patients (88% CI95% [74%-95%]). Time with VT below 4.2 ml kg averaged 1.7 +/- 1.4 days. Sedation drugs were not significantly modified. **Two patients (6%) developed acute cor pulmonale after inclusion. Right ventricle left ventricle ratio increased non-significantly from 0.59 +/- 0.16 at H0 to 0.69 +/- 0.22 on day 2. Eleven patients (32%) presented with severe respiratory acidosis (pH < 7.15). Fourteen patients (41%) died before day 90.
Conclusion(s): Ultraprotective ventilation may be applied in approximately 2 3 of moderately severe to severe ARDS patients, with a mean reduction of DeltaP approximating 3.5cmH2O, at the price of severe respiratory acidosis in 1 3 of the patients. (Table Presented).
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Publisher
Springer

97.

Case report of extracorporeal CO2 removal in a District Hospital.
Pang J., Malik R.
Journal of the Intensive Care Society. Conference: Intensive Care Society State of the Art Meeting, ICS 2018. United Kingdom. 20 (2 Supplement) (pp 30), 2019. Date of Publication: May 2019.
AN: 628978155
65 years old gentleman with 50pack years smoking history, stroke was admitted with increasingly dysponea over 2-3months with weight loss and appetite. His ABG showed Type1 Resp failure with metabolic acidosis on 15L/min. He was diagnosed as community acquired pneumonia and supported with high flow nasal oxygen therapy with increasing oxygen requirment and subsequently intubated. Day 3,

mechanical ventilation with worsening inflammatory markers with renal impariment and a CT chest showed {fig 1}, bronchoscopic Alveolar lavage: Inflamatory changes with no malignancy cell. Sputum grew Coliform growth. His antibiotics were escalated to Tazocin due to rising in inflammatory markers on Day9. With negative auto-immune screen and fungal screen, AIP was diagnosed and pulsed methylprednisolone was initiated with little response. Discussion with Extra-coporeal Membrance Oxygen Therapy (ECMO) centre gave the opinion he was not a suitable candidate due to possibility of malignancy. Day 12 he was proned to improve lung compliance with little response. Day14 Extracorporeal CO2 Removal (ECCO2-R) was started and the reduced the tidal volume and PIP to 32 to 35 (previously was upto 50 to 60). In Lung cancer MDT, consensus was more likely to be inflamatory process than neoplasia but malignancy could still not be ruled out. He continued to deteriorated further and decision was made to withdrawn and he passed away on 8/10/ 2017.
Discussion(s): This case report aims to inform options of ECCO2-R in district Hospital when tertiary centres have turned down patients for ECMO. One crucial beneficiary effect of ECCO2-R is to super-protect ventilation for patients with ARDS by reducing tidal volume and minute volume preventing ventilator induced lung injury {2}. From the study, Bein & team found that ECCO2-R impacted morbidity as more hypoxaemic patients had more ventilator free days with this threapy. Looking into the future, Italy is conducting clinical trials investigating ECCO2-R as treatment option for COPD patients who have hypercapnia respiratory acidosis failing to respond to non-invasive ventilation{3}.
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Publisher
SAGE Publications Inc.

98.

Respiratory drive of ARDS patients on ECMO is correlated to dead space and lung edema.
Spinelli E., Mauri T., Scotti E., Crotti S., Tubiolo D., Lissoni A., Tagliabue P., Abbruzzese C., Grasselli G., Pesenti A.
Perfusion (Germany). Conference: 8th EuroELSO Congress on ECMO-ECLS. Spain. 34 (1 Supplement) (pp 135), 2019. Date of Publication: April 2019.
AN: 627466107
Objective: A significant proportion of patients with early severe ARDS maintain a high respiratory drive despite a substantial amount of CO2 production removed by ECMO. Identifying predictors of uncontrolled respiratory drive by ECMO could guide patient selection for safe switch to early spontaneous breathing.
Method(s): Fifteen mechanically ventilated patients with severe ARDS on ECMO since 2-7 days were included. Patients were switched to minimal sedation and pressure support and CO2 removal by ECMO was increased to 90% of patients CO2 production. After 15 minutes, patients with higher respiratory rate (i.e., >15 bpm) despite nearly total ECMO support were classified as non-responders. The collected pre-test physiologic characteristics included: ventilation settings, respiratory mechanics, gas exchange, dead space, ventilatory ratio and lung weight by computed tomography.
Result(s): Nearly total extracorporeal CO2 removal (VCO2-ECMO = 98.2 +/- 3.3 % of total VCO2) was obtained in all the patients, together with levels of PaCO2, pH and

PaO2 within the normal range (PaCO2 44 +/- 6 mmHg, pH 7.42 +/- 0.05, PaO2 81 +/- 22 mmHg). Respiratory rate response was highly heterogeneous (median 15 bpm, range 0-38 bpm). Compared to respond-ers, only pre-test dead space (p =0.006), ventilatory ratio (p <0.001) and lung weight (p <0.05 for total and non-dependent lung weight) were higher in 7 non-responders. No differences were found in more "classic" indexes ARDS severity, such as respiratory system compliance, driving pressure, intrapulmonary shunt and SOFA score.
Conclusion(s): Predictors of failure to control respiratory drive by ECMO include less efficient CO2 clearance and higher diffuse lung edema.
Institution
(Spinelli, Mauri, Scotti, Crotti, Tubiolo, Lissoni, Tagliabue, Abbruzzese, Grasselli, Pesenti) Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico di Milano, Anesthesia, Critical Care and Emergency, Milano, Italy
Publisher
Verlag Perfusion GmbH

99.

Extracorporeal carbon dioxide removal (ECCO2R) requirements for (ultra)protective mechanical ventilation: Mathematical model predictions.
Leypoldt J., Goldstein J., Pouchoulin D., Harenski K.
Critical Care. Conference: 39th International Symposium on Intensive Care and Emergency Medicine. Belgium. 23 (Supplement 2) (no pagination), 2019. Date of Publication: March 2019.
AN: 627251415
Introduction: ECCO2R facilitates the use of low tidal volumes during protective or ultraprotective mechanical ventilation when managing patients with acute respiratory distress syndrome (ARDS); however, the rate of ECCO2R required to avoid hypercapnia remains unclear.
Method(s): We determined ECCO2R requirements to maintain arterial partial pressure of carbon dioxide or CO2 (PaCO2) at clinically desirable levels in ventilated ARDS patients using a six-compartment mathematical model of CO2 and oxygen (O2) biochemistry [1] and whole-body transport [2] with the addition of an ECCO2R device for extracorporeal veno-venous removal of CO2. The model assumes steady state conditions and is comprehensive from both biochemical and physiological perspectives. O2 consumption and CO2 production rates were assumed proportional to predicted body weight (PBW) and adjusted to achieve PaO2 and PaCO2 levels at a tidal volume of 7.6 mL/(kg of PBW) as reported in LUNG SAFE [3]. Clinically desirable PaCO2 levels during mechanical ventilation were targeted at 46 mm Hg for a ventilation frequency of 20.8/min as previously reported [3].
Result(s): Model simulated PaCO2 levels without and with an ECCO2R device at various tidal volumes are tabulated in Tables 1 and 2, respectively. Table 1 shows a substantial increase in PaCO2 at a tidal volume of 6 mL/(kg of PBW) that is more pronounced when further reducing the tidal volume. Additional simulations showed that predicted ECCO2R rates were significantly influenced by ventilation frequency.
Conclusion(s): The current mathematical model predicts that ECCO2R rates that achieve clinically acceptable PaCO2 levels at tidal volumes of 5-6 mL/(kg of PBW) can likely be achieved with current technologies; achieving such PaCO2 levels with ultraprotective tidal volumes of 3-4 mL/(kg of PBW) may be challenging.
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Publisher
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100.

Editorial: Improving extracorporeal life support outcomes in children.
Sandhu H.S., Fortenberry J.D., MacLaren G.
Frontiers in Pediatrics. 7 (MAR) (no pagination), 2019. Article Number: 140. Date of Publication: 2019.
AN: 627528501
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Publisher
Frontiers Media S.A. (E-mail: info@frontiersin.org)

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101.

Non-ventilatory therapies for acute respiratory distress syndrome.
Bourenne J., Hraiech S., Rambaud R., Forel J.-M., Persico N., Guervilly C., Papazian L.
Minerva Anestesiologica. 84 (9) (pp 1093-1101), 2018. Date of Publication: September 2018.
AN: 623937985
Acute respiratory distress syndrome (ARDS) commonly affects intensive care unit patients and is associated with high mortality. In addition to etiologic treatment and protective ventilation, non-ventilatory therapies represent a significant part of ARDS care. Pharmacological treatments, extra corporeal devices and prone positioning are commonly grouped under this term. Studies have evaluated the individual effects of some of these non-ventilatory therapies in large randomized controlled trials. Recent advances concerning the beneficial use of neuromuscular blocking agents and prone positioning deserve attention. Conversely, the use of inhaled nitric oxide and almitrine remains to be specified. The debate concerning the role of corticosteroids could be renewed considering the emergence of new biomarkers. Finally, the use of extracorporeal membrane oxygenation and extra-corporeal CO2 removal remain

under question. The aim of this review is to summarize the latest data concerning the mainly used non-ventilatory therapies and to integrate them into a global strategy of ARDS patient care.

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29745620 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29745620]
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Publisher
Edizioni Minerva Medica (E-mail: subscriptions.dept@minervamedica.it)

102.

Extracorporeal CO2 removal may improve renal function of patients with acute respiratory distress syndrome and acute kidney injury: An open-label, interventional clinical trial.
Fanelli V., Cantaluppi V., Alessandri F., Costamagna A., Cappello P., Brazzi L., Pugliese F., Biancone L., Terragni P., Marco Ranieri V.
American Journal of Respiratory and Critical Care Medicine. 198 (5) (pp 687-690), 2018. Date of Publication: 01 Sep 2018.
AN: 623750523
PMID
29708394 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29708394]
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Publisher
American Thoracic Society (E-mail: malexander@thoracic.org)

103.

ECCO2R: Are we ready for the prime time?.

Di Nardo M., Taccone F.S., Swol J., Vercaemst L., Belliato M.
Minerva Anestesiologica. 84 (5) (pp 644-645), 2018. Date of Publication: May 2018.
AN: 621948486
PMID
29516711 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29516711]
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Edizioni Minerva Medica (E-mail: subscriptions.dept@minervamedica.it)

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104.

Precision medicine for extracorporeal CO2 removal for acute respiratory distress syndrome: CO2 physiological considerations.
Morales-Quinteros L., Artigas A., Kaufman D.A.
American Journal of Respiratory and Critical Care Medicine. 197 (8) (pp 1090-1091), 2018. Date of Publication: 15 Apr 2018.
AN: 621906986
PMID
29211495 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29211495]
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American Thoracic Society (E-mail: malexander@thoracic.org)

Link to the Ovid Full Text or citation:
Click here for full text options

105.

The evolution of extracorporeal membrane oxygenation for adult respiratory failure.
Brodie D.
Annals of the American Thoracic Society. 15 (Supplement 1) (pp S57-S60), 2018. Date of Publication: February 2018.
AN: 621676107

The use of extracorporeal membrane oxygenation to support patients with cardiac and respiratory failure has increased substantially in the last decade. Although the evidence base for its use in adults with respiratory failure is growing, many questions remain to be answered. Ongoing research is aimed at clarifying the role of extracorporeal membrane oxygenation, as well as extracorporeal carbon dioxide removal, in various forms of hypoxemic and hypercapnic respiratory failure, and at defining the optimal techniques for its use. This, of course, is a moving target, as advances in the technology of extracorporeal membrane oxygenation, and the potential development of a true artificial lung, continue at a brisk pace.

PMID
29461889 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29461889]
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Publisher
American Thoracic Society (E-mail: malexander@thoracic.org)

106.

Patient selection for extracorporeal CO2 removal: A task as challenging as for ECMO therapy.
Hilty M.P., Riva T., Cottini S.R., Kleinert E.-M., Maggiorini A., Maggiorini M.
Minerva Anestesiologica. 84 (3) (pp 410-411), 2018. Date of Publication: March 2018.
AN: 621562537
PMID
29405675 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29405675]
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Publisher
Edizioni Minerva Medica (E-mail: subscriptions.dept@minervamedica.it)

107.

Right patient selection and management in veno-venous extracorporeal carbon dioxide removal.
Pettenuzzo T., Del Sorbo L.
Minerva Anestesiologica. 84 (3) (pp 409-410), 2018. Date of Publication: March 2018.

AN: 621562536
PMID
29152939 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29152939]
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Publisher
Edizioni Minerva Medica (E-mail: subscriptions.dept@minervamedica.it)

108.

Extracorporeal life support as a bridge to lung transplantation-experience of a high-volume transplant center.
Hoetzenecker K., Donahoe L., Yeung J.C., Azad S., Fan E., Ferguson N.D., Del Sorbo L., de Perrot M., Pierre A., Yasufuku K., Singer L., Waddell T.K., Keshavjee S., Cypel M.
Journal of Thoracic and Cardiovascular Surgery. 155 (3) (pp 1316-1328.e1), 2018.
Date of Publication: March 2018.
AN: 619963549
Objectives: Extracorporeal life support (ECLS) is increasingly used to bridge deteriorating patients awaiting lung transplantation (LTx), however, few systematic descriptions of this practice exist. We therefore aimed to review our institutional experience over the past 10 years.
Method(s): In this case series, we included all adults who received ECLS with the intent to bridge to LTx. Data were retrieved from patient charts and our institutional ECLS and transplant databases.
Result(s): Between January 2006 and September 2016, 1111 LTx were performed in our institution. ECLS was used in 71 adults with the intention to bridge to LTx; of these, 11 (16%) were bridged to retransplantation. The median duration of ECLS before LTx was 10 days (range, 0-95). We used a single dual-lumen venous cannula in 23 patients (32%). Nine of 13 patients (69%) with pulmonary hypertension were bridged by central pulmonary artery to left atrium Novalung. Twenty-five patients (35%) were extubated while on ECLS and 26 patients (37%) were mobilized. Sixty-three patients (89%) survived to LTx. Survival by intention to treat was 66% (1 year), 58% (3 years) and 48% (5 years). Survival was significantly shorter in patients undergoing ECLS bridge to retransplantation compared with first LTx (median survival, 15 months (95% CI, 0-31) versus 60 months (95% CI, 37-83); P =.041).
Conclusion(s): In our center experience, ECLS bridge to first lung transplant leads to good short-term and long-term outcomes in carefully selected patients. In contrast, our data suggest that ECLS as a bridge to retransplantation should be used with caution.

PMID
29248282 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29248282]
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Publisher
Mosby Inc. (E-mail: customerservice@mosby.com)

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109.

Artificial Lungs for Lung Failure: JACC Technology Corner.
Naito N., Cook K., Toyoda Y., Shigemura N.
Journal of the American College of Cardiology. 72 (14) (pp 1640-1652), 2018. Date of Publication: 2 October 2018.
AN: 2001109128
Although lung transplantation is an effective treatment for end-stage lung failure, its limitations have led to renewed interest in artificial lung support for patients with lung failure. The use of ventricular assist devices has significantly improved the quality of life and survival of patients with end-stage heart failure. In contrast, there are no devices that can be used long term as destination therapy for end-stage lung failure, and there is a strong need for them. Extracorporeal membrane oxygenation is widely used as a temporary treatment for acute lung failure and as a bridge to lung transplant. Many patients with advanced lung failure cannot return home with good quality of life once they are hospitalized. In this review, the authors discuss the history, status, and future of artificial lungs, focusing on long-term artificial respiratory support as a destination therapy. Respiratory assist devices, such as artificial lungs, could eventually become analogous to ventricular assist devices.

PMID
30261966 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30261966]
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Click here for full text options

110.

Management of acute respiratory failure in interstitial lung diseases: Overview and clinical insights.
Faverio P., De Giacomi F., Sardella L., Fiorentino G., Carone M., Salerno F., Ora J., Rogliani P., Pellegrino G., Sferrazza Papa G.F., Bini F., Bodini B.D., Messinesi G., Pesci A., Esquinas A.
BMC Pulmonary Medicine. 18 (1) (no pagination), 2018. Article Number: 70. Date of Publication: 15 May 2018.
AN: 622136566

Background: Interstitial lung diseases (ILDs) are a heterogeneous group of diseases characterized by widespread fibrotic and inflammatory abnormalities of the lung. Respiratory failure is a common complication in advanced stages or following acute worsening of the underlying disease. Aim of this review is to evaluate the current evidence in determining the best management of acute respiratory failure (ARF) in ILDs.
Method(s): A literature search was performed in the Medline/PubMed and EMBASE databases to identify studies that investigated the management of ARF in ILDs (the last search was conducted on November 2017).
Result(s): In managing ARF, it is important to establish an adequate diagnostic and therapeutic management depending on whether the patient has an underlying known chronic ILD or ARF is presenting in an unknown or de novo ILD. In the first case both primary causes, such as acute exacerbations of the disease, and secondary causes, including concomitant pulmonary infections, fluid overload and pulmonary embolism need to be investigated. In the second case, a diagnostic work-up that includes investigations in regards to ILD etiology, such as autoimmune screening and bronchoalveolar lavage, should be performed, and possible concomitant causes of ARF have to be ruled out. Oxygen supplementation and ventilatory support need to be titrated according to the severity of ARF and patients' therapeutic options. High-Flow Nasal oxygen might potentially be an alternative to conventional oxygen therapy in patients requiring both high flows and high oxygen concentrations to correct hypoxemia and control dyspnea, however the evidence is still scarce. Neither Non-Invasive Ventilation (NIV) nor Invasive Mechanical Ventilation (IMV) seem to change the poor outcomes associated to advanced stages of ILDs. However, in selected patients, such as those with less severe ARF, a NIV trial might help in the early recognition of NIV-responder patients, who may present a better short-term prognosis. More invasive techniques, including IMV and Extracorporeal Membrane Oxygenation, should be limited to patients listed for lung transplant or with reversible causes of ARF.
Conclusion(s): Despite the overall poor prognosis of ARF in ILDs, a personalized approach may positively influence patients' management, possibly leading to improved outcomes. However, further studies are warranted.

PMID
29764401 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29764401]
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Publisher
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111.

Extracorporeal membrane oxygenation for ards: Optimization of lung protective ventilation.
Parekh M., Abrams D., Brodie D., Yip N.H.
Respiratory Care. 63 (9) (pp 1180-1188), 2018. Date of Publication: 01 Sep 2018.
AN: 624220671
The use of extracorporeal membrane oxygenation in the management of ARDS has grown considerably in the past decade, largely as a consequence of improvements in extracorporeal technology and management techniques. Recently published data has helped clarify the use of ECMO in ARDS, and its role in optimizing lung-protective ventilation and minimizing ventilator-induced lung injury has the potential to have a substantial impact on ARDS management and outcomes. In the future, novel extracorporeal management strategies may lead to a new paradigm in our approach to patients with ARDS. Key words: ARDS; extracorporeal membrane oxygenation (ECMO); respiratory failure; extracorporeal life support. [Respir Care 2018;63(9):1180-1188. © 2018 Daedalus Enterprises].

PMID
30166413 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30166413]
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Publisher
American Association for Respiratory Care

112.

Extracorporeal lung support for hypercapnic ventilatory failure.
Pisani L., Polastri M., Pacilli A.M.G., Nava S.
Respiratory Care. 63 (9) (pp 1174-1179), 2018. Date of Publication: 01 Sep 2018.
AN: 624220507
Extracorporeal lung support can be achieved using extracorporeal membrane oxygenation (ECMO) and extracorporeal CO2 removal. The ECMO systems allow a total lung support, providing both blood oxygenation and CO2 removal. Unlike ECMO, extracorporeal CO2 removal refers to an extracorporeal circuit that provides a partial lung support and selectively extracts CO2 from blood. The concept of partial extracorporeal lung support by removing only CO2 without effect on oxygenation was first proposed in 1977 by Kolobow and Gattinoni, with the aim to reduce breathing frequency, ventilator tidal volumes, and inspiratory pressures, facilitating lung-protective ventilation. Patients with end-stage chronic lung disease can survive, while waiting for lung transplantation, only if treated with mechanical ventilation or extracorporeal lung support. ECMO has been considered a suitable approach as a bridge to lung transplantation for patients with advanced respiratory failure waiting for lung transplantation. Extracorporeal CO2 removal has been proposed for the treatment of COPD patients suffering from exacerbation to avoid invasive mechanical ventilation. The rationale is to combine the improvement of alveolar ventilation by

using noninvasive ventilation with muscle unload provided by removing CO2 directly from the blood, using an extracorporeal device. Increasing attention has been given to the possibility of patients performing a variety of physical activities while receiving extracorporeal lung support. This is possible thanks to the continuous development of technology together with the customization of sedative protocols. Awake extracorporeal support is a specific approach in which the patient is awake and potentially cooperative while receiving ECMO. The present analysis aims to synthesize the main results obtained by using extracorporeal circuits in patients with respiratory failure, particularly in those patients with hypercapnia. Key words: extracorporeal membrane oxygenation; physiotherapy; respiratory insufficiency; critical illness; lung transplantation; survival; CO2. [Respir Care 2018;63(9):1174-1179. © 2018 Daedalus Enterprises].

PMID
30166412 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30166412]
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Publisher
American Association for Respiratory Care

113.

Technical advances in the field of ecmo.
Betit P.
Respiratory Care. 63 (9) (pp 1162-1173), 2018. Date of Publication: 01 Sep 2018.
AN: 624219756
Although the fundamentals of extracorporeal membrane oxygenation (ECMO) have not changed in 3 decades, the technical elements continue to improve and have evolved from an assemblage of individual components to more integrated systems with added features, enhanced safety, and improved maneuverability. The introduction of polymethylpentene (PMP) fiber technology has expanded the development of artificial membranes that have low resistance, are more biocompatible, and can be used for extended durations. Extracorporeal carbon dioxide removal techniques continue to be enhanced as stand alone technology and modified renal dialysis systems are introduced. Research continues in the development of compact and wearable artificial lungs that are intended to support patients for prolonged periods (eg, patients awaiting lung transplantation). The use of high-fidelity simulation training has become a standard and important method for reinforcing technical skills, refining troubleshooting sequences, and enhancing team interactions. Modifications to mannequins and ECMO systems coupled with clinical and physiologic scenarios will help achieve greater realism and enhance learning. ECMO technology continues to improve, with adaptability and versatility being essential attributes. Key words: extracorporeal membrane oxygenation; polymethylpentene; centrifugal pump; respiratory dialysis; decarboxylation; high-fidelity simulation. [Respir Care 2018;63(9):1162-1173. © 2018 Daedalus

Enterprises].

PMID
30166411 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30166411]
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Publisher
American Association for Respiratory Care

114.

Acute respiratory distress syndrome.
Matthay M.A., Zemans R.L., Zimmerman G.A., Arabi Y.M., Beitler J.R., Mercat A., Herridge M., Randolph A.G., Calfee C.S.
Nature Reviews Disease Primers. 5 (1) (no pagination), 2018. Article Number: 18.
Date of Publication: 2018.
AN: 627615864
The acute respiratory distress syndrome (ARDS) is a common cause of respiratory failure in critically ill patients and is defined by the acute onset of noncardiogenic pulmonary oedema, hypoxaemia and the need for mechanical ventilation. ARDS occurs most often in the setting of pneumonia, sepsis, aspiration of gastric contents or severe trauma and is present in ~10% of all patients in intensive care units worldwide. Despite some improvements, mortality remains high at 30-40% in most studies. Pathological specimens from patients with ARDS frequently reveal diffuse alveolar damage, and laboratory studies have demonstrated both alveolar epithelial and lung endothelial injury, resulting in accumulation of protein-rich inflammatory oedematous fluid in the alveolar space. Diagnosis is based on consensus syndromic criteria, with modifications for under-resourced settings and in paediatric patients. Treatment focuses on lung-protective ventilation; no specific pharmacotherapies have been identified. Long-term outcomes of patients with ARDS are increasingly recognized as important research targets, as many patients survive ARDS only to have ongoing functional and/or psychological sequelae. Future directions include efforts to facilitate earlier recognition of ARDS, identifying responsive subsets of patients and ongoing efforts to understand fundamental mechanisms of lung injury to design specific treatments.

PMID
30872586 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30872586]
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Publisher
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115.

Extracorporeal carbon dioxide removal for lowering the risk of mechanical ventilation: research questions and clinical potential for the future.
Boyle A.J., Sklar M.C., McNamee J.J., Brodie D., Slutsky A.S., Brochard L., McAuley D.F., Abrams D., Combes A., Fan E., Fraser J., Hodgson C., Patroniti N., Pesenti A., Mac Sweeney R., Manacebo J., Mueller T., Pham T., Ranieri M., Schmidt M., Shekar K.
The Lancet Respiratory Medicine. 6 (11) (pp 874-884), 2018. Date of Publication: November 2018.
AN: 2001217686
As a result of technical improvements, extracorporeal carbon dioxide removal (ECCO2R) now has the potential to play an important role in the management of adults with acute respiratory failure. There is growing interest in the use of ECCO2R for the management of both hypoxaemic and hypercapnic respiratory failure. However, evidence to support its use is scarce and several questions remain about the best way to implement this therapy, which can be associated with serious side-effects. This Review reflects the consensus opinion of an international group of clinician scientists with expertise in managing acute respiratory failure and in using ECCO2R therapies in this setting. We concisely review clinically relevant aspects of ECCO2R, and provide a series of recommendations for clinical practice and future research, covering topics that include the practicalities of ECCO2R delivery, indications for use, and service delivery.

PMID
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Publisher
Lancet Publishing Group (E-mail: cususerv@lancet.com)

116.

A double catheter approach for extracorporeal CO2 removal integrated within a continuous renal replacement circuit.
Bels D.D., Pierrakos C., Spapen H.D., Honore P.M.
Journal of Translational Internal Medicine. 6 (4) (pp 157-158), 2018. Date of Publication: 2018.
AN: 625982977
Institution
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Publisher
De Gruyter Open Ltd (E-mail: peter.golla@degruyter.com)

117.

Life span of different extracorporeal membrane systems for severe respiratory failure in the clinical practice.
Philipp A., De Somer F., Foltan M., Bredthauer A., Krenkel L., Zeman F., Lehle K.
PLoS ONE. 13 (6) (no pagination), 2018. Article Number: e0198392. Date of Publication: June 2018.
AN: 622416775
Over the past decade, veno-venous extracorporeal membrane oxygenation (vvECMO) has been increasingly utilized in respiratory failure in patients. This study presents our institution 's experience focusing on the life span of ECMO systems reflecting the performance of a particular system. A retrospective review of our ECMO database identified 461 adult patients undergoing vvECMO (2010-2017). Patients that required more than one system and survived the first exchange >24 hours (n = 139) were included. Life span until the first exchange and exchange criteria were analyzed for all systems (PLS, Cardiohelp HLS-set, both Maquet Cardiopulmonary, Rastatt, Germany; Deltastream/Hilite7000LT, iLA-activve, Xenios/NovaLung, Heilbronn, Germany; ECC.O5, LivaNova, Mirandola, Italy). At our ECMO center, the frequency of a system exchange was 30%. The median (IQR) life span was 9 (6-12) days. There was no difference regarding the different systems (p = 0.145 and p = 0.108, respectively). However, the Deltastream systems were exchanged more frequently due to elective technical complications (e. g. worsened gas transfer, development of coagulation disorder, increased bleedings complications) compared to the other exchanged systems (p = 0.013). In summary, the used ECMO systems are safe and effective for acute respiratory failure. There is no evidence for the usage of a specific system. Only the increased predictability of an imminent exchange preferred the usage of a Deltastream system. However, the decision to use a particular system should not depend solely on the possible criteria for an exchange.

are credited.
PMID
29856834 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29856834]
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Public Library of Science (E-mail: plos@plos.org)

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Click here for full text options

118.

Extracorporeal life support in thoracic surgery.
Reeb J., Olland A., Massard G., Falcoz P.-E.
European Journal of Cardio-thoracic Surgery. 53 (3) (pp 489-494), 2018. Date of Publication: 01 Mar 2018.
AN: 621200756
PMID
29340579 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29340579]
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Publisher
European Association for Cardio-Thoracic Surgery (E-mail: info@eacts.co.uk)

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119.

Extracorporeal carbondioxide removal (ECCO2R): Case series and review of literature. Ekstrakorporeal karbondioksit uzaklastirma (ECCO2R): olgu serisi ve literatur esliginde degerlendirme <Ekstrakorporeal karbondioksit uzaklastirma (ECCO2R): olgu serisi ve literatur esliginde degerlendirme.>
Bozkus F., Bilal B., Oksuz H.
Tuberkuloz ve Toraks. 66 (3) (pp 258-265), 2018. Date of Publication: 2018.
AN: 2001523451
Introduction: Ventilation treatment has proven success in acute respiratory distress

syndrome (ARDS), while it still remains a challenge to utilize it with lower tidal volumes especially in subjects with respiratory acidosis. The concept of supporting conventional ventilation with extracorporeal carbondioxide removal (ECCO2R) may contribute in adjusting respiratory acidosis consequent to tidal volume reduction in protective ventilation setting. This method allows an easier management of ARDS due to its less invasive approach. As shown by recent studies, ECCO2R can be preferred in subjects with exacerbation of chronic obstructive pulmonary disease (COPD) who are unresponsive to non-invasive ventilation (NIV). One of the most important aspects of this can be stated as the reduced rate of endotracheal intubation.
Material(s) and Method(s): Subjects that were admitted to intensive care unit between March 2014 to November 2015 due to hypercapnic respiratory failure were treated using ECCO2R.
Result(s): Over the study period, five patients received ECCO2R therapy. All subjects were managed with ECCO2R (Hemolung, A Lung Inc., Pittsburgh, USA) via a 15.5 FG percutaneously inserted cannula. We observed that ECCO2R is a promising method in the management of patients having COPD and can be used to protect lungs in patients with ARDS.

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30479235 [http://www.ncbi.nlm.nih.gov/pubmed/?term=30479235]
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Publisher
Ankara University

120.

ECCO2R case study.
van Dyk M.
Egyptian Journal of Critical Care Medicine. 6 (3) (pp 123-125), 2018. Date of Publication: December 2018.
AN: 2001398672
Hypercapnic respiratory failure is common in ICU due to ARDS and COPD exacerbations. The use of ECCO2R has changed the way we manage these patients. We report a patient with COPD exacerbation that failed NIV and placed on low flow ECCO2R. Low flow ECCO2R does not support oxygenation and only clears a proportion of the CO2 produced. Presentation of the case: a 64 y old women with severe COPD who failed NIV was placed on ECCO2R with the Hemolung system. The severe respiratory acidosis cleared and intubation was avoided. After a few days, she became more hypoxic, and the decision was made not to intubate this patient. There is increased CO2 production and decreased clearance of CO2 during COPD exacerbation. ECCO2R has been shown to improve mortality and decrease the need for intubation. There are various ECCO2R systems on the market with different flows and differently sized oxygenators. The use of ECCO2R in selected patients is a promising add-on to conventional management of these patients. The difficulty in predicting the progression of the disease will always be a challenge. Extracorporeal therapies should be performed in centres that are experienced in the

management of these patients.

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Publisher
Egyptian College Of Critical Care Physicians

121.

Extracorporeal Gas Exchange.
Moerer O., Vasques F., Duscio E., Cipulli F., Romitti F., Gattinoni L., Quintel M.
Critical Care Clinics. 34 (3) (pp 413-422), 2018. Date of Publication: July 2018.
AN: 2000839155
Extracorporeal gas exchange is increasingly used for various indications. Among these are refractory acute respiratory failure, including the acute respiratory distress syndrome (ARDS), and the avoidance of ventilator-induced lung injury (VILI) by enabling lung-protective ventilation. Additionally, extracorporeal gas exchange allows the treatment of hypercapnic respiratory failure while helping to unload the respiratory muscles and avoid intubation and invasive ventilation, as well as facilitating weaning from the ventilator. These indications are based on a reasonable physiologic rationale but must be weighed against the costs and complications associated with the technique. This article summarizes current evidence and indications for extracorporeal gas exchange.

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29907273 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29907273]
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Publisher
W.B. Saunders

122.

When the momentum has gone: What will be the role of extracorporeal lung support in the future?.

Abrams D., Bacchetta M., Brodie D.
Current Opinion in Critical Care. 24 (1) (pp 23-28), 2018. Date of Publication: 01 Feb 2018.
AN: 620016798
There has been expanding interest in and use of extracorporeal support in respiratory failure concurrent with technological advances and predominantly observational data demonstrating improved outcomes. However, until there is more available data from rigorous, high-quality randomized studies, the future of extracorporeal support remains uncertain. Recent findings Outcomes for patients supported with extracorporeal devices continue to show favorable trends. There are several large randomized controlled trials that are in various stages of planning or completion for extracorporeal membrane oxygenation (ECMO) and extracorporeal carbon dioxide removal (ECCO2R) in the acute respiratory distress syndrome (ARDS) and chronic obstructive pulmonary disease (COPD), which may help clarify the role of this technology for these disease processes, and which stand to have a significant impact on a large proportion of patients with acute respiratory failure. Novel applications of extracorporeal lung support include optimization of donor organ quality through ex-vivo perfusion and extracorporeal cross-circulation, allowing for multimodal therapeutic interventions. Summary Despite the ongoing rise in ECMO use for acute respiratory failure, its true value will not be known until more information is gleaned from prospective randomized controlled trials. Additionally, there are modalities beyond the current considerations for extracorporeal support that have the potential to revolutionize respiratory failure, particularly in the realm of chronic lung disease and lung transplantation.

PMID
29140963 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29140963]
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Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

123.

Bench Validation of a Compact Low-Flow CO2 Removal Device.
May A.G., Jeffries R.G., Frankowski B.J., Burgreen G.W., Federspiel W.J.
Intensive Care Medicine Experimental. 6 (1) (no pagination), 2018. Article Number: 34. Date of Publication: 01 Dec 2018.
AN: 624014425
Background: There is increasing evidence demonstrating the value of partial extracorporeal CO2 removal (ECCO2R) for the treatment of hypercapnia in patients with acute exacerbations of chronic obstructive pulmonary disease and acute respiratory distress syndrome. Mechanical ventilation has traditionally been used to treat hypercapnia in these patients, however, it has been well-established that aggressive ventilator settings can lead to ventilator-induced lung injury. ECCO2R removes CO2 independently of the lungs and has been used to permit lung protective ventilation to prevent ventilator-induced lung injury, prevent intubation, and aid in ventilator weaning. The Low-Flow Pittsburgh Ambulatory Lung (LF-PAL) is a

low-flow ECCO2R device that integrates the fiber bundle (0.65 m2) and centrifugal pump into a compact unit to permit patient ambulation.
Method(s): A blood analog was used to evaluate the performance of the pump at various impeller rotation rates. In vitro CO2 removal tested under normocapnic conditions and 6-h hemolysis testing were completed using bovine blood. Computational fluid dynamics and a mass-transfer model were also used to evaluate the performance of the LF-PAL.
Result(s): The integrated pump was able to generate flows up to 700 mL/min against the Hemolung 15.5 Fr dual lumen catheter. The maximum vCO2 of 105 mL/min was achieved at a blood flow rate of 700 mL/min. The therapeutic index of hemolysis was 0.080 g/(100 min). The normalized index of hemolysis was 0.158 g/(100 L).
Conclusion(s): The LF-PAL met pumping, CO2 removal, and hemolysis design targets and has the potential to enable ambulation while on ECCO2R.

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124.

Feasibility and safety of low-flow extracorporeal CO2 removal managed with a renal replacement platform to enhance lung-protective ventilation of patients with mild-to-moderate ARDS.
Schmidt M., Jaber S., Zogheib E., Godet T., Capellier G., Combes A.
Critical Care. 22 (1) (no pagination), 2018. Article Number: 122. Date of Publication: 10 May 2018.
AN: 622045663
Background: Extracorporeal carbon-dioxide removal (ECCO2R) might allow ultraprotective mechanical ventilation with lower tidal volume (VT) (<6 ml/kg predicted body weight), plateau pressure (Pplat) (<30 cmH2O), and driving pressure to limit ventilator-induced lung injury. This study was undertaken to assess the feasibility and safety of ECCO2R managed with a renal replacement therapy (RRT) platform to enable very low tidal volume ventilation of patients with mild-to-moderate acute respiratory distress syndrome (ARDS).
Method(s): Twenty patients with mild (n=8) or moderate (n=12) ARDS were included. VT was gradually lowered from 6 to 5, 4.5, and 4 ml/kg, and PEEP adjusted to reach 23<=Pplat<=25 cmH2O. Standalone ECCO2R (no hemofilter associated with the RRT platform) was initiated when arterial PaCO2 increased by >20% from its initial value. Ventilation parameters (VT, respiratory rate, PEEP), respiratory system

compliance, Pplat and driving pressure, arterial blood gases, and ECCO2R-system operational characteristics were collected during at least 24 h of very low tidal volume ventilation. Complications, day-28 mortality, need for adjuvant therapies, and data on weaning off ECCO2R and mechanical ventilation were also recorded.
Result(s): While VT was reduced from 6 to 4 ml/kg and Pplat kept <25 cmH2O, PEEP was significantly increased from 13.4+/-3.6 cmH2O at baseline to 15.0+/-3.4 cmH2O, and the driving pressure was significantly reduced from 13.0+/-4.8 to 7.9+/-3.2 cmH2O (both p<0.05). The PaO2/FiO2 ratio and respiratory-system compliance were not modified after VT reduction. Mild respiratory acidosis occurred, with mean PaCO2 increasing from 43+/-8 to 53+/-9 mmHg and mean pH decreasing from 7.39+/-0.1 to 7.32+/-0.10 from baseline to 4 ml/kg VT, while the respiratory rate was not altered. Mean extracorporeal blood flow, sweep-gas flow, and CO2 removal were 421+/-40 ml/min, 10+/-0.3 L/min, and 51+/-26 ml/min, respectively. Mean treatment duration was 31+/-22 h. Day-28 mortality was 15%.
Conclusion(s): A low-flow ECCO2R device managed with an RRT platform easily and safely enabled very low tidal volume ventilation with moderate increase in PaCO2 in patients with mild-to-moderate ARDS.

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125.

A mathematical model of CO2, O2 and N2 exchange during venovenous extracorporeal membrane oxygenation.
Joyce C.J., Shekar K., Cook D.A.
Intensive Care Medicine Experimental. 6 (1) (no pagination), 2018. Article Number: 25. Date of Publication: 01 Dec 2018.
AN: 623437507
Background: Venovenous extracorporeal membrane oxygenation (vv-ECMO) is an

effective treatment for severe respiratory failure. The interaction between the cardiorespiratory system and the oxygenator can be explored with mathematical models. Understanding the physiology will help the clinician optimise therapy. As others have examined O2 exchange, the main focus of this study was on CO2 exchange.
Method(s): A model of the cardiorespiratory system during vv-ECMO was developed, incorporating O2, CO2 and N2 exchange in both the lung and the oxygenator. We modelled lungs with shunt fractions varying from 0 to 1, covering the plausible range from normal lung to severe acute respiratory distress syndrome. The effects on PaCO2 of varying the input parameters for the cardiorespiratory system and for the oxygenator were examined.
Result(s): PaCO2 increased as the shunt fraction in the lung and metabolic CO2 production rose. Changes in haemoglobin and FIO2 had minimal effect on PaCO2. The effect of cardiac output on PaCO2 was variable, depending on the shunt fraction in the lung. PaCO2 decreased as extracorporeal circuit blood flow was increased, but the changes were relatively small in the range used clinically for vv-ECMO of > 2 l/min. PaCO2 decreased as gas flow to the oxygenator rose and increased with recirculation. The oxygen fraction of gas flow to the oxygenator had minimal effect on PaCO2.
Conclusion(s): This mathematical model of gas exchange during vv-ECMO found that the main determinants of PaCO2 during vv-ECMO were pulmonary shunt fraction, metabolic CO2 production, gas flow to the oxygenator and extracorporeal circuit recirculation.

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Publisher
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126.

Daily use of extracorporeal CO2 removal in a critical care unit: Indications and results.
Winiszewski H., Aptel F., Belon F., Belin N., Chaignat C., Patry C., Clermont C., David E., Navellou J.-C., Labro G., Piton G., Capellier G.
Journal of Intensive Care. 6 (1) (no pagination), 2018. Article Number: 36. Date of Publication: 28 Jun 2018.
AN: 622745461
Background: While outcome improvement with extracorporeal CO2 removal

(ECCO2R) is not demonstrated, a strong pathophysiological rational supports its use in the setting of acute respiratory distress syndrome (ARDS) and COPD exacerbation. We aimed to describe our single-center experience of ECCO2R indications and outcome.
Method(s): Patients treated with ECCO2R in our medial ICU, from March 2014 to November 2017, were retrospectively enrolled. Primary end point was evolution of ventilator settings during the two first days following ECCO2R start.
Result(s): Thirty-three patients received ECCO2R. Seventeen were managed with Hemolung, 10 with Prismalung, 4 with ILA, and 2 with Cardiohelp. Indications for ECCO2R were mild or moderate ARDS (n = 16), COPD exacerbation (n = 11), or uncontrolled hypercapnia due to other causes (n = 6). Four patients were not intubated at the time of ECCO2R start. Median duration of ECCO2R treatment was 7 days [5-10]. In ARDS patients, between baseline and day 2, median tidal volume and driving pressure decreased from 5.3 [4.4-5.9] mL/kg and 10 [8-15] to 3.8 [3.3-4.1] mL/kg and 9 [8-11], respectively. Prone positioning was performed in 10 of the 16 patients, without serious adverse event. In COPD patients, between baseline and day 2, median ventilation minute and PaCO2 decreased significantly from respectively 7.6 [6.6-8.7] L/min and 9.4 [8.4-10.1] kPa to 5.8 [4.9-6.2] L/min and 6 [5.3-6.8] kPa. Four out of 11 COPD patients were extubated while on ECCO2R. Device thrombosis occurred in 5 patients (15%). Hemolysis was documented in 16 patients (48%). One patient died of intracranial hemorrhage, while on ECCO2R. Twenty-four patients were discharged from ICU alive. Twenty-eight day mortality was 31% in ARDS, 9% in COPD patients, and 50% in other causes of refractory hypercapnic respiratory failure.
Conclusion(s): ECCO2R was useful to apply ultra-protective ventilation among ARDS patients and improved PaCO2, pH, and minute ventilation in COPD patients.

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127.

Intermittent extracorporeal CO2 removal in chronic obstructive pulmonary disease patients: A fiction or an option.
Alessandri F., Pugliese F., Mascia L., Ranieri M.V.
Current Opinion in Critical Care. 24 (1) (pp 29-34), 2018. Date of Publication: 01 Feb 2018.
AN: 620016810
Aim of this article is to review evidence recently generated on the application of extracorporeal carbon dioxide removal (ECCO2R) in patients with acute exacerbation of chronic obstructive pulmonary disease (COPD) requiring mechanical ventilation (invasive and non invasive) for hypercapnic respiratory failure. Recent findings To

date, the paucity of evidences on ECCO2R to decrease the rate of noninvasive ventilation (NIV) failure and to wean hypercapnic patients from invasive mechanical ventilation (IMV) precludes to systematically apply this technology to COPD patients. Summary Although several efforts have been made to reduce invasiveness and to improve the efficiency of extracorporeal systems, further randomized studies are needed to assess the effects of this technique on both short-term and long-term clinical outcomes.

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29135616 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29135616]
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128.

A United Kingdom Register study of in-hospital outcomes of patients receiving extracorporeal carbon dioxide removal.
Cummins C., Bentley A., McAuley D.F., McNamee J.J., Patrick H., Barrett N.A.
Journal of the Intensive Care Society. 19 (2) (pp 114-121), 2018. Date of Publication: 01 May 2018.
AN: 622107562
Introduction: Extracorporeal membrane carbon dioxide removal may have a role in treatment of patients with hypercapnic respiratory failure and refractory hypoxaemia and/or hypercapnia.
Method(s): We report on the use, outcomes and complications in United Kingdom intensive care units reporting patients on the Extracorporal Life Support Organisation register.
Result(s): Of 60 patients, 42 (70%) had primarily hypoxic respiratory failure and 18 (30%) primarily hypercapnic respiratory failure. Use of veno-venous procedures increased compared to arterio-venous procedures. Following extracorporeal membrane carbon dioxide removal, ventilatory and blood gas parameters improved at 24 h. Twenty-seven (45%) of patients died before ICU discharge, while 27 (45%) of patients were discharged alive. The most common complications related to thrombosis or haemorrhage.
Discussion(s): There is limited use of extracorporeal membrane carbon dioxide removal in UK clinical practice and outcomes reflect variability in indications and the technology used. Usage is likely to increase with the availability of new, simpler, technology. Further high quality evidence is needed.

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129.

Principles and indications of extracorporeal life support in general thoracic surgery.
McRae K., de Perrot M.
Journal of Thoracic Disease. 10 (Supplement8) (pp S931-S946), 2018. Date of Publication: 01 Apr 2018.
AN: 621862287
The role of extracorporeal life support (ECLS) has expanded rapidly over the past 15 years to become an important tool in advanced general thoracic surgery practice. Intra-operative and in some cases continued post-operative ECLS is redefining the scope of complex surgical care. ECLS encompasses a spectrum of temporary mechanical support that may remove CO2, oxygenate or provide hemodynamic support or a combination thereof. The most common modalities used in general thoracic surgery include extracorporeal membrane oxygenation (ECMO), interventional lung assist device (iLA Novalung, Heilbronn, Germany), and extracorporeal CO2 removal (ECCO2R). The ECMO and Novalung devices can be used in different modes for the short term or long-term support depending on the situation. In this review, the principles and current applications of ECLS in general thoracic surgery are presented.

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130.

Spontaneous breathing during veno-venous extracorporeal membrane oxygenation.
Crotti S., Bottino N., Spinelli E.
Journal of Thoracic Disease. 10 (Supplement5) (pp S661-S669), 2018. Date of Publication: 01 Mar 2018.
AN: 621648487
Veno-venous extracorporeal membrane oxygenation (VV ECMO) has started to be applied in awake spontaneously breathing patients as an alternative to invasive mechanical ventilation. As the physiologic cardiorespiratory variability is increased in

this condition, the dynamic interaction between patient respiratory activity and extracorporeal system function affects the clinical management. The effect of extracorporeal CO2 removal on patient respiratory drive is variable and not always predictable, with some patients responding to CO2 removal with a decrease in respiratory rate and effort and other patients demonstrating a persistently high work of breathing independent on CO2 unload. While the pathophysiological mechanisms of this different interactions are still to be clarified, improved monitoring ability is needed both to titrate the support in responders and to avoid the risk of ventilation injury in nonresponders. Acute changes in patient respiratory patterns may also occur during spontaneous breathing, making it difficult to maintain constant levels of extracorporeal respiratory support, also because changes in the distribution of venous blood volume due to lung-heart interactions affect extracorporeal blood flow. Assessment of native lung function and of its evolution over time is challenging while respiratory gas exchanges are provided by the extracorporeal system, since both oxygenation and decarboxylation capabilities can be fully evaluated only when alveolar ventilation is restored reducing extracorporeal CO2 removal. The rationale for using "awake ECMO" varies across different types of acute respiratory failure: the pathophysiological mechanisms of the underlying disease affect the patient-ECMO interaction and the goal of support. In this review we discuss the pathophysiology, technical challenges and monitoring issues of the use of ECMO in awake spontaneously breathing patients with acute respiratory failure of different etiologies.

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131.

Acute respiratory distress syndrome advances in diagnosis and treatment.
Fan E., Brodie D., Slutsky A.S.
JAMA - Journal of the American Medical Association. 319 (7) (pp 698-710), 2018.
Date of Publication: 20 Feb 2018.
AN: 620805717
IMPORTANCE Acute respiratory distress syndrome (ARDS) is a life-Threatening form of respiratory failure that affects approximately 200 000 patients each year in the United States, resulting in nearly 75 000 deaths annually. Globally, ARDS accounts for 10% of intensive care unit admissions, representing more than 3 million patients with ARDS annually. OBJECTIVE To review advances in diagnosis and treatment of ARDS over the last 5 years. EVIDENCE REVIEW We searched MEDLINE, EMBASE, and the Cochrane Database of Systematic Reviews from 2012 to 2017 focusing on randomized clinical trials, meta-Analyses, systematic reviews, and clinical practice guidelines. Articles were identified for full text review with manual review of bibliographies generating additional references. FINDINGS After screening 1662 citations, 31 articles detailing major advances in the diagnosis or treatment of ARDS were selected. The Berlin definition proposed 3 categories of ARDS based on the severity of hypoxemia: mild (200mmHg<PaO2/FIO2<=300mmHg), moderate (100mmHg<PaO2/FIO2<=200mmHg), and severe (PaO2/FIO2<=100mmHg), along with explicit criteria related to timing of the syndrome's onset, origin of edema, and the chest radiograph findings. The Berlin definition has significantly greater predictive

validity for mortality than the prior American-European Consensus Conference definition. Clinician interpretation of the origin of edema and chest radiograph criteria may be less reliable in making a diagnosis of ARDS. The cornerstone of management remains mechanical ventilation, with a goal to minimize ventilator-induced lung injury (VILI). Aspirin was not effective in preventing ARDS in patients at high-risk for the syndrome. Adjunctive interventions to further minimize VILI, such as prone positioning in patients with a PaO2/FIO2 ratio less than 150mmHg, were associated with a significant mortality benefit whereas others (eg, extracorporeal carbon dioxide removal) remain experimental. Pharmacologic therapies such as beta2 agonists, statins, and keratinocyte growth factor, which targeted pathophysiologic alterations in ARDS, were not beneficial and demonstrated possible harm. Recent guidelines on mechanical ventilation in ARDS provide evidence-based recommendations related to 6 interventions, including low tidal volume and inspiratory pressure ventilation, prone positioning, high-frequency oscillatory ventilation, higher vs lower positive end-expiratory pressure, lung recruitment maneuvers, and extracorporeal membrane oxygenation. CONCLUSIONS AND RELEVANCE The Berlin definition of acute respiratory distress syndrome addressed limitations of the American-European Consensus Conference definition, but poor reliability of some criteria may contribute to underrecognition by clinicians. No pharmacologic treatments aimed at the underlying pathology have been shown to be effective, and management remains supportive with lung-protective mechanical ventilation. Guidelines on mechanical ventilation in patients with acute respiratory distress syndrome can assist clinicians in delivering evidence-based interventions that may lead to improved outcomes.

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132.

Extracorporeal carbon dioxide removal in acute exacerbations of chronic obstructive pulmonary disease.
Pettenuzzo T., Fan E., Del Sorbo L.
Annals of Translational Medicine. 6 (2) (no pagination), 2018. Article Number: 31.
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Extracorporeal carbon dioxide removal (ECCO2R) has been proposed as an adjunctive intervention to avoid worsening respiratory acidosis, thereby preventing or shortening the duration of invasive mechanical ventilation (IMV) in patients with exacerbation of chronic obstructive pulmonary disease (COPD). This review will present a comprehensive summary of the pathophysiological rationale and clinical evidence of ECCO2R in patients suffering from severe COPD exacerbations.

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133.

Can ECCO2R be the rising sun for respiratory failure?.
Sablon A., Jacobs R., Diltoer M., Troubleyn J., Maes T., Malbrain M.
Intensive Care Medicine Experimental. Conference: 31st European Society of Intensive Care Medicine Annual Congress, ESICM 2018. France. 6 (Supplement 2) (no pagination), 2018. Date of Publication: October 2018.
AN: 624865134
INTRODUCTION. Extracorporeal carbon dioxide removal (ECCO2R) devices have been proposed as an adjunctive therapy in patients with acute exacerbations of chronic obstructive pulmonary disease (AECOPD) to avoid intubation or reduce the length of invasive ventilation. In acute respiratory distress syndrome (ARDS) patients it is used to allow ultra-protective ventilation (1-2). OBJECTIVES. We investigated the benefits of ECCO2R, complications encountered and mortality. METHODS. We performed a single-center retrospective observational cohort analysis in a tertiary University Intensive Care Unit (ICU). Over a 34-month period, 59 patients were treated with arterio-venous (AV)-ECCO2R for ARDS or AECOPD. We used a Novalung iLA Membrane Ventilator (Xenios, Heilbronn, Germany). RESULTS. In total, 59 subjects were analyzed. In the ARDS group 35 patients were included, consisting of 16 male and 19 female patients with a mean age of 57 years (54-59) and a mean APACHE score of 25 (23-27). In the AECOPD group 24 patients were included, consisting of 12 male and 12 female patients with a mean age of 64 years (63-65) and a mean APACHE score of 24 (21-27). Mortality for patients treated with AV-ECCO2R for ARDS or AECOPD was respectively 48.6% and 40.9%. In the ARDS group the mean duration of ventilation during ECCO2R was 5.7 days (5.1-6.3), the mean length of ICU and hospital stay was 23.9 days (20.9-26.8) and 44.1 days (37.5-50.9) respectively. Mean arterial blood pH obtained at initiation of ECCO2R treatment was 7.20 mmHg (7.04-7.36) and 7.40 mmHg (7.39-7.42) at termination of ECCO2R therapy. Mean PaCO2 value was 65.8 mmHg (63.3-68.4) at initiation of ECCO2R therapy and 42.8 mmHg (40.9-44.7) at termination of the ECCO2R treatment. In the AECOPD group the mean duration of ventilation during ECCO2R was 2.4 days (1.8-3.0), the mean length of ICU and hospital stay was 10.8 days (9.2-12.4) and 23.2 days (19.9-26.5) respectively. Mean arterial blood pH obtained at initiation of ECCO2R treatment was 7.24 (7.22-7.26) and 7.42 (7.41-7.43) at termination of ECCO2R therapy. Mean PaCO2 value was 80.3 mmHg (77.0-83.6) at initiation of ECCO2R therapy and 56 mmHg (53.3-58.7) at termination of the

ECCO2R treatment. Complications due to AV-ECCO2R had no significant impact on outcome in both groups. CONCLUSIONS. ECCO2R is a feasible, rapidly evolving technology and is an efficient treatment that allows lung protective ventilation. However, evidence for a mortality benefit with ECCO2R is lacking and complications are frequent. Well-designed adequately powered randomized controlled trials (RCTs) are required to better elucidate risk-benefit balance.
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134.

Initial ECCO2R experience in the great Paris area: The REXECOR observatory.
Augy J.L., Aissaoui N., Richard C., Maury E., Fartoukh M., Mekontso-Dessap A., Paulet R., Anguel N., Blayau C., Cohen Y., Megarbane B., Chiche J.-D., Gaudry S., Voicu S., Demoule A., Combes A., Charpentier E., Haghighat S., Panczer M., Diehl J.-L.
Intensive Care Medicine Experimental. Conference: 31st European Society of Intensive Care Medicine Annual Congress, ESICM 2018. France. 6 (Supplement 2) (no pagination), 2018. Date of Publication: October 2018.
AN: 624864566
INTRODUCTION. Veno-venous extracorporeal CO2 removal (ECCO2R) is a promising new therapeutic option in the critical care setting. We conducted a prospective observational study of the use of ECCO2R in selected voluntary centers during two years aiming to assess the prevalence of the ECCOR2 use mainly among COPD and ARDS patients. METHODS AND PATIENTS. Two medical devices: Hemolung (Alung Technologies, Pittsburgh, USA) and iLA Activve (Xenios Novalung, Heilbronn, Germany) were selected after literature and medico-economic evaluations. A specific medical and nurses training was provided in each center. Data were collected on a dedicated form and were centralized by the coordinating center. Primary outcome was the number of patients treated per month and per center during the 2-years study period. Secondary outcomes were ICU and hospital-mortality and adverse events/complications related to device use. RESULTS. We present results from 70 patients recruited in 10 centers (41 men, 29 women, median age 65 years (IC 25-75: 61-74)). The utilization rate was of 0.19 (min: 0.04, max: 1.20) patient/month/center. Fifty-nine pa-tients were under invasive and 11 under noninvasive mechanical ventilation. Hemolung was used in 53 patients (60% in jugular site, cannula size: 15.5 F) and iLA Activve in 19 (56% in jugular site, cannula size: 18 F, 24F for femoral site). Main indications were COPD AE (n=30) and ARDS (n=24). Twenty-one were treated as a part of a clinical trial and 49 were treated as decided by the physician in charge according to current practice. Mean duration of ECCO2R was 5days (IC25-75: 3-8). Thirty-two ECCO2R treatments were discontinued because of clinical condition improvement, 12 because of complications, 9 because of death and 16 for futility. Twenty-one hemolysis (either biological: free Hb > 100mumol/L or clinical), 17 hemorrhagic complications, 11 thrombosis, 1 cannula disinsertion, and 1 local hematoma occurred. Thirty-five deaths occurred during ICU stay, 36 during the hospitalization, 3 of which in relation with ECCO2R. CONCLUSION. Our data indicate a preferential use of veno-venous ECCO2R devices in very severe (as illustrated by the overall high mortality) COPD

and ARDS patients; with a lower than expected rate of utilization. Safety remains a major concern, indicating the need for further technological improvements as well of for optimization of anticoagulation regimen. Ultimately, RCTs will help to delineate clinical indications in these 2 main settings (COPD and ARDS). [Table Presented].
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135.

Switch to spontaneous breathing during nearly total extracorporeal CO2 removal: A novel test to assess severity of ARDS patients on ECMO.
Spinelli E., Mauri T., Albanese M., Tortolani D., Colombo S., Tubiolo D., Lissoni A., Alongi S., Grasselli G., Pesenti A.
Intensive Care Medicine Experimental. Conference: 31st European Society of Intensive Care Medicine Annual Congress, ESICM 2018. France. 6 (Supplement 2) (no pagination), 2018. Date of Publication: October 2018.
AN: 624863977
INTRODUCTION. Few data exist on the control of respiratory drive and effort through extracorporeal CO2 removal in spontaneously breathing early ARDS patients on ECMO [1]. Uncontrolled drive and effort could result in injurious transpulmonary pressure despite ECMO support and this response might be correlated with ARDS severity and clinical outcome [2]. OBJECTIVES. To investigate the spontaneous breathing pattern during nearly total extracorporeal CO2 removal and its correlation with severity and clinical outcome in early severe ARDS patients on ECMO. METHODS. Patients with severe ARDS on ECMO since 2-7 days undergoing ultraprotective mechanical ventilation were included. CO2 excretion from the native lung (VCO2-NL) was continuously monitored by volumetric capnography. After awakening (Richmond Agitation Sedation Scale value between-2 and 0), patients were switched to pressure support ventilation. Sweep gas flow was increased until reaching minimal VCO2-NL, so that extracorporeal CO2 removal (VCO2-ECMO) corrensponded to nearly total CO2 production (VCO2-tot). The waveforms of esophageal (Pes) and airway pressure, flow and volume were continuously recorded to obtain: tidal volume (Vt), respiratory rate (RR), esophageal pressure swings (DELTAPes) and driving transpulmonary pressure (DELTAPL). According to the

value of RR (below or above the median value), patients were categorized as "responders" and "non-responders". RESULTS. Median VCO2-NL was 0 [1-6] ml/min with a VCO2-ML of 290 [266-321] ml/min (98 +/- 3% of VCO2-tot). Responders and non-responders did not differ in terms of baseline controlled mechahical ventilation settings and indexes of lung and systemic severity (Table 1). Despite similar low values of Vt and DELTAPes, higher RR was associated with higher DELTAPL in non-responders vs. responders (Table 2). Moreover, time to successful switch to assisted ventilation was shorter in responders, with similar positive trends for ECMO duration and mortality (Table 2). CONCLUSIONS. In early ARDS on ECMO, failure to decrease respiratory drive and effort during a spontaneous breathing test with "maximized" extracorporeal CO2 removal might help identifying more severe patients requiring longer controlled mechanical ventilation and ECMO course and with higher mortality.
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136.

Extracorporeal life support in critical ill immunocompromised adult patients.
Lopez R., Perez R., Graf J.
Intensive Care Medicine Experimental. Conference: 31st European Society of Intensive Care Medicine Annual Congress, ESICM 2018. France. 6 (Supplement 2) (no pagination), 2018. Date of Publication: October 2018.
AN: 624863460
Acute respiratory failure (ARF) is the first reason for admission to ICU in immunocompromised patients and although survival improved markedly in recent years, when need invasive mechanical ventilation remain having significant mortality. Extracorporeal life support (ECLS) depicts one of the ultimate therapies in intensive care and may possibly be beneficial in patients with acute respiratory distress syndrome in general ICU population. Nevertheless, the immunocompromised state has been described as most common relative contraindication to ECLS [1]. Recently, novel data has emerged about ECLS in patients with hematological malignancies [2] and AIDS-related pneumocystis jiro-vecii [3]. However, limited data is available about the type of ECLS according if the purpose was oxygenation or extracorporeal CO2 removal (ECCO2R). OBJECTIVES. Describe cohort immunocompromised patients on ECLS referral to immunocompetent patients. METHODS. Analysis of cohort of patients supported with respiratory ECLS, with focus on immune status and type of ECLS. Respiratory ECLS was delivered as veno-venous extracorporeal membrane oxy-genation (VV-ECMO) if catastrophic respiratory failure, or as extracor-poreal CO2 removal (ECCO2R) if ventilation is impaired and could not be optimized keeping protective ventilation. Immunocompetent patients with influenza A H1N1 (H1N1) related ARDS supported with ECLS were considered as reference population to compare both im-munocompetent (without H1N1) and immunocompromised patients supported with ECLS. When was possible, mortality proportions were compared with chi-square. RESULTS. We identified 45 patients with respiratory support, twelve of them (27%) were immunocompromised: hematology malignancies (5), AIDS (1),

pulse of steroids and other drugs (6). On other hand, 15 patients were positive to H1N1and the group of patients non-immunocompromised (without H1N1) were 18 patients (60%). Demographic and ECLS support details of immunocompromised patients in table 1 and table 2. Four patients were diagnosed with pneumocystis pneumonia, two of them died. We found difference on inhospital mortality only between patients immunocompetent H1N1 versus immunocompetent non-H1N1 on ECLS, 58% vs 20% respectively (p=0.028). Inhospital mortality according to ECLS and ECLS types are showed in figure 1. CONCLUSIONS. A similar survival between immunocompromised and non-immunocompromised patients supported with ECLS was watched. Probably, with more data, immunocompromised state as contraindication to ECLS could be reconsidered. More data about immunocompromised patients on ECLS is required. [Table Presented].
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137.

Alveolar dead space fraction and respiratory system compliance predict the effect of extracorporeal CO2 removal on driving pressure: Foundation for a precision medicine strategy.
Goligher E.C., Combes A., Brodie D., Amato M.B.P., Fanelli V., Pham T., Ranieri V.M., Slutsky A.S.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2018. United States. 197 (MeetingAbstracts) (no pagination), 2018. Date of Publication: 2018.
AN: 622969479
RATIONALE: Extracorporeal CO2 removal (ECCO2R) may facilitate ultra-protective ventilation but its benefit must be balanced against potential risks. A recent theoretical model, based on patient physiological characteristics, was derived to predict the effect of ECCO2R on driving pressure (DELTAP) (Goligher et al. AJRCCM 2017, PMID 28636403). We set out to validate this model in the recently completed SUPERNOVA pilot study.
METHOD(S): SUPERNOVA was a prospective trial of ECCO2R in moderate ARDS. ECCO2R was applied and tidal volume reduced to 4 ml/kg while maintaining PaCO2 within 20% of baseline. The predicted reduction in DELTAP was estimated using the theoretical model based on individual values of compliance (Crs), PaCO2, and respiratory rate (RR); empiric estimates of alveolar dead space (Vd, alv/Vt); and predicted CO2 removal rates (relying on previously reported ECCO2R device performance). Minute ventilation and Vt before and after ECCO2R were normalized to pH 7.25 and RR 30 to assess changes in DELTAP specifically attributable to ECCO2R. Observed vs. predicted reductions in DELTAP were assessed.
RESULT(S): Ninety-five patients were enrolled (age 60+/-14 years, P/F 153+/-40 mm Hg). Estimated Vd, alv/Vt (0.31+/-0.11) and Crs (31+/-12 ml/cm H2O) varied widely. The reduction in DELTAP (normalized to standard pH and RR) after applying ECCO2R varied widely: 3.1 (IQR 2.2-4.7) cm H2O. As predicted on theoretical grounds, changes in DELTAP were strongly correlated with both Vd, alv/Vt and Crs ($p<0.001$), but were unrelated to baseline P/F. The observed (normalized) reduction

in DELTAP was strongly correlated with (and systematically exceeded) the predicted reduction in DELTAP (Figure 1, beta=1.35, R2=0.76). The predictive model reliably discriminated between responders (change in DELTAP>=4 cm H2O) and non-responders (Figure 1, AUC 0.91).
CONCLUSION(S): The effect of ECCO2R on DELTAP is primarily determined by Crs and Vd, alv/Vt, enabling reliable prediction of treatment effect. The proposed predictive model reliably discriminates between responders and non-responders. Trials of ECCO2R for ultraprotective ventilation in ARDS should consider enrolling patients based on similar modeling and physiological characteristics. Figure 1. The observed change in DELTAP was strongly correlated with the predicted change in DELTAP (beta=1.35, R2=0.76, p<0.001) estimated from Crs and Vd, alv/Vt (left panel). This approach accurately discriminated between patients with and without a reduction in DELTAP >= 4 cm H2O (area under ROC curve 0.91, right panel). (Figure presented).
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138.

Influence of extracorporeal CO2 removal on respiratory drive, effort and driving transpulmonary pressure in early severe ards.
Mauri T., Albanese M., Zanella A., Langer T., Spinelli E., Tubiolo D., Corcione N., Pesenti A., Grasselli G.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2018. United States. 197 (MeetingAbstracts) (no pagination), 2018. Date of Publication: 2018.
AN: 622969444
Rationale CO2 removal by Extra-Corporeal Membrane Oxygenation (ECMO) controls respiratory drive in terms of rate, effort and transpulmonary stress in patients and animal models recovering from severe Acute Respiratory Distress Syndrome (ARDS). The same is unknown in early severe ARDS: thus, we assessed the physiologic effects of extremely elevated CO2 removal (i.e. >= 90% of total CO2 production) early during ECMO. Methods Seven patients with severe ARDS on venovenous ECMO since <=7 days undergoing controlled ventilation were enrolled. Esophageal pressure (Pes) tracings were recorded with airway pressure and flow. RASS value of -2 to 0 and active inspiratory trigger were gradually obtained by stopping paralysis and lowering sedation. Then, patients were switched to Pressure Support Ventilation with target tidal volume (Vt) of 4-6 ml/kg while on clinical positive end-expiratory pressure (PEEP) and ECMO settings. ECMO gas flow (GF) was progressively increased to obtain >= 90% of ECMO CO2 extraction divided by total CO2 production (VCO2-ECMO/VCO2-TOT = VCO2-ECMO/(natural lung VCO2

assessed by volumetric capnography + VCO2-ECMO)). By offline analysis of tracings recorded after 15-20 minutes of stability and normal gas exchange, we measured: respiratory rate (RR), P0.1, Pes swings (DELTAPes), pressure time product (PTPPes), Vt and driving transpulmonary pressure (DELTAPL, calculated as the difference between airway and esophageal pressure during inspiration minus the same difference at end-expiration). Results Patients were 55 [49-59] years-old and were on ECMO since 6 [5-7] days, PEEP was 14 [11-17] cmH2O and respiratory system compliance (Crs) 25 [19-35] ml/cmH2O with intrapulmonary shunt 38 [24-50] %. To reach target extracorporeal CO2 extraction, ECMO GF was increased to 14 [11-17] L/min with blood flow 3.6 [2.3-3.8]L/min, obtaining VCO2-ECMO/VCO2-TOT of 99 [93-100] %. Despite extremely elevated CO2 extraction, RR was 22 [18-29] bpm, PTPPes 115.2 [114.7-215.7] cmH2O*s*min-1, apnea (i.e., absence of inspiratory effort for >=10 seconds) was reached only in 1 patient, Pmus was 4 [4-6] cmH2O and DELTAPL was 8 [7-10] cmH2O. Respiratory drive (RR) was significantly correlated with extracorporeal CO2 extraction (r= -0.815; p= 0.0209 Figure 1A), while effort and transpulmonary stress (Figure 1B and C) weren't (p>0.05 for both). Conclusions In spontaneously breathing early severe ARDS patients undergoing ECMO, the ability of controlling inspiratory effort by extracorporeal CO2 removal might be limited. (Figure presented).

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139.

Transpleural ventilation in patients with severe emphysema undergoing thoracic surgical procedures: A pilot study transpleural ventilation in patients with severe emphysema undergoing thoracic surgical procedures: A pilot study transpleural ventilation in patients with severe emphysema undergoing thoracic surgical procedures: A pilot study.

Redwan B., Biancosino C., Chahla M., Parekh K.R., Eberlein M.H., Bolukbas S.

American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2018. United States. 197 (MeetingAbstracts) (no pagination), 2018. Date of Publication: 2018.
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IntroductionIn patients with emphysema, airway resistance can exceed collateral airflow resistance, causing air to flow preferentially through collateral pathways. In severe emphysema, ventilation through openings (spiracles) directly through the chest wall into the parenchyma could bypass airway obstruction and increase alveolar ventilation via transpleural expiration. Previously, transpleural expiration via spiracles was described in setting of lung-transplantationoperations for emphysema. In this pilot study we quantified transpleural ventilation in emphysema patients with prolonged air leaks following thoracic surgical procedures and evaluated its effect on alveolar ventilation. MethodsBetween 08/2016 and 09/2017, clinical data of all patients with severe emphysema and prolonged air leak following thoracic surgical procedures were collected prospectively. The amount of air leak was quantified by a portable, digital thoracic drainage device (Thopaz, Medela, Germany). Serial capillary

blood gas analyses were performed and the corresponding pCO2 values to the air leak were documented. An amount of < 40 ml/min of air was considered as no relevant air leak. pCO2 values with and without air leak were compared using the paired t-test, since the data was normally distributed. The correlation of air leak amount and pCO2 was calculated using the Pearson coefficient.). ResultsFifteen subjects (4 female) with a mean age of 64 (48-79) years were included and all patients had marked pulmonary hyperinflation with a mean residual volume (RV) of 212.5% of predicted (105.1-381%). Surgical procedures included anatomical resections for lung carcinoma (n = 6), bullectomy (n = 2), atypical wedge resections (n=5) and decortications for empyema (n =2). In two patients, intraoperative single-site veno-venous extracorporeal CO2 removal (ECCO2R) was applied. Surgery was performed in a minimally invasive technique in n = 9 patients. During the presence of a relevant air leak (> 40 ml/min), which resembles the situation of spiracles, mean capillary pCO2 was 38.3 +/- 1.3 mmHg. Disappearance of the air leak was associated with a significant increase of capillary pCO2 48.3 +/- 2.1 (p = 0.0001). Amount of air leak inversely correlated with capillary pCO2 with a Pearson coefficient of - 0.27 (95% CI -0.47 to - 0.05, p = 0.01). ConclusionThe phenomenon of transpleural ventilation in patients with severe emphysema is clinically relevant and was validated in our pilot study of subjects with prolonged air leaks following thoracic surgical procedures. These observations support further studies of spiracles as a possible therapy for hypercarbic respiratory failure in severe emphysema.
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Publisher
American Thoracic Society

140.

Low-flow combined extracorporeal renal-pulmunary support: A retrospective observational case series.
Consales G., Zamidei L., Michelagnoli G., Ammannati B., Boscolo G., Dipalma G., Isoni P., Turani F.
Critical Care. Conference: 38th International Symposium on Intensive Care and Emergency Medicine, ISICEM 2018. Belgium. 22 (Supplement 1) (no pagination), 2018. Date of Publication: 2018.
AN: 621461709
Introduction: We describe the use of a novel low-flow ECCO2R-CRRT device (PrismaLung-Prismaflex, Baxter Healtcare Gambro Lundia-ABLund, Sweden) for simultaneous lung-renal support.
Method(s): A retrospective review of patients submitted to PrismaLung-Prismaflex due to AKI associated to hypercapnic acidosis during the period May 2016 - August 2017 at Prato Hospital ICU was performed. Data collected were: demographic, physiologic, complications, outcome. Data were presented as mean +/- DS; Anova Test was used to compare changes of parameters over time; significance was set at P< 0, 05.
Result(s): We identified 13 patients (mean age 71 +/- 13 yr, mean SOFA 12 +/- 3). Causes of hypercapnia were moderate ARDS (n=4) and AE-COPD (n=9). In all patients a 13fr double lumen cannula was positioned and 350 ml/min blood-flow with

10 lt oxygen sweep-gas-flow was maintained; iv-heparin aiming to double aPTT was used. Haemo-diafiltration (effluent flow 35 ml/kg/hour) was delivered. In all cases PrismaLung-Prismaflex improved respiratory and metabolic parameters (Figs. 1 and 2) without any complications. All patients survived to the treatment, nevertheless 2patients (1AE-COPD; 1ARDS) died during ICU stay due to irreversible cardiac complications. In ARDS cases: 3 patients were successfully weaned from IMV, mean duration of the treatment was 88 +/- 31hours, mean duration of IMV after ECCO2R-CRRT was 2 +/- 2 days. In AE-COPD cases: intubation was avoided in 3 patients at risk of NIV failure, 6 patients were successfully weaning from IMV, mean duration of the treatment was 79 +/- 31 hours, mean duration of IMV after ECCO2R-CRRT was 0, 1 +/- 0, 3 days.
Conclusion(s): The use of PrismaLung-Prismaflex has been safe and effective: it may be argued that it could be due to the low-blood-flow used. The positive results of this preliminary study may constitute the rational for the design of a larger randomized control trial. (Figure presented).
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141.

Feasibility and safety of low-flow extracorporeal CO2 removal managed with a renal replacement platform to enhance lung-protective ventilation of patients with mild-to-moderate ARDS.
Schmidt M., Jaber S., Zogheib E., Godet T., Capellier G., Combes A.
Critical Care. Conference: 38th International Symposium on Intensive Care and Emergency Medicine, ISICEM 2018. Belgium. 22 (Supplement 1) (no pagination), 2018. Date of Publication: 2018.
AN: 621461676
Introduction: Extracorporeal carbon-dioxide removal (ECCO2R) might allow ultraprotective mechanical ventilation with lower tidal volume (VT) (<6 mL/kg predicted body weight), plateau (Pplat) (<30cmH2O) and driving pressures to limit ventilator-induced lung injury. This study was undertaken to assess the feasibility and safety of ECCO2R managed with a renal replacement therapy (RRT) platform to enable ultraprotective ventilation of patients with mild-to-moderate ARDS.
Method(s): 20 patients with mild (n=8) or moderate (n=12) ARDS were included. VT was gradually lowered from 6 to 5, 4.5 and 4 mL/kg, and PEEP adjusted to reach 23<=Pplat<=25 cm H2O. Stand-alone ECCO2R (PRISMALUNG, no hemofilter associated with the RRT platform) was initiated when arterial PaCO2 increased by >20% from its initial value. Ventilation parameters (VT, RR, PEEP), respiratory system compliance, Pplat and driving pressure, arterial blood gases, and ECCO2R-system characteristics were collected during at least 24 hours of ultraprotective ventilation. Complications, day-28 mortality, need for adjuvant therapies, and data on weaning off ECCO2R and mechanical ventilation were also recorded.
Result(s): While VT was reduced from 6 to 4 mL/kg and Pplat kept <25 cmH2O,

PEEP was significantly increased from 13.4+/-3.6 at baseline to 15.0+/-3.4 cm H2O, and the driving pressure was significantly reduced from 13.0+/-4.8 to 7.9+/-3.2 cm H2O (both p<0.05). The PaO2/ FiO2 ratio and respiratory-system compliance were not modified after VT reduction. Mild respiratory acidosis occurred, with mean pH decreasing from 7.39 +/- 0.1 to 7.32 +/- 0.10 from baseline to 4-mL/kg VT. Mean extracorporeal blood flow, sweep-gas flow and CO2 removal were 421+/-40 mL/min, 10+/-0.3 L/min and 51+/-25 mL/min, respectively. Mean treatment duration was 31+/-22 hours. Day-28 mortality was 15%.
Conclusion(s): A low-flow ECCO2R device managed with an RRT platform easily and safely enabled ultraprotective mechanical ventilation in patients with mild-to-moderate ARDS. (ClinicalTrials: NCT02606240).
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142.

Safety and feasibility of extra corporeal carbon dioxide removal (ECCO2R) in ARDS and non ARDS patients.
Clement M., Marion M., Audrey D.J., Albert P., Matthieu C., Gerald C., Julie C., Fouad B., Samir J.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2018. France. 8 (1 Supplement 1) (no pagination), 2018. Date of Publication: February 2018.
AN: 620837131
Introduction: Although necessary, mechanical ventilation can lead to ventilator-induced lung injury (VILI) even when using protective ventilation strategies that combine low tidal volume (Vt)(6 ml kg predicted body weight) and plateau pressure (Pplat) <= 30cmH20. Lower positive pressures and tidal volumes could enhance lung protection + thelimiting factor being carbon dioxide accumulation and hypercapnic acidosis. Extra corporeal carbon dioxide removal (ECCO2R) intervenes by maintaining ph and PCO2 within physiological ranges. This combination is called ultra-protective ventilation. We report our experience with ECCO2R in ARDS and non ARDS patients with a focus on feasibility and safety.
Patients and Methods: From June 2014 to July 2017 all patients who have undergone ECCO2R in our ICU were included consecutively and prospectively. Venovenous ECCO2R was used through a dual lumen venous catheter (femoral or jugular).
Result(s): Nineteen patients underwent ECCO2R for a total of 21 sessions. ECCO2R was implemented through a dual lumen venous catheter (femoral or jugular) with 3 different devices-Hemolung Respiratory Assist System (ALung) (n = 2), iLA activve (Novalung) (n = 5) and Prismalung (Prismaflex system) (n = 12). Sessions were 3 (IQR 2.5-4.0) days long. Catheter diameters were 13 Fr (n = 8), 15 Fr (n = 6), 24 Fr (n = 4) and 17 Fr (n = 1). Thirteen patients suffered from ARDS and 6 had non ARDS

indications for ECCO2R, including ultraprotective ventilation. Tidal volume decreased during ECCO2R from 5.3 (IQR 4.3-5.8) to 3.4 (IQR 2.6-4.1) ml kg of predicted body weight ($p < .001$) while ECCO2R allowed maintaining of pH and PCO2 within acceptable range (Fig. 1). Driving pressure decreased from 17 (IQR 11-21) to 8 (IQR 6-14) cm H2O ($p < .001$). The main adverse effect was thrombocytopenia (8 patients). Six selected patients had no anticoagulation during ECCO2R because of high bleeding risk.
Discussion(s): Ultra-protective ventilation was achieved with a decrease of tidal volumes (Vt < 4 ml kg) and positive pressures. Few data on ECCO2R are available in patients at high risk of hemorrhagic complications, we report here a subgroup of 6 patients who underwent efficiently ECCO2R without anticoagulation. Six patients underwent ECCO2R for non ARDS indications, 3 of them had no structural damages to the lungs which has never been reported and ECCOR allowed implementing ultra-protective ventilation with no major adverse effect.
Conclusion(s): We report our experience on ECCO2R for ARDS and non ARDS indications. Ultra-protective ventilation (Vt < 4 ml kg) was safe and feasible.
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Publisher
Springer Verlag

143.

Feasibility and safety of low-flow extracorporeal CO2 removal with a renal replacement platform to enhance lung protective ventilation in patients with mild to moderate ARDS.
Matthieu S., Samir J., Jean-Michel C., Gilles C., Elie Z., Alain C.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2018. France. 8 (1 Supplement 1) (no pagination), 2018.
Date of Publication: February 2018.
AN: 620837064
Introduction: Extracorporeal carbon dioxide removal (ECCO2R) might allow ultraprotective mechanical ventilation with lower tidal volume (VT) (< 6 mL kg ideal body weight), plateau pressure (Pplat) (< 30 cm H2O), driving pressure, and respiratory rate (RR) to reduce ventilator induced lung injury (VILI). The aim of this study was to assess the feasibility and safety of ECCO2R with a renal replacement platform (RRT) to permit ultra-protective ventilation in patients with mild to moderate acute respiratory distress syndrome (ARDS).
Patients and Methods: Twenty patients with mild (n = 8) or moderate ARDS were included. VT was gradually reduced from 6 to 5, 4.5 and 4 mL kg-1 and PEEP adjusted to reach 23 > Pplat > 25 cm H2O. Standalone ECCO2R (no hemofilter associated on the RRT platform) was initiated when arterial PaCO2 increased by more than 20%. Ventilation parameters (VT, RR, PEEP), respiratory compliance, driving pressure, arterial blood gases, and ECCO2R system operational characteristics (blood flow, sweep gas flow, and CO2 removal rate) were collected during a minimum of 24 h of ultra-protective ventilation. Complications, mortality at day 28, need for adjuvant therapies and data on weaning from both mechanical ventilation and ECCO2R were also collected.
Result(s): While VT was reduced from 6 to 4 mL kg-1 and Pplat kept below 25 cm H2O, PEEP was significantly increased from 13.4 +/- 3.6 at baseline to 15.0 +/- 3.4

cm H2O at VT = 4 mL kg-1. As a result, the driving pressure was significantly reduced to 7.9 +/- 3.2 cm H2O at VT = 4 mL kg-1 ($p < 0.05$) (Fig. 1). No significant differences in RR, PaO2 FiO2 ratio, respiratory system compliance were observed after Vt reduction. Mean extracorporeal blood, sweep gas flow and CO2 removal were 421 +/- 40 mL min-1, 10 +/- 0.3 L min-1 and 51 mL min-1, respectively. Mean treatment duration was 31 +/- 22 h. Main side effects related to ECCO2R were membrane clotting which occurred in 7 patients after 19 +/- 9 h.
Conclusion(s): A low-flow ECCO2R device driven by a RRT platform efficiently removed CO2 while allowing ultra-protective mechanical ventilation settings in patients with mild to moderate ARDS (ClinicalTrials. gov identifier: NCT02606240).
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Publisher
Springer Verlag

144.

Single center experience of ECCO2R.
Hadrien W., Francois A., Gael P., Gilles C.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2018. France. 8 (1 Supplement 1) (no pagination), 2018.
Date of Publication: February 2018.
AN: 620836833
Introduction: Although extra-corporeal CO2 removal (ECCO2R) is not recommended, strong rational supports the concept. We aimed to describe our single-center experience of ECCO2R in the setting of mild to moderate acute respiratory distress syndrome (ARDS) and chronic obstructive pulmonary disease (COPD).
Patients and Methods: We performed a retrospective case note review of patients admitted to our tertiary regional intensive care unit (ICU) and commenced on ECCO2R from November 2015 to August 2017. Demographic data, physiologic data (including pH and partial pressure of carbon dioxide in arterial blood [PaCO2]) before ECCO2R starting, and at day 1 were recorded.
Result(s): Twenty one patients received ECCO2R. Thirteen were managed with Hemolung device, seven with Prismalung and one with ILA . Indication for ECCO2R were COPD exacerbation (n = 11), mild to moderate ARDS (n = 8), uncontrolled hypercapnia due to pneumonia (n = 1), and hypercapnia due to bronchial compression by mediastinal adenopathy (n = 1). Before starting ECCO2R, median minute ventilation, pH and PaCO2 were respectively 7.2 [6.5, 8.5] L/ min, 7.32 [7.23, 7.34] and 8.3 [7.2, 9.8] kPa. After 24 h of treatment, 15 patients were in pressure support ventilation mode. At that time, median minute ventilation, pH and PaCO2 were respectively 8.9 [7.9, 10] L/min, 7.44 [7.40, 7.46] and 5.2 [4.5, 6.9] kPa. Median duration of ECCO2R treatment was 7 days [5, 10]. Prone positioning was performed in 10 patients, without any complications. Four of 11 patients receiving ECCO2R for COPD exacerbation were extubated during extra-corporeal treatment. Device thrombosis occurred in 3 patients, all receiving treatment by Hemolung . Hemolysis was documented in 10 patients treated by Hemolung , and one patient treated by Prismalung . Seventeen patients were discharged from ICU alive.
Discussion(s): Unexpected increase of minute ventilation after beginning of ECCO2R therapy may be related to early weaning of sedation, and pressure support ventilation mode.

Conclusion(s): Our observational cohort shows that ECCO2R therapy is effective to reduce PaCO2 and improve pH in the settings of mild ARDS and COPD exacerbation. However, early weaning of sedation and pressure support ventilation might limit the decrease of respiratory rate and tidal volume.
Institution
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Publisher
Springer Verlag

145.

Initial ECCO2R experience in the great Paris area: Rate of utilization and safety preliminary data.
Jean-Loup A., Christian R., Eric M., Muriel F., Armand M.-D., Remi P., Nadia A., Clarisse B., Yves C., Jean-Daniel C., Stephane G., Sebastian V., Alexandre D., Alain C., Emannuel C., Suzanne H., Manuelle P., Jean-Luc D., Bruno M.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2018. France. 8 (1 Supplement 1) (no pagination), 2018.
Date of Publication: February 2018.
AN: 620836820
Introduction: Veno-venous extracorporeal CO2 removal (ECCO2R) is a promising new therapeutic option in the critical care setting. We conducted a prospective observational study of the use of ECCO2R in selected voluntary centers during 2 years aiming to assess the prevalence of the ECCO2R use mainly among COPD and ARDS patients.
Patients and Methods: Two medical devices: Hemolung (Alung Technologies, Pittsburgh, USA) and iLA Activve (Xenios Novalung, Heilbronn, Germany) were selected after literature and medico-economic evaluations. A specific medical and nurses training was provided in each center. Data were collected on a dedicated form and were centralized by the coordinating center. Primary outcome was the number of patients treated per month and per center during the 2-years study period. Secondary outcomes were ICU and hospital-mortality and adverse events complications related to device use.
Result(s): We present preliminary results from 47 patients recruited in 6 centers (29 men, 18 women, mean age 66.9 yrs +/- 11.3 yrs). The utilization rate was of 0.33 +/- 0.32 patient month center. Thirty-nine patients were under invasive and 8 under noninvasive mechanical ventilation. Hemolung was used in 40 patients (65% in jugular site, cannula size: 15.5 F) and iLA Activve in 7 (71% in femoral site, cannula size: 24 F). Main indications were COPD AE (n = 22) and ARDS (n = 18). Eighteen patients were treated as a part of a clinical trial and 29 were treated as decided by the physician in charge according to current practice. Mean duration of ECCO2R was 5.4 +/- 3.0 days. Twenty-five ECCO2R treatments were discontinued because of clinical condition improvement, 10 because of complications, 7 because of death and 5 for futility. Twenty hemolysis (either biological-free Hb > 100 mumol L or clinical), 15 hemorrhagic complications, 4 thrombosis, 1 cannula disinsertion, and 1 local hematoma occurred. Results according to the used medical devices are presented in Table 1. Twenty-one deaths occurred during ICU stay, 27 during the hospitalization, 3 of which in relation with ECCO2R.
Conclusion(s): Our data indicate a preferential use of veno-venous ECCO2R devices in very severe (as illustrated by the overall high mortality) COPD and ARDS patients; with a lower than expected rate of utilization. Safety remains a major concern,

indicating the need for further technological improvements as well of for optimization of anticoagulation regimen. Ultimately, RCTs will help to delineate clinical indications in these 2 main settings (COPD and ARDS) (Table presented).
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Publisher
Springer Verlag

146.

Cost-effectiveness of ECCO2R in the management of acute respiratory distress syndrome (ARDS).
Ethgen O., Makhija D., Russell S., Harenski K., Combes A., Dessap A.M., Morimont P., Quintel M.
Critical Care Medicine. Conference: 47th Society of Critical Care Medicine Critical Care Congress, SCCM 2018. United States. 46 (Supplement 1) (pp 667), 2018. Date of Publication: January 2018.
AN: 620080281
Learning Objectives: Mechanical ventilation (MV) is a cornerstone in the management of ARDS patients. Recent research suggests that lung protective ventilation (LPV) with lower tidal volume (Vt) and driving pressure (DELTAP) could improve survival (NEJM 2015; 372:747-55). Extra-corporal CO2 removal (ECCO2R) enables LPV by allowing lower Vt and DELTAP while normalizing patients' pH and PaCO2 within normal ranges (Critical Care (2016) 20:36). This study evaluates the potential cost-effectiveness of ECCO2Renabled LPV in France.
Method(s): A state-transition model was used to compare the outcomes of ARDS patients' across 3 ventilation strategies: MV (no ECCO2R at all), LPV (Vt 6mL/kg PBW and Pplat 25-30 cm H2O; ECCO2R for patients with PaCO2> 55 mm Hg) and Ultra-LPV (Vt 3-4 mL/kg PBW Pplat 20-25 cm H2O; ECCO2R for all patients). The model used partitioned survival times across 3 health-states: alive and ventilated, alive and weaned from ventilation, dead. Baseline characteristics, ventilation settings, ventilation duration, survival, ICU and hospital lengths of stay were derived from a large ARDS epidemiology study (JAMA 2016; 315:788- 800). Survival benefits associated with lower DELTAP were taken from the analysis of more than 3,000 patients enrolled in 9 randomized trials. Health outcomes were expressed in life years (LYs) and quality-adjusted life years (QALYs) gained. Costs were documented from published literature. For sensitivity analyses, all parameters were individually varied within their 95%CI bounds when available or within a +/- 20% range,

alternatively.
Result(s): Both LPV and ULPV dominated MV. MV yielded 7.05 LYs, 2.45 QALYs and cost 48,127. In comparison, LPV and ECCO2R produced 2.62 (+0.16) and 2.81 (+0.36) QALYs, respectively. LPV and ULPV also cost less than MV, 45,937 (-2,189) and 46,258 (-1,869), respectively. Cost savings were mainly due to the shortening of ventilation duration allowed by ECCO2R, leading to shorter ICU and hospital stays. Results were robust to sensitivity analysis.
Conclusion(s): ECCO2R-enabled LPV strategies might be costsaving, providing survival benefit and reducing ICU and hospital costs. Additional data from interventional, observational studies are needed to support this model-based analysis.
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Publisher
Lippincott Williams and Wilkins

147.

Commentary on the Homburg Lung: Pro/Con of Miniaturized ECCO2R.
Whitson B.A., Shukrallah B.
ASAIO Journal. 63 (5) (pp 524-525), 2017. Date of Publication: 2017.
AN: 618976640
Seiler et al.1 demonstrate that a miniaturized ECCO2R circuit is effective in removing carbon dioxide in hypercapnic respiratory failure. The impact on those patients with COPD appears to be quite favorable. The overall patient population is quite ill with multiple comorbidities, and the severity of their illnesses does not have many effective treatment options. The single-site approach to ECCO2R with a mobile circuit allows for enhanced mobility with minimal access complications and will undoubtedly have an expanding role in the treatment of selected patients with respiratory collapse.

PMID
28857903 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28857903]
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Publisher
Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

148.

In-parallel connected intermittent hemodialysis through ECMO does not affect hemodynamic parameters derived from transpulmonary thermodilution.
Lahmer T., Mayr U., Rasch S., Batres Baires G., Schmid R.M., Huber W.
Perfusion (United Kingdom). 32 (8) (pp 702-705), 2017. Date of Publication: 01 Nov 2017.
AN: 619374809
Introduction: We report a case of renal replacement therapy (RRT) during extracorporeal membrane oxygenation (ECMO) via a single venous access and analyze the feasibility of transpulmonary thermodilution (TPTD) for hemodynamic monitoring. Case report: ECMO and RRT connected into the ECMO-extracorporeal circuit were performed via a single venous access because of multiple venous thromboses. An indicator for TPTD and pulse contour analysis (PCA) was applied into the central venous catheter (CVC) placed in the right vena jugularis. TPTD and PCA demonstrated comparable cardiac index.
Discussion(s): Congruent data for TPTD and PCA could be observed during TPTD and PCA measurements before ECMO, after ECMO and during ECMO and RRT. This might be explained by high blood flow having the lowest impact on TPTD by venous drainage in the femoral vein/distal vena cava and the TPTD indicator injection using the jugular CVC, as reported in our case.
Conclusion(s): Hemodynamic monitoring using TPTD and PCA during ECMO/RRT is feasible and provides reliable results.

PMID
28440110 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28440110]
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Publisher
SAGE Publications Ltd (E-mail: info@sagepub.co.uk)

149.

Do we need randomized clinical trials in extracorporeal respiratory support? Yes.
Combes A., Pesenti A., Brodie D.
Intensive Care Medicine. 43 (12) (pp 1862-1865), 2017. Date of Publication: 01 Dec 2017.
AN: 618318608
Extracorporeal respiratory support, also known as extracorporeal gas exchange, may be used to rescue the most severe forms of acute hypoxemic respiratory failure with high blood flow venovenous extracorporeal membrane oxygenation. Alternatively, lower flow extracorporeal carbon dioxide removal might be applied to reduce the intensity of mechanical ventilation in patients with less severe forms of the disease. However, critical reading of the results of the randomized trials and case series published to date reveals major methodological biases. Older trials are not relevant anymore since the ECMO circuitry was not heparin-coated leading to severe hemorrhagic complications due to high levels of anticoagulation, and because

extracorporeal membrane oxygenation (ECMO) and control group patients did not receive lung-protective ventilation. Alternatively, in the more recent CESAR trial, many patients randomized to the ECMO arm did not receive ECMO and no standardized protocol for lung-protective mechanical ventilation existed in the control group. Since these techniques are costly and associated with potentially serious adverse events, there is an urgent need for high-quality data, for which the cornerstone remains randomized controlled trials.

PMID
28914339 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28914339]
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(Brodie) Division of Pulmonary, Allergy and Critical Care Medicine, Columbia University Medical Center/New York-Presbyterian Hospital, Columbia University, New York, NY, United States
Publisher
Springer Verlag (E-mail: service@springer.de)

150.

Mechanical ventilation in patients subjected to extracorporeal membrane oxygenation (ECMO). Ventilacion mecanica en pacientes tratados con membrana de oxigenacion extracorporea (ECMO) <Ventilacion mecanica en pacientes tratados con membrana de oxigenacion extracorporea (ECMO).>
Lopez Sanchez M.
Medicina Intensiva. 41 (8) (pp 491-496), 2017. Date of Publication: November 2017.
AN: 614373748
Mechanical ventilation (MV) is a crucial element in the management of acute respiratory distress syndrome (ARDS), because there is high level evidence that a low tidal volume of 6 ml/kg (protective ventilation) improves survival. In these patients with refractory respiratory insufficiency, venovenous extracorporeal membrane oxygenation (ECMO) can be used. This salvage technique improves oxygenation, promotes CO2 clearance, and facilitates protective and ultraprotective MV, potentially minimizing ventilation-induced lung injury. Although numerous trials have investigated different ventilation strategies in patients with ARDS, consensus is lacking on the optimal MV settings during venovenous ECMO. Although the concept of "lung rest" was introduced years ago, there are no evidence-based guidelines on its use in application to MV in patients supported by ECMO. How MV in ECMO patients can promote lung recovery and weaning from ventilation is not clear. The purpose of this review is to describe the ventilation strategies used during venovenous ECMO in clinical practice.

PMID
28188062 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28188062]
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Publisher
Ediciones Doyma, S.L.

151.

Fifty years of research in ARDS VT selection in acute respiratory distress syndrome.
Sahetya S.K., Mancebo J., Brower R.G.
American Journal of Respiratory and Critical Care Medicine. 196 (12) (pp 1519-1525), 2017. Date of Publication: 15 Dec 2017.
AN: 620053247
Mechanical ventilation (MV) is critical in the management of many patients with acute respiratory distress syndrome (ARDS). However, MV can also cause ventilator-induced lung injury (VILI). The selection of an appropriate VT is an essential part of a lung-protective MV strategy. Since the publication of a large randomized clinical trial demonstrating the benefit of lower VTs, the use of VTs of 6 ml/kg predicted body weight (based on sex and height) has been recommended in clinical practice guidelines. However, the predicted body weight approach is imperfect in patients with ARDS because the amount of aerated lung varies considerably due to differences in inflammation, consolidation, flooding, and atelectasis. Better approaches to setting VT may include limits on end-inspiratory transpulmonary pressure, lung strain, and driving pressure. The limits of lowering VT have not yet been established, and some patients may benefit from VTs that are lower than those in current use. However, lowering VTs may result in respiratory acidosis. Tactics to reduce respiratory acidosis include reductions in ventilation circuit dead space, increases in respiratory rate, higher positive end-expiratory pressures in patients who recruit lung in response to positive end-expiratory pressure, recruitment maneuvers, and prone positioning. Mechanical adjuncts such as extracorporeal carbon dioxide removal may be useful to normalize pH and carbon dioxide levels, but further studies will be necessary to demonstrate benefit with this technology.
PMID
28930639 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28930639]
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Publisher
American Thoracic Society (E-mail: malexander@thoracic.org)

152.

Sequential use of extracorporeal devices to avoid mechanical ventilation in a patient with complicated pulmonary fibrosis.
Harnisch L.O., Moerer O.
Journal of Artificial Organs. 20 (4) (pp 365-370), 2017. Date of Publication: 01 Dec 2017.
AN: 618171203
Extracorporeal lung assist devices are widely used these days for a growing number of indications. We report the case of a patient managed with three different flow-range devices sequentially, enabling us to avoid mechanical ventilation. Handling and ethics of this approach are discussed.

PMID
28864998 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28864998]
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Publisher
Springer Tokyo (E-mail: orders@springer.jp)

153.

Pediatric lung transplantation.
Bryant R., Morales D., Schecter M.
Seminars in Pediatric Surgery. 26 (4) (pp 213-216), 2017. Date of Publication: August 2017.
AN: 618025501
Pediatric lung transplantation is a highly specialized clinical endeavor. Since the late 1980's, there have only been slightly more than 2200 implants reported to the International Society for Heart and Lung transplantation registry. This review will discuss the historical aspects of pediatric lung transplantation. It will familiarize the reader with the current indications for transplant and the referral and listing process. The current state of lung assist devices as a bridge to pediatric lung transplantation is discussed in addition to the technical aspects of the transplant procedure. Finally, posttransplant outcomes, including anticipated morbidity and the role of retransplantation, are clarified.

PMID
28964476 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28964476]
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Publisher
W.B. Saunders

154.

The Homburg Lung: Efficacy and Safety of a Minimal-Invasive Pump-Driven Device for Veno-Venous Extracorporeal Carbon Dioxide Removal.
Seiler F., Trudzinski F.C., Hennemann K., Niermeyer T., Schmoll C., Kamp A., Bals R., Muellenbach R.M., Haake H., Lepper P.M.
ASAIO Journal. 63 (5) (pp 659-665), 2017. Date of Publication: 2017.
AN: 614243617
Extracorporeal carbon dioxide removal (ECCO2R) is increasingly considered a viable therapeutic approach in the management of hypercapnic lung failure to avoid intubation or to allow lung-protective ventilator settings. This study aimed to analyze efficacy and safety of a minimal-invasive ECCO2R device, the Homburg lung. The Homburg lung is a pump-driven system for veno-venous ECCO2R with 1/4 tubing and a 0.8 m2 surface oxygenator. Vascular access is usually established via a 19F/21 cm bilumen cannula in the right internal jugular vein. For this work, we screened patient registries from two German centers for patients who underwent ECCO2R with the Homburg lung because of hypercapnic lung failure since 2013. Patients who underwent extracorporeal membrane oxygenation before ECCO2R were excluded. Patients who underwent ECCO2R more than one time were only included once. In total, 24 patients (aged 53.86 +/- 12.49 years; 62.5% male) were included in the retrospective data analysis. Ventilatory failure occurred because of chronic obstructive pulmonary disease (50%), cystic fibrosis (16.7%), acute respiratory distress syndrome (12.5%), and other origins (20.8%). The system generated a blood flow of 1.18 +/- 0.23 liters per minute (lpm). Sweep gas flow was 3.87 +/- 2.97 lpm. Within 4 hours, paCO2 could be reduced significantly from 82.05 +/- 15.57 mm Hg to 59.68 +/- 12.27 mm Hg, thereby, increasing pH from 7.23 +/- 0.10 to 7.36 +/- 0.09. Cannulation-associated complications were transient arrhythmia (1/24 patients) and air embolism (1/24). Fatal complications did not occur. In conclusion, the Homburg lung provides effective carbon dioxide removal in hypercapnic lung failure. The cannulation is a safe procedure, with complication rates comparable to those in central venous catheter implantation.

PMID
28114193 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28114193]
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(Haake) Kliniken Maria Hilf, Division of Cardiology, Electrophysiology and Critical Care Medicine, Monchengladbach, Germany
Publisher
Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

155.

Extracorporeal Circulatory/Life Support: An Update.
Swanevelder J.L.C., Firmin R.K.
Journal of Cardiac Critical Care. 1 (2) (pp 65-71), 2017. Date of Publication: 2017.
AN: 624302292
The evolution of extracorporeal life support technology has added a new advanced dimension to intensive care management of acute cardiac and/or respiratory failure in neonatal, pediatric, and adult patients who fail conventional treatment. ECMO has been a controversial subject within the intensive care community for many years. Perceptions have, however, changed positively over the past decade due to a need for improved management of these groups of patients, technological advances, and evolving evidence. As is common with many emerging therapies, its optimal use is currently not fully backed by quality evidence.

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Publisher
Thieme India

156.

Survival from Septic Shock Secondary to Disseminated GroupA Streptococcal Infection after Central Extracorporeal Membrane Oxygenation.
Asfari A., Ahmed M., Edwards L.R., Irby K., Agarwal A., Pasala S., Prodhan P., Frazier B., Sanders R.C.
Journal of Child Science. 7 (1) (pp e130-e135), 2017. Date of Publication: 01 Jan 2017.
AN: 624160466
Objective The objective of this study was to describe a case of severe life-threatening acute respiratory distress syndrome (ARDS) and septic shock in a child who responded to a prolonged extracorporealmembrane oxygenation (ECMO) support course utilizing different cannulation techniques depending on the physiological derangement until he recovered. Design This is a case report. Setting This study was done at themedical-surgical pediatric intensive care unit in an academic freestanding children's hospital. Patient A previously healthy 4-year-old boy was presented with respiratory distress and fever. He was diagnosed with respiratory syncytial viral upper respiratory tract infection and group A beta-hemolytic Streptococcus septic shock. Interventions The patient was referred to peripheral ECMO for hemodynamic, ventilatory, and oxygenation support; conversion to central ECMO to augment blood flow; and transition to extracorporeal carbon dioxide removal before successful wean off extracorporeal support. Measurements and Main Results Patient experienced severe pediatric ARDS and septic shock that were refractory to maximal medical

therapy. Patient was able to be decannulated after 75 days of extracorporeal support. Hewas weaned completely off of mechanical ventilation and oxygen after 6 months. The only neurological deficit he exhibited was poor fine motor skills of his hands for which he continued to receive physical therapy.

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Publisher
Georg Thieme Verlag (E-mail: iaorl@iaorl.org)

157.

Dead space in ARDS: Die hard.
Lopez-Aguilar J., Magrans R., Blanch L.
Respiratory Care. 62 (10) (pp 1372-1374), 2017. Date of Publication: 01 Oct 2017.
AN: 623984901
PMID
28924024 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28924024]
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Publisher
American Association for Respiratory Care

158.

Low flow extracorporeal CO2 removal in ARDS patients: A prospective short-term crossover pilot study.
Peperstraete H., Eloot S., Depuydt P., De Somer F., Roosens C., Hoste E.
BMC Anesthesiology. 17 (1) (no pagination), 2017. Article Number: 155. Date of Publication: 28 Nov 2017.
AN: 619409392

Background: Lung protective mechanical ventilation (MV) is the corner stone of therapy for ARDS. However, its use may be limited by respiratory acidosis. This study explored feasibility of, effectiveness and safety of low flow extracorporeal CO2 removal (ECCO2R).
Method(s): This was a prospective pilot study, using the Abylcap (Bellco) ECCO2R, with crossover off-on-off design (2-h blocks) under stable MV settings, and follow up till end of ECCO2R. Primary endpoint for effectiveness was a 20% reduction of PaCO2 after the first 2-h. Adverse events (AE) were recorded prospectively. We included 10 ARDS patients on MV, with PaO2/FiO2 < 150 mmHg, tidal volume <= 8 mL/kg with positive end-expiratory pressure >= 5 cmH2O, FiO2 titrated to SaO2 88-95%, plateau pressure >= 28 cmH2O, and respiratory acidosis (pH <7.25).
Result(s): After 2-h of ECCO2R, 6 patients had a >= 20% decrease in PaCO2 (60%); PaCO2 decreased 28.4% (from 58.4 to 48.7 mmHg, p = 0.005), and pH increased (1.59%, p = 0.005). ECCO2R was hemodynamically well tolerated. During the whole period of ECCO2R, 6 patients had an AE (60%); bleeding occurred in 5 patients (50%) and circuit thrombosis in 3 patients (30%), these were judged not to be life threatening.
Conclusion(s): In ARDS patients, low flow ECCO2R significantly reduced PaCO2 after 2 h, Follow up during the entire ECCO2R period revealed a high incidence of bleeding and circuit thrombosis. Trial registration: https://clinicaltrials.gov identifier: NCT01911533 , registered 23 July 2013.

PMID
29179681 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29179681]
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(Hoste) Research Foundation-Flanders (FWO), Brussels, Belgium
Publisher
BioMed Central Ltd. (E-mail: info@biomedcentral.com)

159.

Is Extracorporeal CO2 Removal Really "safe" and "less" Invasive? Observation of Blood Injury and Coagulation Impairment during ECCO2R.
Kalbhenn J., Neuffer N., Zieger B., Schmutz A.
ASAIO Journal. 63 (5) (pp 666-671), 2017. Date of Publication: 2017.
AN: 614408500
Extracorporeal CO2 removal (ECCO2R) is promoted with attributes like "safe" and "less invasive" compared with (high-flow) venovenous extracorporeal membrane oxygenation (ECMO) systems. With our experience in coagulation disorders during ECMO therapy with this observational study, we for the first time prospectively evaluate hemolysis and coagulation disorders during ECCO2R. Eight consecutive patients with predominant hypercapnic respiratory failure were treated with the Hemolung respiratory assist system (Alung-Technologies, Pittsburg, PA). Bleeding as well as changes of coagulation parameters was prospectively assessed. Overall therapy was observed in seven patients with 52 treatment days. In four of seven

patients (57%), relevant clinical bleeding symptoms occurred. Thrombocytopenia, hemolysis, factor XIII deficiency and acquired von Willebrand syndrome (loss of high-molecular-weight von Willebrand factor multimers) were typical findings, and the patients spontaneously recovered after discontinuation of the extracorporeal system. In one patient, extracorporeal system stopped because of thrombotic occlusion. Six of seven patients required transfusion of red blood cells. Our observation shows that even low-flow extracorporeal lung support is associated with relevant clinical bleeding symptoms, blood cell injury, development of acquired von Willebrand syndrome and need for transfusion. In our opinion, it therefore is too early to quote ECCO2R "safe" and "less invasive.".

PMID
28187047 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28187047]
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Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

160.

Rescue therapeutic strategy combining ultra-protective mechanical ventilation with extracorporeal CO 2 removal membrane in near-fatal asthma with severe pulmonary barotraumas.
Pavot A., Mallat J., Vangrunderbeeck N., Thevenin D., Lemyze M.
Medicine (United States). 96 (41) (no pagination), 2017. Article Number: e8248. Date of Publication: 01 Oct 2017.
AN: 618767642
Rationale: Mechanical ventilation of severe acute asthma is still considered a challenging issue, mainly because of the gas trapping phenomenon with the potential for life-threatening barotraumatic pulmonary complications. Patient concerns: Herein, we describe 2 consecutive cases of near-fatal asthma for whom the recommended protective mechanical ventilation approach using low tidal volume of 6mL/kg and small levels of PEEP was rapidly compromised by giant pneumomediastinum with extensive subcutaneousemphysema. Diagnoses: Near fatal asthma.
Intervention(s): A rescue therapeutic strategy combining extracorporeal CO 2 removal membrane with ultra-protective extremely low tidal volume (3mL/kg) ventilation was applied.
Outcome(s): Both patients survived hospital discharge. Lessons: These 2 cases indicate that ECCO 2 R associated with ultra-protective ventilation could be an alternative to surgery in case of life-threatening barotrauma occurring under mechanical ventilation.

PMID
29019893 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29019893]
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Link to the Ovid Full Text or citation:
Click here for full text options

161.

Extracorporeal CO2 removal in the ICU: An effective treatment awaiting proper indications.
Arnal J.-M., Garnero A.
Minerva Anestesiologica. 83 (8) (pp 784-786), 2017. Date of Publication: August 2017.
AN: 617550092
PMID
28631461 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28631461]
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Link to the Ovid Full Text or citation:
Click here for full text options

162.

Extracorporeal CO2 removal in critically ill patients: A systematic review.
Taccone F.S., Heiner M.V.M., Ferrari F., Di Nardo M., Swol J., Broman L.M., Vercaemst L., Barrett N., Pappalardo F., Belohlavek J., Mueller T., Lorusso R., Belliato M.
Minerva Anestesiologica. 83 (7) (pp 762-772), 2017. Date of Publication: July 2017.
AN: 617399365
Introduction: The use of extracorporeal CO2 removal (ECCO2R) is increasingly employed in critically ill patients. However, the clinical evidence supporting its efficacy remains currently poor.
Evidence Acquisition: A systematic review using MEDLINE via PubMed was performed to identify eligible studies (until 30th September 2016). The amount of CO 2 reduction, the effect on the duration of mechanical ventilation and weaning, the impact on patients' outcome and the occurrence of complications were evaluated. The quality of evidence was evaluated according to the GRADE (Grading of Recommendations Assessment, Development and Evaluation) criteria.
Evidence Synthesis: Six studies were included (three evaluating patients with chronic obstructive pulmonary disease [COPD]; three evaluating patients with acute respiratory distress syndrome [ARDS]), involving 279 adult patients; 142 treated with ECCO2R and 137 controls. No study on pediatric population met the inclusion criteria for analysis. The overall quality of evidence of the two randomized trials and four case-control studies varied from moderate to very low. PaCO2 was generally reduced by 25-33% within a few hours following ECCO2R initiation. One ARDS study

showed a significant decrease in the duration of mechanical ventilation, although this result was only found by post-hoc analysis. The three studies on COPD demonstrated that some patients supported by ECCO2R devices could avoid endotracheal intubation, however the ICU-LOS and survival was not influenced by ECCO2R when compared to controls.
Conclusion(s): In COPD patients, a significantly reduced need for endotracheal intubation was reported. However, the use of ECCO2R has not shown significant improvement on the outcome of critically ill patients in the reviewed studies. Therefore appropriately powered, randomized, controlled studies are urgently needed.

PMID
28402093 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28402093]
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Publisher
Edizioni Minerva Medica (E-mail: subscriptions.dept@minervamedica.it)

163.

Extracorporeal CO2 removal: A powerful tool to be handled with care.
Grasselli G., Pesenti A.
Minerva Anestesiologica. 83 (7) (pp 682-684), 2017. Date of Publication: July 2017.
AN: 617399213
PMID
28702958 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28702958]
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Publisher
Edizioni Minerva Medica (E-mail: subscriptions.dept@minervamedica.it)

164.

Extracorporeal lung support. Extrakorporale Verfahren zur Lungenunterstutzung <Extrakorporale Verfahren zur Lungenunterstutzung.>
Braune S., Sieweke A., Jarczak D., Kluge S.
Medizinische Klinik - Intensivmedizin und Notfallmedizin. 112 (5) (pp 426-436), 2017.
Date of Publication: 01 Jun 2017.
AN: 616519627
Systems for extracorporeal lung support have recently undergone significant technological improvements leading to more effective and safe treatment. Despite limited scientific evidence these systems are increasingly used in the intensive care unit for treatment of different types of acute respiratory failure. In general two types of systems can be differentiated: devices for extracorporeal carbon dioxide removal (ECCO2R) for ventilatory insufficiency and devices for extracorporeal membrane oxygenation (ECMO) for severe hypoxemic failure. Despite of all technological developments extracorporeal lung support remains an invasive and a potentially dangerous form of treatment with bleeding and vascular injury being the two main complications. For this reason indications and contraindications should always be critically considered and extracorporeal lung support should only be carried out in centers with appropriate experience and expertise.

PMID
28555443 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28555443]
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Publisher
Springer-Verlag (Germany)

165.

Applying precision medicine to trial design using physiology extracorporeal CO2 removal for acute respiratory distress syndrome.
Goligher E.C., Amato M.B.P., Slutsky A.S.
American Journal of Respiratory and Critical Care Medicine. 196 (5) (pp 558-568), 2017. Date of Publication: 01 Sep 2017.

AN: 618345986
In clinical trials of therapies for acute respiratory distress syndrome (ARDS), the average treatment effect in the study population may be attenuated because individual patient responses vary widely. This inflates sample size requirements and increases the cost and difficulty of conducting successful clinical trials. One solution is to enrich the study population with patients most likely to benefit, based on predicted patient response to treatment (predictive enrichment). In this perspective, we apply the precision medicine paradigm to the emerging use of extracorporeal CO2 removal (ECCO2R) for ultraprotective ventilation in ARDS. ECCO2R enables reductions in tidal volume and driving pressure, key determinants of ventilatorinduced lung injury. Using basic physiological concepts, we demonstrate that dead space and static compliance determine the effect of ECCO2R on driving pressure and mechanical power. This framework might enable prediction of individual treatment responses to ECCO2R. Enriching clinical trials by selectively enrolling patients with a significant predicted treatment response can increase treatment effect size and statistical power more efficiently than conventional enrichment strategies that restrict enrollment according to the baseline risk of death. To support this claim, we simulated the predicted effect of ECCO2R on driving pressure and mortality in a preexisting cohort of patients with ARDS. Our computations suggest that restricting enrollment to patients inwhom ECCO2R allows driving pressure to be decreased by 5 cm H2O or more can reduce sample size requirement by more than 50% without increasing the total number of patients to be screened. We discuss potential implications for trial design based on this framework.

PMID
28636403 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28636403]
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Publisher
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166.

Extracorporeal Support for Chronic Obstructive Pulmonary Disease: A Bright Future.
Trahanas J.M., Lynch W.R., Bartlett R.H.
Journal of Intensive Care Medicine. 32 (7) (pp 411-420), 2017. Date of Publication: 01 Aug 2017.
AN: 617244098
In the past the only option for the treatment of respiratory failure due to acute exacerbation of chronic obstructive pulmonary disease (aeCOPD) was invasive mechanical ventilation. In recent decades, the potential for extracorporeal carbon dioxide (CO2) removal has been realized. We review the various types of extracorporeal CO2 removal, outline the optimal use of these therapies for aeCOPD,

and make suggestions for future controlled trials. We also describe the advantages and requirements for an ideal long-term ambulatory CO2 removal system for palliation of COPD.

PMID
27509917 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27509917]
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Publisher
SAGE Publications Inc. (E-mail: claims@sagepub.com)

167.

Clinical trials in acute respiratory distress syndrome: challenges and opportunities.
Matthay M.A., McAuley D.F., Ware L.B.
The Lancet Respiratory Medicine. 5 (6) (pp 524-534), 2017. Date of Publication: June 2017.
AN: 616484401
This year is the 50th anniversary of the first description of acute respiratory distress syndrome (ARDS). Since then, much has been learned about the pathogenesis of lung injury in ARDS, with an emphasis on the mechanisms of injury to the lung endothelium and the alveolar epithelium. In terms of treatment, major progress has been made in reducing mortality from ARDS with lung-protective ventilation, using a tidal volume of 6 mL per kg of predicted bodyweight and a plateau airway pressure of less than 30 cm H2O. In more severely hypoxaemic patients with ARDS, neuromuscular blockade and prone positioning have further reduced mortality, probably by extending the therapeutic effects of lung protective ventilation. Fluid-conservative therapy has also increased ventilator-free days in patients with ARDS. The lack of success of pharmacological therapies for ARDS, however, presents a continued challenge in the field. In addition to presenting a brief summary of previous experience with clinical trials in ARDS, we focus in this Review on future opportunities to improve clinical trial design to maximise the likelihood of identifying beneficial pharmacological therapies. In view of the heterogeneity in ARDS, both prognostic and predictive enrichment strategies are needed that target therapies toward specific subgroups of patients with ARDS on the basis of both severity and biology. Approaches to reducing heterogeneity in ARDS clinical trials include using physiological, radiographic, and biological criteria to select patients for both phase 2 and 3 trials. Additionally, interest is growing in the design of preventive clinical trials in ARDS and to initiate early treatment of patients with acute lung injury before the need for endotracheal intubation. We also present promising new approaches to treating ARDS, including combination therapies, cell-based therapies, and generic pharmacological compounds with low-risk profiles that are already in routine clinical use for other clinical indications.

PMID
28664851 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28664851]

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Lancet Publishing Group (E-mail: cususerv@lancet.com)

168.

Thrombectomy for Acute Stroke in Childhood: A Case Report, Literature Review, and Recommendations.
Buompadre M.C., Andres K., Slater L.-A., Mohseni-Bod H., Guerguerian A.-M., Branson H., Laughlin S., Armstrong D., Moharir M., deVeber G., Humpl T., Honjo O., Keshavjee S., Ichord R., Pereira V., Dlamini N.
Pediatric Neurology. 66 (pp 21-27), 2017. Date of Publication: 01 Jan 2017.
AN: 613934497
The updated American Heart Association/American Stroke Association guidelines include recommendation for thrombectomy in certain adult stroke cases. The safety and efficacy of thrombectomy in children are unknown. An 8-year-old girl experienced acute stroke symptoms on two occasions while therapeutically anticoagulated on Novalung. Computed tomography scans showed proximal vessel thrombi, which were retrieved using a Trevo device without hemorrhagic complications. Postprocedural assessment found respective decreases in the National Institutes of Health Stroke Scale score from 10 to 4 and 12 to 7. The indications for treatment and early benefits observed in our case are consistent with other pediatric thrombectomy cases reported. However, publication bias and the heterogeneity of reported cases prevent drawing conclusions about the safety and efficacy of thrombectomy in children. Anticipating that updates to adult stroke guidelines would likely incite stroke providers to consider thrombectomy in children, our institution developed guidelines for thrombectomy before the index patient. Establishing institutional guidelines before considering thrombectomy in children may optimize patient safety.

PMID
27769730 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27769730]
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Publisher
Elsevier Inc. (E-mail: usjcs@elsevier.com)

169.

How best to set the ventilator on extracorporeal membrane lung oxygenation.
Gattinoni L., Tonetti T., Quintel M.
Current Opinion in Critical Care. 23 (1) (pp 66-72), 2017. Date of Publication: 2017.
AN: 613534642
Purpose of review Extracorporeal respiratory support in patients with acute respiratory distress syndrome is applied either as rescue maneuver for life-threatening hypoxemia or as a tool to reduce the harm of mechanical ventilation. Depending on the blood and gas flow, extracorporeal support may completely substitute the natural lung as a gas exchanger (high-flow venovenous bypass) or reduce the need for mechanical ventilation, enabling the removal of a fraction of the metabolically produced CO2. Recent findings Recent studies provide a description on how mechanical ventilation is normally applied in combination with extracorporeal support in acute respiratory distress syndrome. The data show a general trend: a variable decrease of fraction of inspired oxygen (0.9 to 0.7 or 0.4), a consistent decrease in tidal volume (by 2 ml/ kg), no change in positive end-expiratory pressure (maintained around 12-13cmH2O) and a moderate decrease in the respiratory rate (22 to 15 bpm). These ventilatory settings are applied in whatever extracorporeal membrane lung oxygenation modality (venovenous versus venoarterial) and independent from the extent of extracorporeal support (partial or total substitution of gas exchange). Summary Mechanical ventilation and extracorporeal support are marginally integrated. The best environment for lung healing - complete lung collapse or protective ventilation strategy or fully open and immobile lung (all three conditions feasible with extracorporeal support) - remains to be defined.

PMID
27898437 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27898437]
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170.

Focus on ECMO and ECCO2R in ARDS patients.
Bein T., Aubron C., Papazian L.
Intensive Care Medicine. 43 (9) (pp 1424-1426), 2017. Date of Publication: 01 Sep 2017.
AN: 617412712
PMID
28717835 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28717835]
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Publisher
Springer Verlag (E-mail: service@springer.de)

171.

Adjunctive extracorporeal carbon dioxide removal in refractory status asthmaticus.
Jiang C., Galaydick J., Fernandez H., Caronia J.
BMJ Case Reports. 2017 (no pagination), 2017. Article Number: 220693. Date of Publication: 2017.
AN: 617547559
Status asthmaticus (SA) is a life-threatening disorder. Severe respiratory failure may require extracorporeal membrane oxygenation (ECMO). Previous reports have demonstrated utility of ECMO in SA in various patients with varying success. A 25-year-old man was admitted with status asthmatics and severe hypercapnic respiratory failure. Despite tailored ventilator therapies, such as pressure control ventilation and maximal pharmacological therapy, including general anaesthesia, the patient's condition deteriorated rapidly. Veno-venous ECMO (VV-ECMO) was provided for respiratory support. The patient's clinical condition improved over the following 72 hours and was discharged from the intensive care unit on day 3. This case report demonstrates the successful use of VV-ECMO in a patient with severe respiratory failure due to SA, who failed to respond to maximal therapy. This case adds support to a growing body of literature that shows that ECMO can be used with success for refractory status asthmaticus.

PMID
28754757 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28754757]
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172.

Comments on Morelli et al.: Extracorporeal carbon dioxide removal (ECCO2R) in patients with acute respiratory failure.
Allardet-Servent J., Castanier M., Signouret T., Seghboyan J.-M., Morelli A.
Intensive Care Medicine. 43 (8) (pp 1171-1172), 2017. Date of Publication: 01 Aug 2017.
AN: 616606853
PMID
28573390 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28573390]
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173.

The role of extracorporeal removal of CO2 (ECCO2R) in the management of respiratory diseases. Place de l'epuration extracorporelle de CO2 (ECCO2R) dans la prise en charge des pathologies respiratoires <Place de l'epuration extracorporelle de CO2 (ECCO2R) dans la prise en charge des pathologies respiratoires.>
Diehl J.L., Boisrame-Helms J., Chardon-Couteau A., Commereuc M., Augy J.-L., Sokoloff A., Rivet N., Gaussem P., Smadja D.M., Aissaoui N.
Revue des Maladies Respiratoires. 34 (6) (pp 598-606), 2017. Date of Publication: June 2017.
AN: 616174882
Introduction The aim of extracorporeal removal of CO2 (ECCO2R) is to ensure the removal of CO2 without any significant effect on oxygenation. ECCO2R makes use of low to moderate extracorporeal blood flow rates, whereas extracorporeal membrane oxygenation (ECMO) requires high blood flows. State of the art For each ECCO2R device it is important to consider not only performance in terms of CO2 removal, but also cost and safety, including the incidence of hemolysis and of hemorrhagic and thrombotic complications. In addition, it is possible that the benefits of such techniques may extend beyond simple removal of CO2. There have been preliminary reports of benefits in terms of reduced respiratory muscle workload. Mobilization of endothelial progenitor cells could also occur, in analogy to the data

reported with ECMO, with a potential benefit in term of pulmonary repair. The most convincing clinical experience has been reported in the context of the acute respiratory distress syndrome (ARDS) and severe acute exacerbations of chronic obstructive pulmonary disease (COPD), especially in patients at high risk of failure of non-invasive ventilation. Perspectives Preliminary results prompt the initiation of randomized controlled trials in these two main indications. Finally, the development of these technologies opens new perspectives in terms of long-term ventilatory support.

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28506729 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28506729]
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174.

Extracorporeal CO2 Elimination (ECCO2R) for Hypercapnic Respiratory Failure: From Pathophysiology to Clinical Application. Extrakorporale CO2-Elimination (ECCO2R): von der Pathophysiologie zur klinischen Anwendung beim hyperkapnischen respiratorischen Versagen <Extrakorporale CO2-Elimination (ECCO2R): von der Pathophysiologie zur klinischen Anwendung beim hyperkapnischen respiratorischen Versagen.>
Karagiannidis C., Philipp A., Strassmann S., Schafer S., Merten M., Windisch W.
Pneumologie. 71 (4) (pp 215-220), 2017. Date of Publication: 01 Apr 2017.
AN: 615340964
Extracorporeal CO2 removal (ECCO2R) is becoming an increasingly established treatment option for patients with acute severe hypercapnic respiratory failure. Technically, pumpless arterio-venous systems using the natural arterio-venous pressure gradient and also pump-driven veno-venous systems are available. Here, veno-venous ECCO2R has become the preferred technique, as settings for arterio-venous ECCO2R are restricted and side effects are more common with arterio-venous ECCO2R. Using veno-venous ECCO2R with blood flow rates up to 450 ml/min 60 to 80 ml CO2 can be removed per minute corresponding to 20 to 30 % of the total amount of CO2 production. However, in case of very severe hypercapnic respiratory failure with severe respiratory acidosis (pH 7.1 or less) blood flow rates of around 1000 ml/min are required for compensating severe respiratory acidosis corresponding to the elimination of 50 to 60 % of the total amount of CO2 production. Relevant side effects include the activation of blood coagulation and associated bleeding complications. Two recent case-control studies in severely exacerbated

COPD patients could demonstrate that intubation rates can be reduced by the application of ECCO2R, but this was associated with non-ignorable side effects. Therefore, randomized controlled trials are urgently needed to more precisely establish the risks and benefits of ECCO2R when aimed at avoiding intubation.

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28407675 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28407675]
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Publisher
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175.

Acquired von Willebrand syndrome in respiratory extracorporeal life support: a systematic review of the literature.
Malfertheiner M.V., Pimenta L.P., Bahr V.V., Millar J.E., Obonyo N.G., Suen J.Y., Pellegrino V., Fraser J.F.
Critical care and resuscitation : journal of the Australasian Academy of Critical Care Medicine. 19 (Supplement 1) (pp 45-52), 2017. Date of Publication: 01 Oct 2017.
AN: 627012820
BACKGROUND AND OBJECTIVE: Venovenous extracorporeal membrane oxygenation (VV ECMO) and extracorporeal CO2 removal (ECCO2R) are increasingly used in the management of severe respiratory failure. With bleeding complications being one of the major risks of these techniques, our aim in this systematic review was to assess the available literature on acquired von Willebrand syndrome (AvWS) and extracorporeal support. AvWS has previously been associated with bleeding and shear stress. DESIGN AND DATA SOURCES: A systematic review, using Medline via PubMed, was performed to identify eligible studies up to January 2017. RESULTS AND
CONCLUSION(S): The prevalence of AvWF among patients on VV ECMO or ECCO2R is high, but only a limited number of studies are reported in the literature. AvWS testing should be performed, including vWF multimer analysis, vWF activity and vWF antigen concentration. The extent to which vWF contributes to bleeding during ECMO, or how much changes in ECMO management can influence high molecular weight vWF multimer levels, cannot be answered from the currently available evidence and there remains a need for future studies.
PMID
29084501 [http://www.ncbi.nlm.nih.gov/pubmed/?term=29084501]
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NLM (Medline)

176.

Interstitial pneumonia with autoimmune features: an additional risk factor for ARDS?.
Grasselli G., Vergnano B., Pozzi M.R., Sala V., D'Andrea G., Scaravilli V., Mantero M., Pesci A., Pesenti A.
Annals of Intensive Care. 7 (1) (no pagination), 2017. Article Number: 98. Date of Publication: 01 Dec 2017.
AN: 618363141
Background: Interstitial pneumonia with autoimmune features (IPAF) identifies a recently recognized autoimmune syndrome characterized by interstitial lung disease and autoantibodies positivity, but absence of a specific connective tissue disease diagnosis or alternative etiology. We retrospectively reviewed the clinical presentation, diagnostic workup and management of seven critically ill patients who met diagnostic criteria for IPAF. We compared baseline characteristics and clinical outcome of IPAF patients with those of the population of ARDS patients admitted in the same period.
Result(s): Seven consecutive patients with IPAF admitted to intensive care unit for acute respiratory distress syndrome (ARDS) were compared with 78 patients with ARDS secondary to a known risk factor and with eight ARDS patients without recognized risk factors. Five IPAF patients (71%) survived and were discharged alive from ICU: Their survival rate was equal to that of patients with a known risk factor (71%), while the subgroup of patients without risk factors had a markedly lower survival (38%). According to the Berlin definition criteria, ARDS was severe in four IPAF patients and moderate in the remaining three. All had multiple organ dysfunction at presentation. The most frequent autoantibody detected was anti-SSA/Ro52. All patients required prolonged mechanical ventilation (median duration 49 days, range 10-88); four received extracorporeal membrane oxygenation and one received low-flow extracorporeal CO2 removal. All patients received immunosuppressive therapy.
Conclusion(s): This is the first description of a cohort of critical patients meeting the diagnostic criteria for IPAF presenting with ARDS. This diagnosis should be considered in any critically ill patient with interstitial lung disease of unknown origin. While management is challenging and level of support high, survival appears to be good and comparable to that of patients with ARDS associated with a known clinical insult.

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177.

ARDS and ventilator induced lung injury: Current therapeutic strategies. ARDS e danno polmonare da ventilazione meccanica: Recenti acquisizioni terapeutiche <ARDS e danno polmonare da ventilazione meccanica: Recenti acquisizioni terapeutiche.>
Piervincenzi E., Ranieri V.M., Mollica C.
Rassegna di Patologia dell'Apparato Respiratorio. 32 (3-4) (pp 139-147), 2017. Date of Publication: 2017.
AN: 618076763
Over the years the ARDS (Acute Respiratory Distress Syndrome) has undergone numerous renames and classifications until reaching the current classification given by the study group "ARDS network" in Berlin in 2012. Despite the efforts undertaken in the last years in the therapeutic strategies, it still remains a very high mortality disease with a not unique etiology, that leads the clinical research on ventilatory therapy to have the highest priority. Mechanical ventilation, with increasingly stringent standards, can be indeed identified as the main cause for the amplification of lung injury. Recent clinical evidence has shown how biotrauma lung induced by ventilator can spread to other organs through extracellular signaling pathways contributing to the onset of Multi-Organ Failure (MOF) and dramatically increasing mortality rates. Nowadays, the most common trend is towards a low Tidal Volume (Vt) ventilation (6 mL/kg Predicted Body Weight or PBW), adequate PEEP (Positive End-Expiratory Pressure) level (10-15 cmH2O in mild and moderate ARDS and > 15 cmH2O in severe ARDS) with plateau Pressure (Pplat) < 30 cmH2O to avoid alveolar opening/closing events (atelectrauma) or alveolar overdistention (barotrauma) combined with additional strategies such as prone position. The latest evidence suggests that, perhaps, a traditional protective ventilation may not be suffiscient to prevent further lung damage. Therefore, further clinical trials have been commenced on the use of a ventilation technique at lower Vt (overprotective) (4 mL/kg PBW). In this regard, with a growing level of clinical evidence, the extracorporeal gas purification techniques such as ECCO2R (Extra-Corporeal CO2 Removal) have been combined with ventilatory strategies, allowing more and more complex ventilatory therapies in order to protect the lung parenchyma and guarantee an adequate gas exchange.
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178.

Systematic review and meta-analysis of complications and mortality of veno-venous extracorporeal membrane oxygenation for refractory acute respiratory distress syndrome.

Vaquer S., de Haro C., Peruga P., Oliva J.C., Artigas A.

Annals of Intensive Care. 7 (1) (no pagination), 2017. Article Number: 51. Date of Publication: 01 Dec 2017.
AN: 617935129

Veno-venous extracorporeal membrane oxygenation (ECMO) for refractory acute respiratory distress syndrome (ARDS) is a rapidly expanding technique. We performed a systematic review and meta-analysis of the most recent literature to analyse complications and hospital mortality associated with this technique. Using the PRISMA guidelines for systematic reviews and meta-analysis, MEDLINE and EMBASE were systematically searched for studies reporting complications and hospital mortality of adult patients receiving veno-venous ECMO for severe and refractory ARDS. Studies were screened for low bias risk and assessed for study size effect. Meta-analytic pooled estimation of study variables was performed using a weighted random effects model for study size. Models with potential moderators were explored using random effects meta-regression. Twelve studies fulfilled inclusion criteria, representing a population of 1042 patients with refractory ARDS. Pooled mortality at hospital discharge was 37.7% (CI 95% = 31.8-44.1; I2 = 74.2%). Adjusted mortality including one imputable missing study was 39.3% (CI 95% = 33.1-45.9). Meta-regression model combining patient age, year of study realization, mechanical ventilation (MV) days and prone positioning before veno-venous ECMO was associated with hospital mortality ($p < 0.001$; R2 = 0.80). Patient age (b = 0.053; $p = 0.01$) and maximum cannula size during treatment (b = -0.075; $p = 0.008$) were also independently associated with mortality. Studies reporting H1N1 patients presented inferior hospital mortality (24.8 vs 40.6%; $p = 0.027$). Complication rate was 40.2% (CI 95% = 25.8-56.5), being bleeding the most frequent 29.3% (CI 95% = 20.8-39.6). Mortality due to complications was 6.9% (CI 95% = 4.1-11.2). Mechanical complications were present in 10.9% of cases (CI 95% = 4.7-23.5), being oxygenator failure the most prevalent (12.8%; CI 95% = 7.1-21.7). Despite initial severity, significant portion of patients treated with veno-venous ECMO survive hospital discharge. Patient age, H1N1-ARDS and cannula size are independently associated with hospital mortality. Combined effect of patient age, year of study realization, MV days and prone positioning before veno-venous ECMO influence patient outcome, and although medical complications are frequent, their impact on mortality is limited.

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179.

Efficacy and safety of argatroban in patients with acute respiratory distress syndrome and extracorporeal lung support.
Menk M., Briem P., Weiss B., Gassner M., Schwaiberger D., Goldmann A., Pille C., Weber-Carstens S.
Annals of Intensive Care. 7 (1) (no pagination), 2017. Article Number: 82. Date of Publication: 01 Dec 2017.
AN: 617643264
Background: Extracorporeal membrane oxygenation (ECMO) or pumpless extracorporeal lung assist (pECLA) requires effective anticoagulation. Knowledge on the use of argatroban in patients with acute respiratory distress syndrome (ARDS) undergoing ECMO or pECLA is limited. Therefore, this study assessed the feasibility, efficacy and safety of argatroban in critically ill ARDS patients undergoing extracorporeal lung support.
Method(s): This retrospective analysis included ARDS patients on extracorporeal lung support who received argatroban between 2007 and 2014 in a single ARDS referral center. As controls, patients who received heparin were matched for age, sex, body mass index and severity of illness scores. Major and minor bleeding complications, thromboembolic events, administered number of erythrocyte concentrates, thrombocytes and fresh-frozen plasmas were assessed. The number of extracorporeal circuit systems and extracorporeal lung support cannulas needed due to clotting was recorded. Also assessed was the efficacy to reach the targeted activated partial thromboplastin time (aPTT) in the first consecutive 14 days of therapy, and the controllability of aPTT values is within a therapeutic range of 50-75 s. Fisher's exact test, Mann-Whitney U tests, Friedman tests and multivariate nonparametric analyses for longitudinal data (MANOVA; Brunner's analysis) were applied where appropriate.
Result(s): Of the 535 patients who met the inclusion criteria, 39 receiving argatroban and 39 matched patients receiving heparin (controls) were included. Baseline characteristics were similar between the two groups, including severity of illness and organ failure scores. There were no significant differences in major and minor bleeding complications. Rates of thromboembolic events were generally low and were similar between the two groups, as were the rates of transfusions required and device-associated complications. The controllability of both argatroban and heparin improved over time, with a significantly increasing probability to reach the targeted aPTT corridor over the first days ($p < 0.001$). Over time, there were significantly fewer aPTT values below the targeted aPTT goal in the argatroban group than in the heparin group ($p < 0.05$). Both argatroban and heparin reached therapeutic aPTT values for adequate application of extracorporeal lung support.
Conclusion(s): Argatroban appears to be a feasible, effective and safe anticoagulant for critically ill ARDS patients undergoing extracorporeal lung support.

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180.

Extracorporeal techniques in acute respiratory distress syndrome.
Parekh M., Abrams D., Brodie D.
Annals of Translational Medicine. 5 (14) (no pagination), 2017. Article Number: 296.
Date of Publication: July 2017.
AN: 617591396
Extracorporeal membrane oxygenation (ECMO) was first introduced for patients with acute respiratory distress syndrome (ARDS) in the 1970s. However, enthusiasm was tempered due to the high mortality seen at that time. The use of ECMO has grown considerably in recent years due to technological advances and the evidence suggesting potential benefit. While the efficacy of ECMO has yet to be rigorously demonstrated with high-quality evidence, it has the potential not only to have a substantial impact on outcomes, including mortality, but also to change the paradigm of ARDS management.

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181.

Spontaneous breathing: A double-edged sword to handle with care.
Mauri T., Cambiaghi B., Spinelli E., Langer T., Grasselli G.
Annals of Translational Medicine. 5 (14) (no pagination), 2017. Article Number: 292.
Date of Publication: July 2017.
AN: 617591392
In acute hypoxemic respiratory failure (AHRF) and acute respiratory distress syndrome (ARDS) patients, spontaneous breathing is associated with multiple physiologic benefits: it prevents muscles atrophy, avoids paralysis, decreases sedation needs and is associated with improved hemodynamics. On the other hand, in the presence of uncontrolled inspiratory effort, severe lung injury and asynchronies, spontaneous ventilation might also worsen lung edema, induce diaphragm dysfunction and lead to muscles exhaustion and prolonged weaning. In the present review article, we present physiologic mechanisms driving spontaneous breathing, with emphasis on how to implement basic and advanced respiratory monitoring to assess lung protection during spontaneous assisted ventilation. Then, key benefits and risks associated with spontaneous ventilation are described. Finally, we propose some clinical means to promote protective spontaneous breathing at the bedside. In summary, early switch to spontaneous assisted breathing of acutely hypoxemic patients is more respectful of physiology and might yield several advantages. Nonetheless, risk of additional lung injury is not completely avoided during spontaneous breathing and careful monitoring of target physiologic variables such as tidal volume (Vt) and driving transpulmonary pressure should be applied routinely. In clinical practice, multiple interventions such as extracorporeal CO2

removal exist to maintain inspiratory effort, Vt and driving transpulmonary pressure within safe limits but more studies are needed to assess their long-term efficacy.

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182.

Tidal volume in acute respiratory distress syndrome: How best to select it.
Umbrello M., Marino A., Chiumello D.
Annals of Translational Medicine. 5 (14) (no pagination), 2017. Article Number: 287.
Date of Publication: July 2017.
AN: 617591387
Mechanical ventilation is the type of organ support most widely provided in the intensive care unit. However, this form of support does not constitute a cure for acute respiratory distress syndrome (ARDS), as it mainly works by buying time for the lungs to heal while contributing to the maintenance of vital gas exchange. Moreover, it can further damage the lung, leading to the development of a particular form of lung injury named ventilator-induced lung injury (VILI). Experimental evidence accumulated over the last 30 years highlighted the factors associated with an injurious form of mechanical ventilation. The present paper illustrates the physiological effects of delivering a tidal volume to the lungs of patients with ARDS, and suggests an approach to tidal volume selection. The relationship between tidal volume and the development of VILI, the so called volotrauma, will be reviewed. The still actual suggestion of a lung-protective ventilatory strategy based on the use of low tidal volumes scaled to the predicted body weight (PBW) will be presented, together with newer strategies such as the use of airway driving pressure as a surrogate for the amount of ventilatable lung tissue or the concept of strain, i.e., the ratio between the tidal volume delivered relative to the resting condition, that is the functional residual capacity (FRC). An ultra-low tidal volume strategy with the use of extracorporeal carbon dioxide removal (ECCO2R) will be presented and discussed. Eventually, the role of other ventilator-related parameters in the generation of VILI will be considered (namely, plateau pressure, airway driving pressure, respiratory rate (RR), inspiratory flow), and the promising unifying framework of mechanical power will be presented.

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183.

Is extracorporeal circulation the future of acute respiratory distress syndrome management?.
Combes A., Pesenti A., Ranieri V.M.
American Journal of Respiratory and Critical Care Medicine. 195 (9) (pp 1161-1170), 2017. Date of Publication: 01 May 2017.
AN: 615888052
Mechanical ventilation (MV) remains the cornerstone of acute respiratory distress syndrome (ARDS) management. It guarantees sufficient alveolar ventilation, high FIO2 concentration, and high positive end-expiratory pressure levels. However, experimental and clinical studies have accumulated, demonstrating that MV also contributes to the high mortality observed in patients with ARDS by creating ventilator-induced lung injury. Under these circumstances, extracorporeal lung support (ECLS) may be beneficial in two distinct clinical settings: to rescue patients from the high risk for death associated with severe hypoxemia, hypercapnia, or both not responding to maximized conventional MV, and to replace MV and minimize/abolish the harmful effects of ventilator-induced lung injury. High extracorporeal blood flow venovenous extracorporeal membrane oxygenation (ECMO) may therefore rescue the sickest patients with ARDS from the high risk for death associated with severe hypoxemia, hypercapnia, or both not responding to maximized conventional MV. Successful venovenous ECMO treatment in patients with extremely severe H1N1-associated ARDS and positive results of the CESAR trial have led to an exponential use of the technology in recent years. Alternatively, lower-flow extracorporeal CO2 removal devices may be used to reduce the intensity of MV (by reducing VT from 6 to 3-4 ml/kg) and to minimize or even abolish the harmful effects of ventilator-induced lung injury if used as an alternative to conventional MV in nonintubated, nonsedated, and spontaneously breathing patients. Although conceptually very attractive, the use of ECLS in patients with ARDS remains controversial, and high-quality research is needed to further advance our knowledge in the field.

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184.

Pulmonary reperfusion injury.
Yuan S.-M.
Signa Vitae. 13 (1) (pp 14-18), 2017. Date of Publication: 2017.
AN: 617024737
Pulmonary reperfusion injury is a clinical syndrome with no single and recognized pathophysiologic mechanism. It is a major cause of morbidity and mortality following lung transplantation, cardiogenic shock, or cardiopulmonary bypass. The underlying mechanisms remain uncertain. Lung inflammatory injury induced by lipopolysaccharide, characterized by rapid sequestration of neutrophils in response to inflammatory chemokines and cytokines released in the lungs is an acceptable theory. Structural or functional impairment of surfactant has been noted in pulmonary reperfusion injury. The pathological changes may include bilateral pulmonary infiltrates, reduced lung compliance and worsening of gas exchange in the immediate posttransplant period. Recruitment maneuver and high positive end-expiratory pressure can relieve postoperative respiratory failure, especially in the patient with reperfusion pulmonary edema after pulmonary thromboendarterectomy. Pharmaceutical agents, including inhaled nitric oxide, soluble complement receptor type 1, prostaglandin E1 and exogenous surfactant, attenuate pulmonary reperfusion injury through distinct mechanisms. Extracorporeal membrane oxygenation and Novalung are temporary assistance in bridging to lung transplantation, stabilization of hemodynamics during transplantation and treatment of severe lung dysfunction and primary graft failure. Modulation of heme oxygenase-1 expression, ischemic conditioning and gene therapy are future directions for pulmonary reperfusion injury management.

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185.

Extracorporeal carbon dioxide removal (ECCO2R) in patients with acute respiratory failure.
Morelli A., Del Sorbo L., Pesenti A., Ranieri V.M., Fan E.
Intensive Care Medicine. 43 (4) (pp 519-530), 2017. Date of Publication: 01 Apr 2017.
AN: 614254790
Purpose: To review the available knowledge related to the use of ECCO2R as adjuvant strategy to mechanical ventilation (MV) in various clinical settings of acute respiratory failure (ARF).
Method(s): Expert opinion and review of the literature.
Result(s): ECCO2R may be a promising adjuvant therapeutic strategy for the management of patients with severe exacerbations of COPD and for the

achievement of protective or ultra-protective ventilation in patients with ARDS without life-threatening hypoxemia. Given the observational nature of most of the available clinical data and differences in technical features and performances of current devices, the balance of risks and benefits for or against ECCO2R in such patient populations remains unclear
Conclusion(s): ECCO2R is currently an experimental technique rather than an accepted therapeutic strategy in ARF-its safety and efficacy require confirmation in clinical trials.

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186.

Extracorporeal carbon dioxide removal (ECCO2R) in respiratory deficiency and current investigations on its improvement: a review.
Manap H.H., Abdul Wahab A.K.
Journal of Artificial Organs. 20 (1) (pp 8-17), 2017. Date of Publication: 01 Mar 2017.
AN: 610481185
The implementation of extracorporeal carbon dioxide removal (ECCO2R) as one of the extracorporeal life support system is getting more attention today. Thus, the objectives of this paper are to study the clinical practice of commercial ECCO2R system, current trend of its development and also the perspective on future improvement that can be done to the existing ECCO2R system. The strength of this article lies in its review scope, which focuses on the commercial ECCO2R therapy in the market based on membrane lung and current investigation to improve the efficiency of the ECCO2R system, in terms of surface modification by carbonic anhydrase (CA) immobilization technique and respiratory electrodialysis (R-ED). Our methodology approach involves the identification of relevant published literature from PubMed and Web of Sciences search engine using the terms Extracorporeal Carbon Dioxide Removal (ECCO2R), Extracorporeal life support, by combining terms between ECCO2R and CA and also ECCO2R with R-ED. This identification only limits articles in English language. Overall, several commercial ECCO2R systems are known and proven safe to be used in patients in terms of efficiency, safety and risk of complication. In addition, CA-modified hollow fiber for membrane lung and R-ED are proven to have good potential to be applied in conventional ECCO2R design. The detailed technique and current progress on CA immobilization and R-ED development were also reviewed in this article.

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Publisher
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187.

pRotective vEntilation with veno-venouS lung assisT in respiratory failure: A protocol for a multicentre randomised controlled trial of extracorporeal carbon dioxide removal in patients with acute hypoxaemic respiratory failure.
McNamee J.J., Gillies M.A., Barrett N.A., Agus A.M., Beale R., Bentley A., Bodenham A., Brett S.J., Brodie D., Finney S.J., Gordon A.J., Griffiths M., Harrison D., Jackson C., McDowell C., McNally C., Perkins G.D., Tunnicliffe W., Vuylsteke A., Walsh T.S., Wise M.P., Young D., McAuley D.F.
Journal of the Intensive Care Society. 18 (2) (pp 159-169), 2017. Date of Publication: 01 May 2017.
AN: 615982900
One of the few interventions to demonstrate improved outcomes for acute hypoxaemic respiratory failure is reducing tidal volumes when using mechanical ventilation, often termed lung protective ventilation. Veno-venous extracorporeal carbon dioxide removal (vv-ECCO2R) can facilitate reducing tidal volumes. pRotective vEntilation with veno-venouS lung assisT (REST) is a randomised, allocation concealed, controlled, open, multicentre pragmatic trial to determine the clinical and cost-effectiveness of lower tidal volume mechanical ventilation facilitated by vv-ECCO2R in patients with acute hypoxaemic respiratory failure. Patients requiring intubation and mechanical ventilation for acute hypoxaemic respiratory failure will be randomly allocated to receive either vv-ECCO2R and lower tidal volume mechanical ventilation or standard care with stratification by recruitment centre. There is a need for a large randomised controlled trial to establish whether vv-ECCO2R in acute hypoxaemic respiratory failure can allow the use of a more protective lung ventilation strategy and is associated with improved patient outcomes.

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188.

Effect of body mass index on the outcome of surgical patients receiving extracorporeal devices (VV ECMO, pECLA) for respiratory failure.
Swol J., Buchwald D., Strauch J.T., Schildhauer T.A., Ull C.
International Journal of Artificial Organs. 40 (3) (pp 102-108), 2017. Date of Publication: 2017.
AN: 615821496
Introduction: To determine whether obese surgical patients are at a significant disadvantage in terms of outcomes after extracorporeal device (ECD) support, such as veno-venous extracorporeal membrane oxygenation (VV ECMO) or pumpless extracorporeal lung assist (pECLA), for respiratory failure, the relationship between body mass index (BMI) and hospital outcomes was analyzed.
Method(s): This retrospective study included data on patients who were supported with an ECD between January 1, 2008 and December 31, 2014. The analysis included 89 patients (74 male).

Result(s): The median BMI was 30 kg/m2 (19-88.5). The median duration of the ECD support was 9.0 days, with a maximum of 37.1 days. The median LOS (length of stay) in the intensive care unit (ICU) was 21 days (range 0.06197.6). The median hospital LOS was 34.9 days (range 0.1-213.8). VV ECMO was performed 72 times, and pECLA was performed 18 times. The number of patients successfully weaned off the ECD was 54 (60.6%). Survival at the discharge from the hospital was 48.3%. Conclusion(s): 54 (60.6%) patients were successfully weaned off the ECD; 43 (48.3%) patients survived and were discharged from the hospital. The analysis of correlations between BMI and outcomes of surgical patients treated with ECD showed no association between BMI and mortality. Complications (especially oxygenator clotting) were not more frequent in obese and extremely obese patients. We hypothesized that patients with higher or morbid BMIs would have increased mortality after ECD support. A BMI of 30.66 kg/m2 corresponded to the desired sensitivity and specificity to predict mortality. This finding applied only to the study group. Treatment with ECD in obese patients presents unique challenges, including percutaneous cannulation and increased staff requirements. However, based on these data, obesity should not be an exclusion criterion for ECD therapy.

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189.

Interventional lung assist and extracorporeal membrane oxygenation in a patient with near-fatal asthma.
Lee S.J., Cha Y.S., Byun C.S., Kim S.-H., Lee M.K., Yong S.J., Lee W.-Y.
American Journal of Emergency Medicine. 35 (2) (pp 374.e3-374.e4), 2017. Date of Publication: 01 Feb 2017.
AN: 613359724
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27553829 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27553829]
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Publisher
W.B. Saunders

190.

Extracorporeal CO2 removal by hemodialysis: in vitro model and feasibility.
May A.G., Sen A., Cove M.E., Kellum J.A., Federspiel W.J.
Intensive Care Medicine Experimental. 5 (1) (no pagination), 2017. Article Number: 20. Date of Publication: 01 Dec 2017.
AN: 615228410
Background: Critically ill patients with acute respiratory distress syndrome and acute exacerbations of chronic obstructive pulmonary disease often develop hypercapnia and require mechanical ventilation. Extracorporeal carbon dioxide removal can manage hypercarbia by removing carbon dioxide directly from the bloodstream. Respiratory hemodialysis uses traditional hemodialysis to remove CO2 from the blood, mainly as bicarbonate. In this study, Stewart's approach to acid-base chemistry was used to create a dialysate that would maintain blood pH while removing CO2 as well as determine the blood and dialysate flow rates necessary to remove clinically relevant CO2 volumes.
Method(s): Bench studies were performed using a scaled down respiratory hemodialyzer in bovine or porcine blood. The scaling factor for the bench top experiments was 22.5. In vitro dialysate flow rates ranged from 2.2 to 24 mL/min (49.5-540 mL/min scaled up) and blood flow rates were set at 11 and 18.7 mL/min (248-421 mL/min scaled up). Blood inlet CO2 concentrations were set at 50 and 100 mmHg.
Result(s): Results are reported as scaled up values. The CO2 removal rate was highest at intermittent hemodialysis blood and dialysate flow rates. At an inlet pCO2 of 50 mmHg, the CO2 removal rate increased from 62.6 +/- 4.8 to 77.7 +/- 3 mL/min when the blood flow rate increased from 248 to 421 mL/min. At an inlet pCO2 of 100 mmHg, the device was able to remove up to 117.8 +/- 3.8 mL/min of CO2. None of the test conditions caused the blood pH to decrease, and increases were <=0.08.
Conclusion(s): When the bench top data is scaled up, the system removes a therapeutic amount of CO2 standard intermittent hemodialysis flow rates. The zero bicarbonate dialysate did not cause acidosis in the post-dialyzer blood. These results demonstrate that, with further development, respiratory hemodialysis can be a minimally invasive extracorporeal carbon dioxide removal treatment option.

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Publisher
SpringerOpen

191.

Cardiac output: A central issue in patients with respiratory extracorporeal support.
Romagnoli S., Zagli G., Ricci Z., Villa G., Barbani F., Pinelli F., De Gaudio R., Chelazzi C.
Perfusion (United Kingdom). 32 (1) (pp 44-49), 2017. Date of Publication: 01 Jan 2017.
AN: 614004319
The iLA-activve Novalung is a new extracorporeal device specifically designed for lung support in patients with hypercapnic and/or hypoxemic respiratory failure. To date, only low-flow applications for decompensated hypercapnic chronic obstructive pulmonary disease have been reported in the literature. Here, we briefly report three cases of iLA-activve use in patients with hypercapnic-hypoxemic acute lung failure assisted with mid-flow (up to 2.4 L/min) and different single/double venous cannulation. The main findings of our small case series were: firstly, extracorporeal blood flows over 2.0 L/min across the membrane provided clinically satisfying decarboxylation and improved oxygenation; secondly, the ratio between blood flow through the membrane and the patient's cardiac output (CO) was a major determinant for the oxygen increase. The latter could, therefore, be a useful indicator for understanding performance in the complex and multifactorial evaluation of patients with extracorporeal veno-venous lung support.

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192.

Management of severe traumatic brain injury and acute respiratory distress syndrome using pumped extracorporeal carbon dioxide removal device.
Martindale T., McGlone P., Chambers R., Fennell J.
Journal of the Intensive Care Society. 18 (1) (pp 66-70), 2017. Date of Publication: 2017.
AN: 614327265
The effects of a high carbon dioxide on cerebral perfusion and intracranial pressure are well known. We report the case of a man who presented after with a severe traumatic brain injury including intracranial and extradural haemorrhage.

Neuroprotective ventilation was impossible without supramaximal tidal volumes due to a combination of chest trauma and severe bronchospasm. A pump driven Novalung iLA active system was inserted to achieve both ARDSnet ventilation and a lowering of intracranial pressure. To our knowledge, this is the first time this system has been used to this effect. The patient went on to make a good recovery.

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Publisher
SAGE Publications Inc. (E-mail: claims@sagepub.com)

193.

Low-Flow Extracorporeal Carbon Dioxide Removal Using the Hemolung Respiratory Dialysis System to Facilitate Lung-Protective Mechanical Ventilation in Acute Respiratory Distress Syndrome.
Akkanti B., Rajagopal K., Patel K.P., Aravind S., Nunez-Centanu E., Hussain R., Shabari F.R., Hofstetter W.L., Vaporciyan A.A., Banjac I.S., Kar B., Gregoric I.D., Loyalka P.
The journal of extra-corporeal technology. 49 (2) (pp 112-114), 2017. Date of Publication: 01 Jun 2017.
AN: 621485474
Extracorporeal carbon dioxide removal (ECCO2R) permits reductions in alveolar ventilation requirements that the lungs would otherwise have to provide. This concept was applied to a case of hypercapnia refractory to high-level invasive mechanical ventilator support. We present a case of an 18-year-old man who developed post-pneumonectomy acute respiratory distress syndrome (ARDS) after resection of a mediastinal germ cell tumor involving the left lung hilum. Hypercapnia and hypoxemia persisted despite ventilator support even at traumatic levels. ECCO2R using a miniaturized system was instituted and provided effective carbon dioxide elimination. This facilitated establishment of lung-protective ventilator settings and lung function recovery. Extracorporeal lung support increasingly is being applied to treat ARDS. However, conventional extracorporeal membrane oxygenation (ECMO) generally involves using large cannulae capable of carrying high flow rates. A subset of patients with ARDS has mixed hypercapnia and hypoxemia despite high-level ventilator support. In the absence of profound hypoxemia, ECCO2R may be used to reduce ventilator support requirements to lung-protective levels, while avoiding risks associated with conventional ECMO.
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28638160 [http://www.ncbi.nlm.nih.gov/pubmed/?term=28638160]
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194.

Abstracts 28th Annual ELSO Conference 2017.
Anonymous
ASAIO Journal. Conference: 28th Annual Conference of the Extracorporeal Life Support Organization, ELSO 2017. United States. 63 (5 Supplement 1) (no pagination), 2017. Date of Publication: September 2017.
AN: 624229484
The proceedings contain 96 papers. The topics discussed include: outcome after perioperative veno-venous extracorporeal life support as bridge to lung volume reduction surgery in patients with severe hypercapnia: a single-center prospective study; a 5 year retrospective study of electroencephalography and neurological outcomes children undergoing extracorporeal membrane oxygenation (ECMO) at a quaternary academic hospital setting; high body mass index (BMI) does not predict worsened outcomes in patients on veno-venous extracorporeal membrane oxygenation for acute respiratory distress syndrome (ARDS); longevity of cardiohelp disposable: a case report of 13 weeks on single ECMO circuit with minimal anticoagulation; case report: successful use of pulmonary cryotherapy tracheobronchial thrombus debridement during a pediatric V-V ECMO run; in vitro comparison of two neonatal ECMO circuits using a roller or centrifugal pump with three different in-line hemoconcentrators for maintaining hemodynamic energy delivery to the patient; hematopoietic stem cell transplantation on veno- arterial ECMO in a pediatric patient with aplastic anemia and septic shock; implementation of multidisciplinary ECMO team improves outcomes in high volume adult ECMO program; evaluation of laboratory tests for monitoring hemostasis and heparin therapy during pediatric extracorporeal membrane oxygenation; the use of a CRRT machine to create extracorporeal co2 removal in a pediatric patient; and safety and efficacy of left internal jugular bicaval dual lumen catheter for extracorporeal membrane oxygenation.
Publisher
Lippincott Williams and Wilkins

195.

The Use of a CRRT Machine to Create Extracorporeal CO2 Removal in a Pediatric Patient.
Guillermo H., Danielle R., Tammy E., Jill P., Roberto C., Elizabeth S., Jose O.
ASAIO Journal. Conference: 28th Annual Conference of the Extracorporeal Life Support Organization, ELSO 2017. United States. 63 (5 Supplement 1) (pp 24), 2017. Date of Publication: September 2017.
AN: 624229472
Introduction: Extracorporeal CO2 removal (ECCO2R) in patients with acute lung

injury decreases further lung damage as a result of mechanical ventilation. In addition, ECCO2R reduces the negative impact of elevated intrathoracic pressures on cardiac output and hemodynamics. We are presenting a case of a six-year-old female with end stage cystic fibrosis in whom we performed successful extracorporeal CO2 removal using a Maquet Quadrox-iD pediatric oxygenator in line with a continuous renal replacement therapy (CRRT) machine.
Method(s): We initially performed an in-vitro trial using a Prisma Flex 0800 CRRT circuit and a Maquet Quadrox-iD pediatric oxygenator to establish education, procedure, and policy. In this simulation, we used simulated blood and different size catheters to assess flows and pressures across the CRRT membrane and oxygenator. We established that an 11 or 12 fr. catheter must be used to maintain a blood flow of 150 to 200 ml/min through the oxygenator. Patient selection according to policy includes patients with lung injury who require mechanical ventilation and renal replacement therapy. Policy requires that these patients also did not meet criteria for full ECMO support, dialysis catheters (11 or 12 fr.) could be placed, and had no contraindications for anti-coagulation. One patient met the inclusion criteria. This patient was on very high ventilator settings with significant hemodynamic instability requiring inotropic support and was also in renal failure. An 11.5 fr. dialysis catheter was inserted percutaneously at the bedside into the right imnominate vein. The CRRT return line was connected to the inflow of the Maquet QuadroxiD pediatric oxygenator using a Medtronic ' perfusion adaptor. The outflow of the Maquet Quadrox-iD pediatric oxygenator was then connected to the dialysis catheter using another Medtronic ' perfusion adaptor. A heparin infusion was added to the inlet luer of the oxygenator in order to achieve therapeutic heparin assay levels. Once the CRRT was running, we added sweep gas to the oxygenator up to 6 liters per minute. We tested the amount of CO2 removal through the mechanical ventilator and the gas outlet port of the oxygenator. Using a GE ventilator with the respiratory metabolic cart, the total rate of elimination of CO2 including the rate of elimination of CO2 of the oxygenator were determined. We used a calculation that determined the elimination of CO2 which included the sweep flow and average exhaled CO2 using an end tidal CO2 monitor. The end tidal CO2 monitor was connected to the gas outflow of the oxygenator.
Result(s): Once the system was started, it was determined that the pediatric Quadrox-iD could extract up to 47 mls/min of CO2, which was about 40% of this patient's total CO2 production. The patient was weaned from the ventilator and subsequently extubated on hour 87 of ECCO2R. Inotropic support which included epinephrine and dopamine were decreased progressively at the start of ECCO2R and weaned to off on hour 31. She remained extubated for the remainder of the therapy. The patient's sedation was also reduced allowing her to have appropriate communication with her family. Once ECCO2R was discontinued, the patient went back to intermittent hemodialysis for her renal support. ECCO2R was well tolerated without complications lasting almost 6 days. The patient was eventually discharged from the ICU with improved respiratory status.
Conclusion(s): Extracorporeal CO2 removal in combination with CRRT in pediatric patients is feasible. Adequate blood flow is essential to maintaining proper oxygenator and CRRT function thus reducing the likelihood of complications. The same oxygenator was used throughout ECCO2R support, and the CRRT circuit was changed out once because of institution protocol.
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Publisher
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196.

Statistical analysis plans for internal pilots in randomised controlled trials.
McDowell C., Gardner E., Harrison D., McNamee J., McAuley D.F.
Trials. Conference: 4th International Clinical Trials Methodology Conference , ICTMC and the 38th Annual Meeting of the Society for Clinical Trials. United Kingdom. 18 (Supplement 1) (no pagination), 2017. Date of Publication: 2017.
AN: 620924949
Background It is common practice for clinical effectiveness trials to include an internal pilot but guidance on how they should be analysed is lacking. The REST study is a pragmatic randomised controlled trial to determine whether Veno-Venous Extracorporeal Carbon Dioxide Removal (VV-ECCO2R) in mechanically ventilated patients with hypoxaemic respiratory failure improves 90 day mortality. An internal 6-month pilot study in 10 sites to confirm both recruitment and adherence assumptions that have contributed to study design will precede the main trial. Method A statistical analysis plan (SAP) has been written for the internal pilot for the REST trial which will be signed off separately to the full trial SAP but will form an appendix to it once it's written. It covers the analyses required for the internal pilot to assist with making the decision to progress to the full trial. For the REST internal pilot the following analyses will be completed: The overall recruitment rate will be compared to target recruitment of 7 per month. Analysis of separation in terms of tidal volume (ml/kg predicted bodyweight) between the two arms will be undertaken on an intention to treat and a per protocol basis including the patients in receipt of VV-ECCO2R on day 2 and 3. Completeness of datasets with respect to the primary outcome measure of 90 day mortality will be assessed for patients recruited in the first 3 months. Like a full trial SAP, the SAP for the internal pilot was reviewed by the Data Monitoring and Ethics Committee and the Trial Management Group. Discussion A formal SAP for an internal pilot is not standard clinical trial methodology and there are pros and cons to having one which are open for discussion. In general, the advantages are as for the SAP for the final analysis: to pre-specify the analysis and reporting in order to avoid intentional or unintentional bias caused by multiple unplanned analyses and selective reporting of data. Without a SAP, investigators who are convinced of the usefulness of an intervention may manipulate pilot results to make a convincing case for progression to a full trial ultimately leading to a trial showing no difference and a waste of research funding. On the other hand, one may argue that the risks of multiple analyses and "data dredging" leading to spurious findings are primarily associated with large sample sizes that will not be present in a pilot study. Furthermore, relying too strictly on prespecified criteria for progression to a full trial could result in stopping a trial of a promising treatment in the presence of practical issues with delivery that may be easy to overcome. One specific pro to having a SAP for the internal pilot that is separate from the full SAP is the ability to have the pilot analyses documented without the need to have the full SAP signed off at an early stage of the trial. The SPIRIT guidelines should give consideration to internal pilot studies and the need to document planned analyses and progression criteria.
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197.

A reviewof physiotherapy management and interventions provided to CF patients requiring ECMO or ECCO2 removal.
Funnell L., Arnold J.
Physiotherapy (United Kingdom). Conference: Physiotherapy UK Conference 2017. United Kingdom. 103 (Supplement 1) (pp e28), 2017. Date of Publication: December 2017.
AN: 620235617
Purpose: The use of extracorporeal membrane oxygenation (ECMO) is often used to bridge Cystic Fibrosis (CF) patients to lung transplantation and support with ECMO is not ineffective in this patient population (Hayes et al. 2014). The frequency of physiotherapy contacts with CF patients will vary but should occur daily during each hospitalisation including on intensive care units (ICU) (ECSF 2014).
Objective(s): To analyse data of adult CF admissions to Intensive care from a large CF centre (n = 585 pre transplant patients) and identify common themes and differences between patients receiving ECMO or Extra-corporeal Carbon dioxide Removal (ECCO2r).
Method(s): Retrospective review of all CF adults who were admitted to ICU over a three and half year period (September 2013-January 2017). Full ICU medical records were reviewed data collection was completed on those patients who received ECMO or ECCO2r.
Result(s): 15 patients (n = 7 female), median (IQR) FEV1 31% (28.3-36.8%) predicted at their last clinic appointment andmedian (IQR) age 28 (24-39)were admitted to ICU.Most common reason for admission was respiratory failure (53% n = 8), of which 47% (n = 7) received ECMO or ECCO2r support. Once on extra-corporeal support the median time to target range CO2 was 4 hours (3-5 hours) for VVECMO patients whereas the CO2 for patients on other ECCO2r did not normalise. The median total hours on VV ECMO was 156 hours compared to 56.5 hours on ECCO2r. All patients were seen daily, the median number of physiotherapy contacts being 20 (12-87) with the average contact being twice daily, over median length of stay of 7 days (IRQ 4-7 days) Analysis of which treatments were provided in each physiotherapy session was completed. There was no difference between physiotherapy techniques provided to those on ECCO2r and VV ECMO. 59% (n = 98) contacts were by Band 7 or 8 physiotherapists, with the CF clinical specialist treating the ECMO and ECCO2r patients 5% of these contacts. Of the 7 patients reviewed 5 were not active on the transplant list and died on ICU, with amedian length of stay 7days (4-7), with the remaining 2 patients going on to receive a transplant. Last clearance treatment sessions are comparable with patients who receive end of life care on the ward setting for the same hospital trust. Conclusion(s): Conclusions are limited due to the small sample size however physiotherapy input did not differ between the two different extra-corporeal supports used. Interestingly the CF clinical lead has less documented hands-on input than the surgical team physiotherapy specialist. Implications: This potentially could be an area for future developments with establishing guidelines for clinical care and protocols between the two teams to ensure fluidity of care with this patient group.
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Publisher
Elsevier Ltd

198.

Adjunctive extracorporeal carbon dioxide removal in refractory status asthmaticus.
Jiang C., Caronia J., Rodriguez C., Chandra S.
Chest. Conference: CHEST 2017 Annual Meeting. Canada. 152 (4 Supplement 1) (pp A760), 2017. Date of Publication: October 2017.
AN: 619298469
INTRODUCTION: Intubated patients with status asthmaticus (SA) are at risk for dynamic hyperinflation [1], which may lead to alveolar rupture. When ventilator management is not successful, extracorporeal membrane oxygenation (ECMO) is entertained as a salvage therapy. ECMO is a method of respiratory support in which oxygen is added and carbon dioxide is removed through an extracorporeal membrane. The goal of this therapy is to facilitate ventilation and oxygenation while minimizing risk of ventilator induced lung injury. CASE PRESENTATION: A 25 year old man with a history of severe persistent asthma presented with an acute exacerbation of asthma. He admitted to non-compliance with medications. Initial arterial blood gas (ABG) demonstrated primary respiratory acidosis at pH 6.99/ PaCO2 123/ PaO2 249. The patient was endotracheally intubated to ventilator settings of Tidal Volume 350cc/ respiratory rate 10/ PEEP 5cmH2O/FiO2 50%. He proved extremely difficult to ventilate despite pressure control ventilation, cisatracurium, ketamine and Heliox use. The patient required repeated disconnection from the ventilator to relieve auto-PEEP. Repeat ABG did not improve. Veno-venous ECMO was initiated with the same ventilator settings. His next ABG was pH 7.32/ PaCO2 46/ PaO2 133. He was extubated 36 hours after ECMO initiation. He was discharged from ICU 72 hours after being admitted. DISCUSSION: Although potentially helpful, the literature on the use of ECMO in SA remains sparse and routine use for the asthmatic patient remains controversial. Mikkelsen et al [2] analyzed data from the Extracorporeal Life Support Organization (ELSO) registry and had found a suggestion for survival advantage for ECMO in asthmatics compared to other forms of acute respiratory failure. One multi-center European case series of 16 patients of ECMO use in SA had demonstrated good efficacy in improving gas exchange parameters and leading to successful extubation without neurological sequelae in all study patients. [3]
CONCLUSION(S): Despite the limited evidence base for use of ECMO in status asthmatics, it is our expert opinion that the initiation of ECMO should be considered when severe DHI or respiratory acidosis persists despite optimal conventional management. Our case illustrates the application of these principles in treatment of this patient successfully and without chronic respiratory disability or other sequelae.
Institution
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Publisher
Elsevier Inc.

Link to the Ovid Full Text or citation:
Click here for full text options

199.

Low flow veno-venous extracorporeal carbon dioxide removal (ECCO2R) in a cardiothoracic transplant centre.
Laxton V.P., Rosenberg A., Walker C.
Intensive Care Medicine Experimental. Conference: 30th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2017. Austria. 5 (2 Supplement 1) (no pagination), 2017. Date of Publication: September 2017.
AN: 619043795
INTRODUCTION.Low flow veno-venous extracorporeal carbon dioxide (CO2) removal (ECCO2R) is a safe and effective treatment for hypercapnic respiratory failure that has been successfully used to enable lung protective ventilation in acute respiratory distress syndrome (ARDS)1, to avoid tracheal intubation in exacerbation of chronic obstructive pulmonary disease (COPD)2,3 and as an adjunct therapy in life threatening acute asthma.4 Our centre is a quaternary referral centre specialising in heart and lung transplantation and cardiothoracic surgery with ready access to many different modalities of extra-corporeal and mechanical circulatory support and thus presents a different demographic to previous published case series.5 OBJECTIVES.To evaluate the use of ECCO2R at a quaternary referral centre for cardio-thoracic surgery, heart lung transplant and extra corporeal life support (ECLS).METHODS.Case notes of all patients receiving ECCO2R at this centre between February 2014 and March 2017 were reviewed.Demographic, physiological and outcome data were examined.RESULTS.16 adult patients were commenced on ECCO2R using the Hemolung (ALung Inc, Pittsburgh, PA) for ARDS, pneumonia, and to facilitate weaning from extracorporeal membrane oxygenation systems (ECMO).9 patients (56%) had previous bilateral lung transplants.Median age was 38 years and at commencement of therapy median SOFA score was 17 points.At instigation of ECCO2R median blood gas analysis values were pH 7.17, PaCO2 11.47 kPa and PaO2 16.09 kPa.At 24 hours lung protective ventilation was achieved in 100% of patients.The median pH was 7.36 and median PaCO2 6.23 kPa.The mean time to normal pH, in patients not being weaned from ECMO, was 14.3 hours.Median duration of ECCO2R was 121 hours and this was weaned successfully in eight (50%) patients, withdrawn for futility in six (37.5%), upgraded to ECMO in one (6.25%) and was ceased for device failure due to major air entrainment in one patient (6.25%).No serious adverse outcome resulted from device failure.Median mechanical ventilation time was 16.5 days and intensive care unit (ICU) length of stay (LOS) was 23.5 days.All patients successfully weaned from ECCO2R survived to discharge from ICU.CONCLUSIONS.ECCO2R has proved a useful addition to the armamentarium for management of severe respiratory failure in our centre.The treatment achieved the therapeutic goals of normalising blood pH (with lowered PaCO2) and attaining lung protective ventilation in our population of lung transplant recipients and cardio-thoracic surgical patients.
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Publisher
SpringerOpen

200.

Candica albicans induced failure of extracorporeal membrane oxygenation.

Krause R., Schilcher G., Valentin T., Prettenthaler H., Hackl G., Brcic L., Zollner-Schwetz I., Eller P.
Mycoses. Conference: 8th Congress on Trends in Medical Mycology, TIMM 2017. Serbia. 60 (Supplement 2) (pp 158), 2017. Date of Publication: September 2017.
AN: 618755399
Objective: Lung assistance with extracorporeal membrane oxygenation has become a standard therapy for patients suffering from severe acute respiratory distress syndrome.
Methods and Results: Here we present a case of a 58-year- old man who was admitted to the Intensive Care Unit with community-acquired pneumonia due to Legionella pneumophila. Acute hypoxic respiratory failure necessitated controlled invasive mechanical ventilation and active interventional lung assistance. After 11 days of extracorporeal membrane oxygenation, multiple whitish spots appeared on the extracorporeal membrane oxygenator. The multiple whitish spots on the extracorporeal membrane oxygenator were due to extensive colonization with Candida albicans (Figure A). Blood samples from the inflow and outflow lines of the extracorporeal membrane oxygenator were obtained and 100 muL each plated onto chocolate agar. While no colonies were detected from the inflow line (Figure B), a high load of Candida albicans (Figure C) was found in the outflow line reintroducing oxygenated blood to the patient. Histological section of the extracorporeal membrane oxygenator (Figure C) showed massive accumulation of Periodic-Acid Schiff-positive branching Candida hyphae (arrow) between the crystalline-looking polymethylpentene membrane particles (asterisk) (magnification x20). The patient died on the same day. Post mortem analysis revealed extensive colonization of the extracorporeal membrane oxygenator with Candida albicans that had led to failure of extracorporeal circulation, and ultimately death.
Conclusion(s): Candida albicans colonization of the extracorporeal membrane oxygenator is a rare but severe complication of active extracorporeal lung assistance. It can be fatal and must be immediately recognized and treated with intravenous antifungal drugs and prompt change of the extracorporeal membrane oxygenator.
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Publisher
Blackwell Publishing Ltd

201.

Succesful treatment with Cytosorb in a case of septic shock, ARDS, multiorgan failure and purpura fulminans due to Acinetobacter baumannii pneumonia.
Kogelmann K., Scheller M., Jarczak D., Druner M.
Infection. Conference: 8th International Congress "Sepsis and Multiorgan Dysfunction". Germany. 45 (1 Supplement 1) (pp S48-S49), 2017. Date of Publication: September 2017.
AN: 618210642
Introduction: In several studies and in in-vitro data is demonstrated that treatment with an extracorporal cytokine adsorber (CytoSorb) may be useful in patients with septic multiple organ failure or other critical diseases due to an excess of cytokines. This therapy has meanwhile been used in over 500 hospitals worldwide, more than

23000 applications, is well tolerated and safe. Purpura fulminans is a rare disease with thrombosis and tissue necrosis caused by protein C deficiency. Data on this life threatening disease are rare, treatment guidelines have not been established.
Objective(s): We treated a patient with septic shock, ARDS, multiorgan failure and purpura fulminans due to community acquired Acinetobacter baumannii pneumonia with ECMO, protein C and Cytosorb. The Patient without any chronic diseases beside alcohol abuse (male, 47 years old) has been admitted to our ward from another hospital, ventilated and in septic shock. At admission APACHE II 38, heart rate 133 bpm, MAP 60/Norepinephrine 2.8 mg/h, fever 38.5 degreeC, severe ARDS (paO2/fiO2 95).
Method(s): Initial protocol treatment (lung protective ventilation, volume resuscitation) failed; we treated therefore with ECMO (XLung, Novalung), CVVHD (Fresenius multifiltrate) and as adjunctive therapy with Cytosorb haemadsorption (7 applications). In initial treatment we changed the adsorber every 12 h, from day 3 we changed every 24 h. Adsorber was used with CVVHD (Citrat anticoagulation) in pre-filter position, blood flow 150 ml/min. Protein C 3000 IE was applicated.
Result(s): ECMO could be weaned after 10 days (paO2/fiO2 308), after 7 cycles of Cytosorb therapy we reached shock reversal (Norepinephrine 0.5 mg/h, MAP 85) and catecholamines could be terminated several days later. After application of 3000 IE protein C tissue necrosis stopped immediately and plasma protein c levels normalized (from 26% up to 83%). SOFA decreased from 15 to 10, SAPS 2 from 58 to 43, other laboratory and physiological data are shown in table 1. After 10 days we started weaning from ventilator, patient was awake and vigilant, but ventilation had to be continued because of severe Critical ill PNP and tetraparesis. In the next 4 weeks patient developed stable clinical conditions. Catecholamine demand even as intermittent dialysis could be finished, skin necrosis went better, no surgical intervention was necessary of it. Only ventilation had to be continued because of the persistent tetraparesis caused by CIP. After 57 days of ICU treatment we transferred our patient in good clinical conditions to a rehabilitation Center.
Conclusion(s): We reached complete shock reversal after 7 applications of Cytosorb therapy even as complete restitution of the purpura. Treatment with CytoSorb adsorber in a patient with sepsis acquired purpura fulminans had shown great effect, been safe and without any side effects. (Table Presented).
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202.

Near-fatal asthma: Differential role of ECCO2R and VV-ECMO as rescue therapies.
Mesquita R., Coentrao L., Veiga R., Paiva J.-A., Roncon-Albuquerque R.
Clinical and Translational Allergy. Conference: 3rd International Severe Asthma Forum, ISAF 2016. United Kingdom. 7 (Supplement 2) (no pagination), 2017. Date of Publication: 2017.
AN: 616800215
Introduction: During a near-fatal attack of asthma (NFA) alveolar hypoventilation underlies respiratory acidosis while severe hypoxemia indicates intrapulmonary shunt. Illustrate the differential role of lowflow extracorporeal CO2 removal

(ECCO2R) and high-flow veno-venous extracorporeal membrane oxygenation (VV-ECMO) as rescue therapies in NFA.
Method(s): Patient 1 A 31-year-old male with early-onset asthma and epilepsy was admitted with acute respiratory failure (ARF) complicated by generalized tonic-clonic seizure. He presented severe acute respiratory acidosis without hypoxemia after intubation (pH-7.10 pCO2- 82 mmHg P/F 556). Thoracic CT: diffuse bronchial wall thickness without atelectasis. On Day-5 dynamic hyperinflation (auto- PEEP 10 cmH2O) under deep sedation and neuromuscular blockade persisted, precluding weaning from invasive mechanical ventilation (IMV). ECCO2R was initiated. Extubation, active physical therapy and full patient mobilization were possible on Day-6. ECCO2R discontinuation, ICU and hospital discharges occurred on Day-8, -9 and -11, respectively.
Result(s): Patient 2 A 34-year-old obese female with late-onset and poorly controlled asthma was admitted with ARF with severe hypoxemia (pH-7.45 pCO2-30 mmHg P/F 69). After a trial of non-invasive (Figure presented) ventilation, IMV was initiated. On Day-1, despite medical therapy and IMV optimizations, severe dynamic hyperinflation with refractory hypoxemia persisted and VV-ECMO was initiated. Thoracic CT revealed almost complete bilateral lung collapse. Methicillin-sensitive S. aureus and S. pneumoniae were isolated in endotracheal aspirate. Normal lung function was progressively reestablished following considerable viscid mucus secretions elimination and antibiotherapy. ECMO-VV was discontinued on Day-18. Extubation, ICU and hospital discharges occurred on Day-24, -27 and -55, respectively.
Conclusion(s): How this report contributes to current knowledge. During refractory NFA, low-flow ECCO2R allows correction of severe respiratory acidosis and facilitates extubation while high-flow VV-ECMO is needed when significant atelectasis complicates airway narrowing and severe hypoxemia ensues. Knowledge of respiratory failure pathophysiology in refractory NFA allows the correct use of different ECLS modalities as a bridge to recovery.
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203.

Factors associated with outcome of patient with acute respiratory failure on pumpless extracorporeal interventional lung assist: Pilot study.
Park S.Y., Park S.H., Ko Y., Park Y.B.
European Journal of Heart Failure. Conference: 6th Euro-ELSO Annual Congress. Netherlands. 19 (Supplement 2) (pp 31), 2017. Date of Publication: May 2017.
AN: 616170737
Pumpless interventional lung assist (iLA) have been advocated in patients suffering from severe acute respiratory failure who are at risk for life-threatening hypercapnia. However, there is few evidence about factors with outcome of patient with acute respiratory failure using iLA. We evaluated effect and prognostic factor of the iLA in patients with acute respiratory failure Methods: We evaluated retrospectively our experience with iLA between March 2013 and August 2016. iLA was implemented patients from multiple etiologies with severe hypercapnia (pH<7.1 and PCO2>70

mmHg). Laboratory parameters include arterial blood gas analysis, ventilator parameters, hemodynamic parameter and adverse events were recorded serially. Our primary outcome was ICU mortality.
Result(s): Between March 2013 and August 2016, we enrolled 11 patients with severe respiratory failure, 2 patients had prone pone positioning using iLA and they all survived in ICU. iLA lead to an acute and moderate increase in arterial oxygenation (PaO2/FiO2 ratio 2 hr after initiation of iLA (150+/-25 mmHg) compared with pre iLA(110+/-20.2 mmHg). Hypercapnia was promptly reversed within 2 hr (PaCO2, 35.9+/-12.4 mmHg) in comparison with before (75.9+/-23.4mmHg, p>0.05], which allowed a more protective ventilator strategy. In our study, ICU mortality is 36.4 %, Hospital mortality is 45.5%. SOFA score and lactate clearance were significantly related with ICU mortality.
Conclusion(s): Interventional lung assist might provide a sufficient rescue measure with easy handling properties in patients with severe hypercapnic respiratory failure. Also, prone position during iLA is safe and could be improved outcome.
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John Wiley and Sons Ltd

204.

Lobar double lung transplantation in a patient with cystic fibrosis after extended ECMO-therapy.
Feth M., Wilkens H., Seiler F., Kamp A., Wehrfritz H., Langer F., Bals R., Schafers H.-J., Lepper P.M., Trudzinski F.C.
European Journal of Heart Failure. Conference: 6th Euro-ELSO Annual Congress. Netherlands. 19 (Supplement 2) (pp 27), 2017. Date of Publication: May 2017.
AN: 616170651
:Introduction: The prognosis of cystic fibrosis (CF) patients treated on extracorporeal membrane oxygenation (ECMO) is limited and often depending on timely lung transplantation (LTX). Case Report: We report the case of an 18 year old CF patient (139 cm/38 kg). He had pneumonia complicated by a tension pneumothorax and was hospitalized in an external hospital. After intubation and mechanical ventilation (MV), he progressed to severe ARDS and was put on ECMO. He was already treated on ECMO for 10 days when he was transferred to our center by our mobile ECMO team. After retrieval he was weaned from ECMO and MV and listed for LTX after a structured and critical review of all data. However, during the same hospital stay the patient deteriorated again, MV, extracorporeal carbon dioxide removal (ECCO2R) and finally ECMO with a double-lumen cannula were established. Being 139 cm tall, he required an offer of relatively small lungs. After a prolonged course of extracorporeal support without a donor organ offer, extended organ acceptance criteria without an upper total lung capacity (TLC) limit were set. An allograft with a TLC of 7 liter was accepted for transplantation after a course of 46 days on ECMO in total. According to the size mismatch an anatomic lobar reduction with transplantation of the left upper-and the right upper and middle lobe was performed. The patient could be weaned from ECMO 3 days and from MV 18 days later and was finally discharged home. Three month after LTX, he started to work again.
Conclusion(s): The time frame for LTX in CF patients on extracorporeal support is

short. Lobar transplantation is a lifesaving option for patients who cannot wait for size matched organs.
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205.

Recirculation in venovenous extracorporeal membrane oxygenation.
Badruddin S.
European Journal of Heart Failure. Conference: 6th Euro-ELSO Annual Congress. Netherlands. 19 (Supplement 2) (pp 58), 2017. Date of Publication: May 2017.
AN: 616170615
Venovenous extracorporeal membrane oxygenation (ECMO) has the ability to support gas exchange in respiratory failure. VV ECMO has fewer vascular complications as compared pumpless interventional lung assist and veno-arterial ecmo. The effectiveness of ECMO is dependent on multiple factors such as the amount of blood flow, cardiac output, metabolic demand, sweep gas, diffusion and surface area of oxygenator and the amount of recirculation within the circuit. Other ontributing factors to recirculation include patient movement which may affect cannula position, volume status, high ECMO flow and the distance between the return and drainage cannula has been shown in multiple studies to increase recirculation. Higher recirculation many decrease the efficacy of VV ecmo and may lead to severe hypoxemia and multi-organ failure.
Method(s): A literature review was conducted by using different electronic data bases such asMEDLINE, PubMed, CINAHL, Sage and Science Direct. The following terms were used such as recirculation, respiratory failure, extracorporeal membrane oxygenation (ECMO) as keywords or combined to guide the search.
Result(s): There is no routine method to measure the recirculation fraction. Two method such as use of bicaval double-lumen cannula and correct positioning can reduce significant recirculation. Studies have proposed a step wise approach/algorithm to guide specific intervention to decrease the amount of recirculation in the circuit.
Conclusion(s): The combine echocardiography and ultrasound dilution may help to optimize cannula positioning. Advances in extracorporeal cannulation strategies, particularly the development of the dual-lumen cannula has lessen the amount of recirculation in VV ecmo.
Institution
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Publisher
John Wiley and Sons Ltd

206.

New technologies in extracorporeal CO2 removal.
Rauch S.
Journal of Clinical Monitoring and Computing. Conference: 26th Congress of the European Society for Computing and Technology in Anaesthesia and Intensive Care, ESCTAIC 2016. Romania. 31 (3) (pp 494-495), 2017. Date of Publication: June 2017.
AN: 615733846
Extracorporeal CO2 removal is used not only in patients with ARDSbut also with acute exacerbations of chronic obstructive pulmonary disease (AE-COPD). The aim in the ARDS patient is to avoid hypercapnia and respiratory acidosis in a ventilation strategy consisting of very low tidal volumes. In the AE-COPD patients ECCO2R may avoid intubation or facilitate extubation and potentially improve outcome. In 2009, Terragni et al. (1) presented a ventilation model of low VT (4 ml/kg of PBW) for severe ARDS patients using a modified renal replacement system coupled with a vv-ECCO2R device (DECAP) which allowed safe and efficient management of acidosis resulting from VT reduction. The DECAP/DECAPSMART ECCO2R device is a modified renal replacement circuit, incorporating a neonatal polypropylene membrane lung (0.3 m2), coupled in series with a polysulfone hemofilter (1.35 m2). The blood flow into the membrane is aided by a nonocclusive roller pump (maximum 450 mL/min), whereby CO2 is eliminated by diffusion against a concentration gradient, created by sweep gas flow of 6-8 L min of O2. Kluge et al. 2012 (2) was able to show in his clinical trial that the use of extracorporeal carbon dioxide removal with the iLA-system in patients with AE-COPD allowed avoiding intubation and invasive mechanical ventilation without changes in mortality. In the prospective randomized Xtravent-study published 2013, Bein et al. (3) were using the same system to reduce VT to 3 ml/kg PBW in patients with moderate ARDS. The primary outcome, the 28-and 60-days ventilator-free days, was not different in both groups. The prototype of this pumpless av-ECCO2R device used in both studies is the iLA (Novalung, Xenios). It consists of a single-use, high-molecular-weight heparin-coated, very low resistance and highly efficient poly(4-methyl-1-pentene) membrane (1.3 m2). Blood is drained via the femoral artery and returned via the femoral vein (15-to 21-french catheters). The more advanced iLA-activve platform consists of a centrifugal pump and four different oxygenators that can be used depending on the type of gas exchange disturbance. The blood flow can be regulated between 500 mL and 7 l/min. The currently running pilot and feasibility "SUPERNOVA" study will use three different devices (Hemolung, iLA-activve, HLS SET ADVANCED 5.0) for the low-flow extracorporeal CO2 removal in patients with moderate ARDS to enhance lung protective ventilation. The REST trial is the first multicenter clinical study to determine whether vv-ECCO2R (Hemolung) and lower tidal volume mechanical ventilation improves outcome and is cost-effective. The ultra-low flow pumpdriven ECCO2R device exclusively used in this trial (Hemolung RAS, ALung Technologies) uses a 15.5 French dual lumen catheter inserted in either the femoral or jugular vein, and provides removal of up to 50% of basal CO2 production at flows of 400-500 mL/min. Previous studies have shown that the use of partial ECCO2R facilitates lung protective ventilation, is easily implemented, and found to be safe and effective. Whether it improves outcome remains to be determined.
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Publisher
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207.

Extracorporeal life support for acute respiratory failure in immunocompromised patients: An international multicenter retrospective study (The IDEA study).
Schmidt M., Schellongowski P., Dorget A., Patroniti N., Taccone F.S., Miranda D.R., Reuter J., Prodanovic H., Sonneville R., Pierrot M., Balik M., Park S., Combes A.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2017. France. 7 (1 Supplement 1) (pp 19-20), 2017. Date of Publication: January 2017.
AN: 614625986
Introduction The proportion of immunocompromised patients with extracorporeal life support (ECLS)-treated severe ARDS varies from 5 to 31% in recent cohorts. To date, very few data on ECMO use and its associated outcomes are available on this population. Our aims were to (1) describe the clinical features, (2) compare the outcomes between causative immunocompromised status, (3) identify predictive pre-ECLS factors of 6-month mortality, and (4) report the rate of ECLSrelated complications. Patients and methods We performed an international multicenter retrospective study in 10 ICUs from 2008 to 2014. mmunocompromised status was defined by hematologic malignancies, solid tumor, solid organ transplant, human immunodeficiency virus (HIV), or long term or high dose glucosteroids or immunosuppressant use. Inclusion criteria were immunocompromised patient with acute respiratory failure rescued by extracorporeal membrane oxygenation or (ECMO) or extracorporeal CO2 removal (ECCO2R). Results 1. A total of 225 patients (age 48.6 +/- 15.1 years; APACHE II 26.4 +/- 9.0) were included in the study (30% hematologic malignancies, 28% long-term corticosteroids or immunosuppressant use, 18% solid tumor, 16% solid organ transplant, and 9% HIV). ECLS was initiated for severe ARDS, moderate ARDS, or chronic end-stage respiratory in 190(84%), 14(6%), and 19(8%) patients, respectively. Main ARDS etiologies were bacterial pneumonia (30%), viral pneumonia (18%), and specific lung involvement (12%). Refractory hypoxemia (73%) was the main indication for ECLS with lowest pre-ECLS PaO2/FiO2 at 63 (51-87) mmHg. Venovenous ECMO and ECCO2R were initiated in 199 (88%) and 15(7%) patients, respectively. Pre-ECLS tidal volume was 5.7(4.7-6.4) mL/kg, with a positive end-expiratory pressure at 10(8-13) cmH2O and a plateau pressure at 32(30-35) cmH2O. Interval between mechanical ventilation onset and cannulation was 2(1-8) days. 2. Six-month mortality of patients with hematologic malignancies, long-term corticosteroids or immunosuppressant use, solid tumor, solid organ transplant, and HIV were 76, 60, 80, 51, and 71%, respectively (log-rank test, p = 0.02). Cumulative survival at 6 months were lower for patients with hematologic malignancies versus others (log-rank test, p = 0.003) whereas those with solid organ transplant exhibited higher cumulative survival at 6 months (log-rank test, p = 0.02). 3. One hundred and three patients (46%) were successfully weaned from ECLS. In-ICU and 6-month post ICU discharge survival were 37% (n = 83/225) and 32% (n = 72/225), respectively. Compared to patients who died within 6 months after ICU admission, 6-month survivors were younger (46 vs. 49 years, p = 0.05), had more frequently a newly diagnosed immunocompromised status (39 vs. 17%, p = 0.0003), were more frequently patients with solid organ transplant (24 vs 12%, p = 0.02, had a higher pre-ECMO hemoglobin (9.4 vs 8.8 g/ dL) and platelet counts (160 vs 112 x 103/muL; p = 0.008), and exhibited lower mechanical ventilation-ECMO onset interval (1[0-5] vs 3[1- 9] days, p = 0.002). Age (OR 1.02/year, 95% CI [1.002-1.04], p = 0.035), solid organ transplant (0.38 [0.17-0.85], p = 0.019), newly diagnosed immunocompromised status (0.32 [0.16-0.65], p = 0.002), platelet count >=200,000 x

103/muL (0.33[0.15-0.72], p = 0.005) and delay from mechanical ventilation initiation to ECMO cannulation >7 days (3.23 [1.42-7.34], p = 0.005) were independently associated with 6-month mortality. 4. Eighty-two (36%) patients had at least one ECMO-related major bleeding event (oro-nasal bleeding 10%; hemothorax 7%; cerebral bleeding 7%), which was less frequent with patients alive at 6-months. One hundred and four (46%) and 20 (9%) patients reported ventilator associated pneumonia and cannula infection, respectively, with no impact on 6-month survival. Conclusion Six-month survival of ECLS-treated severe ARDS in immunocompromised patients appears low, especially for patients with hematologic malignancies and solid tumor. However, young age, solid organ transplant, newly diagnosed immunocompromised status and rapid decision to start ECLS seem associated with a better prognosis.
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Publisher
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208.

A retrospective observational case series of low-flow venovenous extracorporeal carbon dioxide removal use in patients with respiratory failure.
Moss C.E., Galtrey E.J., Camporota L., Meadows C., Gillon S., Ioannou N., Barrett N.A.
ASAIO Journal. 62 (4) (pp 458-462), 2016. Date of Publication: 01 Aug 2016.
AN: 610480461
We aimed to describe the use of venovenous extracorporeal carbon dioxide removal (ECCO2 R) in patients with hypercapnic respiratory failure. We performed a retrospective case note review of patients admitted to our tertiary regional intensive care unit and commenced on ECCO2 R from August 2013 to February 2015. Fourteen patients received ECCO2 R. Demographic data, physiologic data (including pH and partial pressure of carbon dioxide in arterial blood [PaCO 2]) when starting ECCO2 R (t = 0), at 4 hourly intervals for the first 24 hours, then at 24 hour intervals until cessation of ECCO2 R, and overall outcome were recorded. Patients are

reported separately depending on whether the indication for ECCO2 R was an exacerbation of chronic obstructive pulmonary disease (COPD; n = 5), or acute respiratory distress syndrome (ARDS) and persisting hypercapnoea (n = 9). Patients were managed with ECCO2 R (Hemolung, ALung Inc, Pittsburgh, PA). Median duration of ECCO2 R was 5 days. Four complications related to ECCO2 R were reported, none resulting in serious adverse outcomes. Ten patients were discharged from intensive care unit (ICU) alive. A statistically significant improvement in pH (p = 0.012) was demonstrated. Our observational series of ECCO2 R shows that this technique can be safely used to achieve therapeutic goals in patients requiring lung protection, and in COPD, in line with current publications in this area.

PMID
27195746 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27195746]
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Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

209.

Pharmacokinetics of anidulafungin during venovenous extracorporeal membrane oxygenation.
Aguilar G., Ferriols R., Carbonell J.A., Ezquer C., Alonso J.M., Villena A., Puig J., Navarro D., Alos M., Belda F.J.
Critical Care. 20 (1) (no pagination), 2016. Article Number: 325. Date of Publication: 17 Oct 2016.
AN: 612846023
PMID
27745549 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27745549]
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210.

Extracorporeal Gas Exchange: The Expanding Role of Extracorporeal Support in Respiratory Failure.
Bhatt N., Osborn E.
Clinics in Chest Medicine. 37 (4) (pp 765-780), 2016. Date of Publication: 01 Dec 2016.
AN: 613297813
The use of extracorporeal support is expanding quickly in adult respiratory failure. Extracorporeal gas exchange is an accepted rescue therapy for severe acute respiratory distress syndrome (ARDS) in select patients. Extracorporeal carbon dioxide removal is also being investigated as a preventative, preemptive, and management platform in patients with respiratory failure other than severe ARDS. The non-ARDS patient population is much larger, so the potential for rapid growth is high. This article hopes to inform decisions about the use of extracorporeal support by increasing understanding concerning the past and present practice of extracorporeal gas exchange.

PMID
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Publisher
W.B. Saunders

211.

Managing Acute Lung Injury.
Schmidt G.A.
Clinics in Chest Medicine. 37 (4) (pp 647-658), 2016. Date of Publication: 01 Dec 2016.
AN: 613254948
The foundation of mechanical ventilation for acute respiratory distress syndrome involves limiting lung overdistention by using small tidal volumes or transpulmonary pressures. Potential for additional lung recruitment with higher positive end-expiratory pressure (PEEP) should be assessed. When stress index indicates tidal recruitment-derecruitment, PEEP is increased to higher values. Alternatively, a high PEEP table is used in all patients. When these conventional approaches are insufficient to sustain acceptable gas exchange, rescue is attempted using extracorporeal therapies, airway pressure-release ventilation, inhaled vasodilators, or high-frequency oscillatory ventilation. An integrated approach takes into account acute respiratory distress syndrome severity, the potential for recruitment with PEEP, and the response to initial ventilator choices.

PMID
27842745 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27842745]
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212.

The feasibility and safety of extracorporeal carbon dioxide removal to avoid intubation in patients with COPD unresponsive to noninvasive ventilation for acute hypercapnic respiratory failure (ECLAIR study): multicentre case-control study.
Braune S., Sieweke A., Brettner F., Staudinger T., Joannidis M., Verbrugge S., Frings D., Nierhaus A., Wegscheider K., Kluge S.
Intensive Care Medicine. 42 (9) (pp 1437-1444), 2016. Date of Publication: 01 Sep 2016.
AN: 611396422
Introduction: The aim of the study was to evaluate the feasibility and safety of avoiding invasive mechanical ventilation (IMV) by using extracorporeal CO2 removal (ECCO2R) in patients with acute exacerbation of chronic obstructive pulmonary disease (COPD) and acute hypercapnic respiratory failure refractory to noninvasive ventilation (NIV).
Method(s): Case-control study. Patients with acute hypercapnic respiratory failure refractory to NIV being treated with a pump-driven veno-venous ECCO2R system (iLA-Activve; Novalung, Heilbronn, Germany) were prospectively observed in five European intensive care units (ICU). Inclusion criteria were respiratory acidosis (pH <= 7.35, PaCO2 > 45 mmHg) with predefined criteria for endotracheal intubation (ClinicalTrials.gov NCT01784367). The historical controls were patients with acute hypercapnic respiratory failure refractory to NIV who were treated with IMV. The matching criteria were main diagnosis, age, SAPS-II score and pH.
Result(s): Twenty-five cases (48.0 % male, mean age 67.3 years) were matched with 25 controls. Intubation was avoided in 14 patients (56.0 %) in the ECCO2R group with a mean extracorporeal blood flow of 1.3 L/min. Seven patients were intubated because of progressive hypoxaemia and four owing to ventilatory failure despite ECCO2R and NIV. Relevant ECCO2R-associated adverse events were observed in 11 patients (44.0 %), of whom 9 (36.0 %) suffered major bleeding complications. The mean time on IMV, ICU stay and hospital stay in the case and control groups were 8.3 vs. 13.7, 28.9 vs. 24.0 and 36.9 vs. 37.0 days, respectively, and the 90-day mortality rates were 28.0 vs. 28.0 %.
Conclusion(s): The use of veno-venous ECCO2R to avoid invasive mechanical ventilation was successful in just over half of the cases. However, relevant ECCO2R-associated complications occurred in over one-third of cases. Despite the shorter period of IMV in the ECCO2R group there were no significant differences in length of stay or in 28- and 90-day mortality rates between the two groups. Larger, randomised studies are warranted for further assessment of the effectiveness of ECCO2R.

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27456703 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27456703]

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213.

Clinical implications of mycobacterium chimaera detection in thermoregulatory devices used for extracorporeal membrane oxygenation (ECMO), Germany, 2015 to 2016.
Trudzinski F.C., Schlotthauer U., Kamp A., Hennemann K., Muellenbach R.M., Reischl U., Gartner B., Wilkens H., Bals R., Herrmann M., Lepper P.M., Becker S.L.
Eurosurveillance. 21 (46) (no pagination), 2016. Date of Publication: 17 Nov 2016.
AN: 613538454
Mycobacterium chimaera, a non-tuberculous mycobacterium, was recently identified as causative agent of deep-seated infections in patients who had previously undergone open-chest cardiac surgery. Outbreak investigations suggested an aerosol-borne pathogen transmission originating from water contained in heater-cooler units (HCUs) used during cardiac surgery. Similar thermoregulatory devices are used for extracorporeal membrane oxygenation (ECMO) and M. chimaera might also be detectable in ECMO treatment settings. We performed a prospective microbiological study investigating the occurrence of M. chimaera in water from ECMO systems and in environmental samples, and a retrospective clinical review of possible ECMO-related mycobacterial infections among patients in a pneumological intensive care unit. We detected M. chimaera in 9 of 18 water samples from 10 different thermoregulatory ECMO devices; no mycobacteria were found in the nine room air samples and other environmental samples. Among 118 ECMO patients, 76 had bronchial specimens analysed for mycobacteria and M. chimaera was found in three individuals without signs of mycobacterial infection at the time of sampling. We conclude that M. chimaera can be detected in water samples from ECMO-associated thermoregulatory devices and might potentially pose patients at risk of infection. Further research is warranted to elucidate the clinical significance of M. chimaera in ECMO treatment settings.

PMID
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214.

The goldilocks principle, carbon dioxide, and acute respiratory distress syndrome: Too much, too little, or just right?.
Curley G.F.
Anesthesiology. 124 (3) (pp 532-534), 2016. Date of Publication: 01 Mar 2016.
AN: 607446251
PMID
26709573 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26709573]
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Publisher
Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

215.

Update in critical care 2015.
Dres M., Mancebo J., Curley G.F.
American Journal of Respiratory and Critical Care Medicine. 194 (1) (pp 19-25), 2016. Date of Publication: 01 Jul 2016.
AN: 612374200
This review documents important progress made in 2015 in the field of critical care. Significant advances in 2015 included further evidence for early implementation of low tidal volume ventilation as well as new insights into the role of open lung biopsy, diaphragmatic dysfunction, and a potential mechanism for ventilator-induced fibroproliferation. New therapies, including a novel low-flow extracorporeal CO2 removal technique and mesenchymal stem cell-derived microparticles, have also

been studied. Several studies examining the role of improved diagnosis and prevention of ventilator-Associated pneumonia also showed relevant results. This review examines articles published in the American Journal of Respiratory and Critical Care Medicine and other major journals that have made significant advances in the field of critical care in 2015.

PMID
27367886 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27367886]
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216.

Bridging to lung transplantation for severe pulmonary hypertension using dual central Novalung lung assist devices.
Mayes J., Niranjan G., Dark J., Clark S.
Interactive Cardiovascular and Thoracic Surgery. 22 (5) (pp 677-678), 2016. Date of Publication: 01 May 2016.
AN: 610249550
This case describes the technique of using dual Novalungs (a pumpless extracorporeal system) to bridge a patient with idiopathic pulmonary hypertension to bilateral lung transplantation. A 41-year old lady with idiopathic pulmonary hypertension (with a possible veno-occlusive element) presented with symptoms of end-stage heart and lung failure. This was refractory to medical management with iloprost, sildenafil and bosentan. The patient was placed on the urgent waiting list for lung transplantation and central pulmonary artery to left atrial Novalung insertion was performed. Local anaesthetic was given before performing peripheral cardiopulmonary bypass due to the high risk of cardiac arrest. Two days later, donor organs became available and the patient was taken for double-lung transplantation. The pulmonary artery cannula was removed leaving a large defect. This was then closed using a bovine pericardial patch. Due to the damaged right superior pulmonary vein from Novalung cannulation, cardioplegia was given to facilitate an open atrial anastomosis. After 13 days in the intensive therapy unit, she was transferred to the ward. There were no further complications and she has been discharged home.

PMID
26819271 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26819271]
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Link to the Ovid Full Text or citation:
Click here for full text options

217.

Intraoperative extracorporeal carbon dioxide removal during apneic oxygenation with an EZ-Blocker in tracheal surgery.
Rispoli M., Nespoli M.R., Mattiacci D.M., Esposito M., Corcione A., Buono S.
A and A Case Reports. 6 (11) (pp 358-361), 2016. Date of Publication: 01 Jun 2016.
AN: 610661980
Tracheal surgery requires continued innovation to manage the anesthetic during an open airway phase. A common approach is apneic oxygenation with continuous oxygen flow, but the lack of effective ventilation causes hypercapnia, with respiratory acidosis. We used extracorporeal carbon dioxide removal for intraoperative decapneization during apneic oxygenation in a 64-year-old woman who was scheduled for tracheal surgery because of tracheal stenosis caused by long-term intubation. Our findings demonstrate that even after 40 minutes of total apnea, using an EZ-blocker for oxygenation and external decapneization, hemodynamic and gas exchange variables never demonstrated any dangerous alterations.

PMID
27075426 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27075426]
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218.

Experts' opinion on management of hemodynamics in ARDS patients: focus on the effects of mechanical ventilation.
Vieillard-Baron A., Matthay M., Teboul J.L., Bein T., Schultz M., Magder S., Marini J.J.
Intensive Care Medicine. 42 (5) (pp 739-749), 2016. Date of Publication: 01 May 2016.
AN: 609594992
Rationale: Acute respiratory distress syndrome (ARDS) is frequently associated with hemodynamic instability which appears as the main factor associated with mortality. Shock is driven by pulmonary hypertension, deleterious effects of mechanical ventilation (MV) on right ventricular (RV) function, and associated-sepsis. Hemodynamic effects of ventilation are due to changes in pleural pressure (Ppl) and changes in transpulmonary pressure (TP). TP affects RV afterload, whereas changes in Ppl affect venous return. Tidal forces and positive end-expiratory pressure (PEEP) increase pulmonary vascular resistance (PVR) in direct proportion to their effects on

mean airway pressure (mPaw). The acutely injured lung has a reduced capacity to accommodate flowing blood and increases of blood flow accentuate fluid filtration. The dynamics of vascular pressure may contribute to ventilator-induced injury (VILI). In order to optimize perfusion, improve gas exchange, and minimize VILI risk, monitoring hemodynamics is important.
Result(s): During passive ventilation pulse pressure variations are a predictor of fluid responsiveness when conditions to ensure its validity are observed, but may also reflect afterload effects of MV. Central venous pressure can be helpful to monitor the response of RV function to treatment. Echocardiography is suitable to visualize the RV and to detect acute cor pulmonale (ACP), which occurs in 20-25 % of cases. Inserting a pulmonary artery catheter may be useful to measure/calculate pulmonary artery pressure, pulmonary and systemic vascular resistance, and cardiac output. These last two indexes may be misleading, however, in cases of West zones 2 or 1 and tricuspid regurgitation associated with RV dilatation. Transpulmonary thermodilution may be useful to evaluate extravascular lung water and the pulmonary vascular permeability index. To ensure adequate intravascular volume is the first goal of hemodynamic support in patients with shock. The benefit and risk balance of fluid expansion has to be carefully evaluated since it may improve systemic perfusion but also may decrease ventilator-free days, increase pulmonary edema, and promote RV failure. ACP can be prevented or treated by applying RV protective MV (low driving pressure, limited hypercapnia, PEEP adapted to lung recruitability) and by prone positioning. In cases of shock that do not respond to intravascular fluid administration, norepinephrine infusion and vasodilators inhalation may improve RV function. Extracorporeal membrane oxygenation (ECMO) has the potential to be the cause of, as well as a remedy for, hemodynamic problems. Continuous thermodilution-based and pulse contour analysis-based cardiac output monitoring are not recommended in patients treated with ECMO, since the results are frequently inaccurate. Extracorporeal CO2 removal, which could have the capability to reduce hypercapnia/acidosis-induced ACP, cannot currently be recommended because of the lack of sufficient data.

PMID
27038480 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27038480]
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Publisher
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219.

Novel Extracorporeal Therapies for Combined Renal-Pulmonary Dysfunction.
Romagnoli S., Ricci Z., Ronco C.
Seminars in Nephrology. 36 (1) (pp 71-77), 2016. Date of Publication: 01 Jan 2016.
AN: 609097214
In modern intensive care medicine, lungs and kidneys frequently are involved in the context of multiorgan failure. When organ dysfunction occurs, the primary clinical management of critically ill patients is based on support/replacement of organ function until recovery. Mechanical ventilation is the first-line intervention in case of respiratory failure, but in most severe cases may, itself, cause ventilator-induced lung injury. The same inflammatory mechanism also may harm the kidney through mediator spillover from the injured lungs into the bloodstream. To limit the deleterious effects of mechanical ventilation and avoid excessive carbon dioxide accumulation, devices for extracorporeal CO2 removal (ECCO2R), have been developed. Some consistent clinical experience currently has been reached in patients with obstructive pulmonary disease and acute respiratory distress syndrome. Interestingly, ECCO2R recently has been coupled with continuous renal replacement therapy systems into specific lung-renal support. The results from the first experimental and clinical applications are encouraging: it is expected that a system including continuous renal replacement therapy and ECCO2R will develop from the current pioneering attempts into a feasible multiple-organ support platform to become commonly used as a routine tool in intensive care units. This review focuses on recent literature and clinical applications of renal-pulmonary support with specific attention to technical aspects of the most recent materials and devices.

PMID
27085737 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27085737]
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W.B. Saunders

220.

Partial extracorporeal lung support in acute respiratory distress syndrome: preliminary experience in a second level hospital.
Consales G., Zamidei L., Michelagnoli G.
Intensive Care Medicine. 42 (5) (pp 944-945), 2016. Date of Publication: 01 May 2016.
AN: 608268269
PMID
26862019 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26862019]
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221.

Adult venovenous extracorporeal membrane oxygenation for severe respiratory failure: Current status and future perspectives.
Sen A., Callisen H.E., Alwardt C.M., Larson J.S., Lowell A.A., Libricz S.L., Tarwade P., Patel B.M., Ramakrishna H.
Annals of Cardiac Anaesthesia. 19 (1) (pp 97-111), 2016. Date of Publication: January-March 2016.
AN: 607816707
Extracorporeal membrane oxygenation (ECMO) for severe acute respiratory failure was proposed more than 40 years ago. Despite the publication of the ARDSNet study and adoption of lung protective ventilation, the mortality for acute respiratory failure due to acute respiratory distress syndrome has continued to remain high. This technology has evolved over the past couple of decades and has been noted to be safe and successful, especially during the worldwide H1N1 influenza pandemic with good survival rates. The primary indications for ECMO in acute respiratory failure include severe refractory hypoxemic and hypercarbic respiratory failure in spite of maximum lung protective ventilatory support. Various triage criteria have been described and published. Contraindications exist when application of ECMO may be futile or technically impossible. Knowledge and appreciation of the circuit, cannulae, and the physiology of gas exchange with ECMO are necessary to ensure lung rest, efficiency of oxygenation, and ventilation as well as troubleshooting problems. Anticoagulation is a major concern with ECMO, and the evidence is evolving with respect to diagnostic testing and use of anticoagulants. Clinical management of the patient includes comprehensive critical care addressing sedation and neurologic issues, ensuring lung recruitment, diuresis, early enteral nutrition, treatment and surveillance of infections, and multisystem organ support. Newer technology that delinks oxygenation and ventilation by extracorporeal carbon dioxide removal may lead to ultra-lung protective ventilation, avoidance of endotracheal intubation in some situations, and ambulatory therapies as a bridge to lung transplantation. Risks, complications, and long-term outcomes and resources need to be considered and weighed in before widespread application. Ethical challenges are a reality and a multidisciplinary approach that should be adopted for every case in consideration.

PMID
26750681 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26750681]
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Medknow Publications (B9, Kanara Business Centre, off Link Road, Ghatkopar (E), Mumbai 400 075, India)

222.

Effects of extracorporeal carbon dioxide removal on work of breathing in patients with chronic obstructive pulmonary disease.
Diehl J.-L., Piquilloud L., Richard J.-C.M., Mancebo J., Mercat A.
Intensive Care Medicine. 42 (5) (pp 951-952), 2016. Date of Publication: 01 May 2016.
AN: 608354203
PMID
26873832 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26873832]
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Springer Verlag (E-mail: service@springer.de)

223.

The clinical management of patients on partial/total extracorporeal support.
Abrams D., Brodie D.
Current Opinion in Critical Care. 22 (1) (pp 73-79), 2016. Date of Publication: 2016.
AN: 607209220
Purpose of review Despite advances in extracorporeal membrane oxygenation (ECMO) technology, much is unknown about the optimal management strategies for patients receiving extracorporeal support. There is a growing body of literature

investigating patient selection and outcomes, mechanical ventilation approaches, anticoagulation, pharmacokinetics, early mobilization, and the role of ECMO transport among others. Recent findings Nonrandomized data suggest a survival advantage from ECMO compared with conventional management in acute respiratory distress syndrome, with mechanical ventilation practices varying widely across centers. A randomized controlled trial is currently ongoing with standardized ventilation approaches in both arms. Low-level anticoagulation appears to be well tolerated, and ECMO circuitry appears to affect the pharmacokinetics of certain drugs. Pilot and matched cohort studies suggest that extracorporeal carbon dioxide removal is effective in preventing intubation in chronic obstructive pulmonary disease, with larger randomized studies being planned. ECMO may be successful in bridging selected patients to lung transplantation, with early mobilization serving as a well tolerated and effective means of optimizing these patients. Regionalization of ECMO may maximize outcomes and is facilitated by the development of ECMO transport teams. Summary Recently published data highlight the evolving management strategies of patients receiving extracorporeal support and help identify those patients most appropriate for ECMO and extracorporeal carbon dioxide removal. More data will ultimately be needed to develop an evidence-based consensus.

PMID
26645552 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26645552]
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224.

Management of acute hypercapnic respiratory failure.
Pisani L., Corcione N., Nava S.
Current Opinion in Critical Care. 22 (1) (pp 45-52), 2016. Date of Publication: 2016.
AN: 607151564
Purpose of review The objective of this article is to review the most recent literature regarding the management of acute hypercapnic respiratory failure (AHRF). Recent findings In the field of AHRF management, noninvasive ventilation (NIV) has become the standard method of providing primary mechanical ventilator support. Recently, extracorporeal carbon dioxide removal (ECCO2R) devices have been proposed as new therapeutic option. Summary NIV is an effective strategy in specific settings and in selected population with AHRF. To date, evidence on ECCO2R is based only on case reports and case-control trials. Although the preliminary results using ECCO2R to decrease the rate of NIV failure and to wean hypercapnic patients from invasive ventilation are remarkable; further randomized studies are needed to assess the effects of this technique on both short-term and long-term clinical outcomes.

PMID
26627537 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26627537]
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225.

Adverse effects of extracorporeal carbon dioxide removal (ECCO2R) for acute respiratory failure: A systematic review protocol.
Liu Z., Duarte R.V., Bayliss S., Bramley G., Cummins C.
Systematic Reviews. 5 (1) (no pagination), 2016. Article Number: 98. Date of Publication: 07 Jun 2016.
AN: 610619965
Background: The extracorporeal membrane carbon dioxide removal (ECCO2R) system is primarily designed for the purpose of removing CO2 from the body for patients with potentially reversible severe acute hypercapnic respiratory failure or being considered for lung transplantation. Systematic reviews have focused on the effectiveness of ECCO2R. To the author's best knowledge, this is the first systematic review to focus on the adverse effects of this procedure.
Method(s): We will conduct a systematic review of procedure-related adverse effects of ECCO2R systems. A high sensitivity search strategy will be employed in Cochrane Library, MEDLINE, EMBASE, Web of Science and product regulatory databases and ongoing trial registers to identify citations. Reference lists of relevant studies and grey literature will also be searched. Screening of the results will be performed by two reviewers independently using pre-defined inclusion and exclusion criteria. Clinical trials and observational studies will be included. Data will be extracted using a purposefully developed extraction form. Appropriateness for statistical pooling of the results will be determined and carried out if heterogeneity is low to moderate. The GRADE framework will be employed to grade the overall quality of the evidence.
Discussion(s): In the UK, the current access to the use of ECCO2R is possible only with special arrangements for clinical governance, consent and for audit or research. Current evidence on ECCO2R suggests that there are a number of well-recognised complications which vary greatly across studies. This systematic review will consolidate the existing knowledge on adverse effects resulting from the use of ECCO2R. Systematic review registration: PROSPERO CRD42015023503.

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226.

Extracorporeal CO2 removal devices: Basics, indications, and actual results. Les dispositifs d'epuration extracorporelle du CO2 en reanimation : principes, indications potentielles, resultats actuels <Les dispositifs d'epuration extracorporelle du CO2 en reanimation : principes, indications potentielles, resultats actuels.>
Diehl J.-L., Aissaoui N., Hauw-Berlemont C., Boissier F., Monnier A., Novara A., Fagon J.-Y., Guerot E.
Reanimation. 25 (1) (pp 21-25), 2016. Date of Publication: 01 Jan 2016.
AN: 610266521
Extracorporeal CO2 removal (ECCO2R) primarily ensures CO2 removal, without significant effect on oxygenation. This is possible with low or moderate extracorporeal blood flows unlike ECMO devices. It is important to consider for each ECCO2R device not only the performance in terms of CO2 elimination but also the cost and safety, including the incidence of hemorrhagic and thrombotic complications. The most convincing clinical experience has been reported in the context of ARDS and severe acute exacerbations of COPD, particularly in patients at high risk of non invasive ventilation failure. Preliminary reported clinical benefits prompt to achieve in the short term randomized controlled trials in these two major indications.

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Publisher
Springer-Verlag France (22, Rue de Palestro, Paris 75002, France. E-mail: york@springer-paris.fr)

227.

Vascular access for extracorporeal life support: Tips and tricks.
Reeb J., Olland A., Renaud S., Lejay A., Santelmo N., Massard G., Falcoz P.-E.
Journal of Thoracic Disease. 8 (Supplement4) (pp S353-S363), 2016. Date of Publication: 01 Apr 2016.
AN: 610231905
In thoracic surgery, extracorporeal life support (ECLS) techniques are performed to (I) provide a short to mid term extracorporeal mechanical support; (II) realize the gas exchanges; and (III)-depending the configuration of the circuit-substitute the failed heart function. The objective of this review is to describe the rational of the different ECLS techniques used in thoracic surgery and lung transplantation (LTx) with a specific attention to the vascular access. Venovenous extracorporeal membrane oxygenation (VV ECMO) is the most common ECLS technique used in thoracic surgery and represents the best strategy to support the lung function. VV ECMO needs peripheral vascular access. The selection between his double-site or single-site configuration should be decided according the level of O2 requirements, the nosological context, and the interest to perform an ECLS ambulatory strategy. Venoarterial (VA) ECMO uses peripheral and/or central cannulation sites. Central VA

ECMO is mainly used in LTx instead a conventional cardiopulmonary bypass (CPB) to decrease the risk of hemorrhagic issues and the rate of primary graft dysfunction (PGD). Peripheral VA ECMO is traditionally realized in a femoro-femoral configuration. Femoro-femoral VA ECMO allows a cardiocirculatory support but does not provide an appropriate oxygenation of the brain and the heart. The isolated hypercapnic failure is currently supported by extracorporeal CO2 removal (ECCO2R) devices inserted in jugular or subclavian veins. The interest of the Novalung (Novalung GmbH, Hechingen, Germany) persists due to his central configuration indicated to bridge to LTx patients suffering from pulmonary hypertension. The increasing panel of ECLS technologies available in thoracic surgery is the results of a century of clinical practices, engineering progress, and improvements of physiological knowledges. The selection of the ECLS technique-and therefore the vascular access to implant the device-for a given nosological context trends to be defined according an evidence-based medicine.

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Publisher
Pioneer Bioscience Publishing (E-mail: jtd@thepbpc.org)

228.

Association between hyperglycaemia with neurological outcomes following severe head trauma.
Khajavikhan J., Vasigh A., Kokhazade T., Khani A.
Journal of Clinical and Diagnostic Research. 10 (4) (pp PC11-PC13), 2016. Date of Publication: 01 Apr 2016.
AN: 609925271
Introduction: Head Trauma (HT) is a major cause of death, disability and important public health problem. HT is also the main cause of hyperglycaemia that can increase mortality.
Aim(s): The aim of this study was to assess the correlation between hyperglycaemia with neurological outcomes following severe Traumatic Brain Injury (TBI).
Material(s) and Method(s): This is a descriptive and correlation study that was carried out at the Imam Khomeini Hospital affiliated with Ilam University of Medical Sciences, Ilam, IR, during March 2014-March 2015 on patients with severe TBI. Data were collected from the patient records on mortality, Intensive Care Unit (ICU) length of stay, hospital length of stay, admission GCS score, Injury Severity Score (ISS), mechanical ventilation, Ventilation Associated Pneumonia (VAP) and Acute Respiratory Distress Syndrome (ARDS). Random Blood Sugar (RBS) level on admission was recorded. Patients with diabetes mellitus (to minimize the overlap between acute stress hyperglycaemia and diabetic hyperglycaemia) were excluded.
Result(s): About 34(40%) of patients were admitted with hyperglycaemia (RBS >= 200 mg/dl) over the study period. The mortality rate, length of ICU stay, hospital stay, ISS and VAP and ARDS in patients with RBS levels >= 200 mg was significantly higher than patients with RBS levels below <= 200mg ($p<0.05$, $p<0.001$). A significant correlation was found between RBS with GCS arrival, length of ICU stay,

length of hospital stay,ISS, mechanical ventilation and VAP and ARDS (p<0.05, p< 0.001). RBS is a predicate factor for ISS (p <0.05, OR: 1.36), GCS (p <0.001, OR: 1.69), mechanical ventilation (p< 0.05, OR: 1.27), VAP and ARDS (p <0.001, OR: 1.68), length of ICU stay (p <0.001, OR: 1.87) and length of hospital stay (p <0.05, OR: 1.24).
Conclusion(s): Hyperglycaemia after severe TBI (RBS >= 200) is associated with poor outcome. It can be a predictive factor for mortality rate, ICU stay, GCS arrival, VAP and RDS, hospital stay and ISS. Management of hyperglycaemia with insulin protocol in cases with value >200mg/dl, is critical in improving the outcome of patients with TBI.

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Journal of Clinical and Diagnostic Research (No 3, 1/9 Roop Nagar, G T Road, Delhi 110007, India)

229.

Hypercapnic respiratory failure: Pathophysiology, indications for mechanical ventilation and management. Hyperkapnisches Atemversagen: Pathophysiologie, Beatmungsindikationen und -durchfuhrung <Hyperkapnisches Atemversagen: Pathophysiologie, Beatmungsindikationen und -durchfuhrung.>
Kreppein U., Litterst P., Westhoff M.
Medizinische Klinik - Intensivmedizin und Notfallmedizin. 111 (3) (pp 196-201), 2016.
Date of Publication: 01 Apr 2016.
AN: 608644783
Background: Acute hypercapnic respiratory failure is mostly seen in patients with chronic obstructive pulmonary disease (COPD) and obesity hypoventilation syndrome (OHS). Depending on the underlying cause it may be associated with hypoxemic respiratory failure and places high demands on mechanical ventilation.
Objective(s): Presentation of the current knowledge on indications and management of mechanical ventilation in patients with hypercapnic respiratory failure.
Material(s) and Method(s): Review of the literature.
Result(s): Important by the selection of mechanical ventilation procedures is recognition of the predominant pathophysiological component. In hypercapnic respiratory failure with a pH < 7.35 non-invasive ventilation (NIV) is primarily indicated unless there are contraindications. In patients with severe respiratory acidosis NIV requires a skilled and experienced team and close monitoring in order to perceive a failure of NIV. In acute exacerbation of COPD ventilator settings need a long expiration and short inspiration time to avoid further hyperinflation and an increase in intrinsic positive end-expiratory pressure (PEEP). Ventilation must be adapted to the pathophysiological situation in patients with OHS or overlap syndrome. If severe respiratory acidosis and hypercapnia cannot be managed by mechanical ventilation therapy alone extracorporeal venous CO2 removal may be necessary. Reports on this approach in awake patients are available.
Conclusion(s): The use of NIV is the predominant treatment in patients with hypercapnic respiratory failure but close monitoring is necessary in order not to miss

the indications for intubation and invasive ventilation. Methods of extracorporeal CO2 removal especially in awake patients need further evaluation.

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Publisher
Springer-Verlag (Germany)

230.

Applying a low-flow CO2 removal device in severe acute hypercapnic respiratory failure.
Sharma A.S., Weerwind P.W., Strauch U., Van Belle A., Maessen J.G., Wouters E.F.M.
Perfusion (United Kingdom). 31 (2) (pp 149-155), 2016. Date of Publication: 01 Mar 2016.
AN: 608593215
A novel and portable extracorporeal CO2-removal device was evaluated to provide additional gas transfer, auxiliary to standard therapy in severe acute hypercapnic respiratory failure. A dual-lumen catheter was inserted percutaneously in five subjects (mean age 55+/-0.4 years) and, subsequently, connected to the CO2-removal device. The median duration on support was 45 hours (interquartile range 26-156), with a blood flow rate of approximately 500 mL/min. The mean PaCO2 decreased from 95.8+/-21.9 mmHg to 63.9+/-19.6 mmHg with the pH improving from 7.11+/-0.1 to 7.26+/-0.1 in the initial 4 hours of support. Three subjects were directly weaned from the CO2-removal device and mechanical ventilation, one subject was converted to ECMO and one subject died following withdrawal of support. No systemic bleeding or device complications were observed. Low-flow CO2 removal adjuvant to standard therapy was effective in steadily removing CO2, limiting the progression of acidosis in subjects with severe acute hypercapnic respiratory failure.

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231.

Feasibility and safety of low-flow extracorporeal carbon dioxide removal to facilitate ultra-protective ventilation in patients with moderate acute respiratory distress sindrome.

Fanelli V., Ranieri M.V., Mancebo J., Moerer O., Quintel M., Morley S., Moran I., Parrilla F., Costamagna A., Gaudiosi M., Combes A.

Critical Care. 20 (1) (no pagination), 2016. Article Number: 36. Date of Publication: February 10, 2016.
AN: 608161249

Background: Mechanical ventilation with a tidal volume (VT) of 6 mL/kg/predicted body weight (PBW), to maintain plateau pressure (Pplat) lower than 30 cmH2O, does not completely avoid the risk of ventilator induced lung injury (VILI). The aim of this study was to evaluate safety and feasibility of a ventilation strategy consisting of very low VT combined with extracorporeal carbon dioxide removal (ECCO2R).
Method(s): In fifteen patients with moderate ARDS, VT was reduced from baseline to 4 mL/kg PBW while PEEP was increased to target a plateau pressure - (Pplat) between 23 and 25 cmH2O. Low-flow ECCO2R was initiated when respiratory acidosis developed (pH < 7.25, PaCO2 > 60 mmHg). Ventilation parameters (VT, respiratory rate, PEEP), respiratory compliance (CRS), driving pressure (DeltaP = VT/CRS), arterial blood gases, and ECCO2R system operational characteristics were collected during the period of ultra-protective ventilation. Patients were weaned from ECCO2R when PaO2/FiO2 was higher than 200 and could tolerate conventional ventilation settings. Complications, mortality at day 28, need for prone positioning and extracorporeal membrane oxygenation, and data on weaning from both MV and ECCO2R were also collected.
Result(s): During the 2 h run in phase, VT reduction from baseline (6.2 mL/kg PBW) to approximately 4 mL/kg PBW caused respiratory acidosis (pH < 7.25) in all fifteen patients. At steady state, ECCO2R with an average blood flow of 435 mL/min and sweep gas flow of 10 L/min was effective at correcting pH and PaCO2 to within 10 % of baseline values. PEEP values tended to increase at VT of 4 mL/kg from 12.2 to 14.5 cmH2O, but this change was not statistically significant. Driving pressure was significantly reduced during the first two days compared to baseline (from 13.9 to 11.6 cmH2O; p < 0.05) and there were no significant differences in the values of respiratory system compliance. Rescue therapies for life threatening hypoxemia such as prone position and ECMO were necessary in four and two patients, respectively. Only two study-related adverse events were observed (intravascular hemolysis and femoral catheter kinking).
Conclusion(s): The low-flow ECCO2R system safely facilitates a low volume, low pressure ultra-protective mechanical ventilation strategy in patients with moderate ARDS.

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232.

Extracorporeal support for pulmonary resection: Current indications and results.
Rosskopfova P., Perentes J.Y., Ris H.-B., Gronchi F., Krueger T., Gonzalez M.
World Journal of Surgical Oncology. 14 (1) (no pagination), 2016. Article Number: 25. Date of Publication: February 02, 2016.
AN: 608056900
Extracorporeal assistances are exponentially used for patients, with acute severe but reversible heart or lung failure, to provide more prolonged support to bridge patients to heart and/or lung transplantation. However, experience of use of extracorporeal assistance for pulmonary resection is limited outside lung transplantation. Airways management with standard mechanical ventilation system may be challenging particularly in case of anatomical reasons (single lung), presence of respiratory failure (ARDS), or complex tracheo-bronchial resection and reconstruction. Based on the growing experience during lung transplantation, more and more surgeons are now using such devices to achieve good oxygenation and hemodynamic support during such challenging cases. We review the different extracorporeal device and attempt to clarify the current practice and indications of extracorporeal support during pulmonary resection.

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233.

Extracorporeal CO2 removal: Technical and physiological fundaments and principal indications. Eliminacion extracorporea de CO2: Fundamentos fisiologicos y tecnicos y principales indicaciones <Eliminacion extracorporea de CO2: Fundamentos fisiologicos y tecnicos y principales indicaciones.>
Romay E., Ferrer R.
Medicina Intensiva. 40 (1) (pp 33-38), 2016. Date of Publication: 01 Jan 2016.
AN: 607142512
In recent years, technological improvements have reduced the complexity of extracorporeal membrane oxygenation devices. This have enabled the development of specific devices for the extracorporeal removal of CO2. These devices have a simpler configuration than extracorporeal membrane oxygenation devices and uses lower blood flows which could reduce the potential complications. Experimental studies have demonstrated the feasibility, efficacy and safety of extracorporeal removal of CO2 and some of its effects in humans.This technique was initially conceived as an adjunct therapy in patients with severe acute respiratory distress

syndrome, as a tool to optimize protective ventilation. More recently, the use of this technique has allowed the emergence of a relatively new concept called "tra-protective ventilation"whose effects are still to be determined. In addition, the extracorporeal removal of CO2 has been used in patients with exacerbated hypercapnic respiratory failure with promising results.In this review we will describe the physiological and technical fundamentals of this therapy and its variants as well as an overview of the available clinical evidence, focused on its current potential.

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234.

Ultra-protective ventilation and hypoxemia.
Gattinoni L.
Critical Care. 20 (1) (no pagination), 2016. Article Number: 130. Date of Publication: 2016.
AN: 613982388
Partial extracorporeal CO2 removal allows a decreasing tidal volume without respiratory acidosis in patients with acute respiratory distress syndrome. This, however, may be associated with worsening hypoxemia, due to several mechanisms, such as gravitational and reabsorption atelectasis, due to a decrease in mean airway pressure and a critically low ventilation-perfusion ratio, respectively. In addition, an imbalance between alveolar and artificial lung partial pressures of nitrogen may accelerate the process. Finally, the decrease in the respiratory quotient, leading to unrecognized alveolar hypoxia and monotonous low plateau pressures preventing critical opening, may contribute to hypoxemia.

PMID
27170273 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27170273]
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Publisher
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235.

Extracorporeal CO2 removal as life support system for a severe organizing pneumonia. Epuration extracorporelle du CO2 pour suppleance d'une pneumonie

organisee severe <Epuration extracorporelle du CO2 pour suppleance d'une pneumonie organisee severe.>
Rival G., Millet O., Capellier G.
Revue de Pneumologie Clinique. 72 (6) (pp 373-376), 2016. Date of Publication: 01 Dec 2016.
AN: 613439855
Introduction Acute lung injuries are usually found in intensive care unit. The diffuse alveolar damage (DAD) is the associated histological pattern and the most severe end-stage of the disease. Organizing pneumonia (OP), for which corticosteroids are the reference therapy, can mimic DAD. While postponing the response to treatment, to limit mechanical ventilation side effects, extracorporeal membrane oxygene can be proposed. We present a case of a severe OP for which extracorporeal CO2 removal (ECCO2R) is used as a bridge to recovery under corticosteroid therapy. Case report In the context of a flu-like syndrome, the non-recovery of a lung impairment is reported to a severe OP. ECCO2R is applied when using an ultraprotective ventilation and while waiting for lung healing under corticosteroid. This strategy allowed successful recovery, early physical therapy and active mobilization. Conclusion This observation presents the diagnostic and therapeutic difficulties of the lung parenchymental disease in intensive care. OP must be recognized. ECCO2R can be used in severe OP as a bridge to recovery while waiting for the corticosteroid efficacy.

PMID
27836209 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27836209]
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Publisher
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236.

Effect of extracorporeal CO2 removal on right ventricular and hemodynamic parameters in a patient with acute respiratory distress syndrome.
Cherpanath T.G.V., Landburg P.P., Lagrand W.K., Schultz M.J., Juffermans N.P.
Perfusion (United Kingdom). 31 (6) (pp 525-529), 2016. Date of Publication: 01 Sep 2016.
AN: 612001812
We present a female patient with severe acute respiratory distress syndrome (ARDS) necessitating intubation and mechanical ventilation on the intensive care unit (ICU). High ventilatory pressures were needed because of hypoxia and severe hypercapnia with respiratory acidosis, resulting in right ventricular dysfunction with impaired haemodynamic stability. A veno-venous extracorporeal CO2 removal (ECCO2R) circuit was initiated, effectively eliminating carbon dioxide while improving oxygenation and enabling a reduction in applied ventilatory pressures. We noted a

marked improvement of right ventricular function with restoration of haemodynamic stability. Within one week, the patient was weaned from both ECCO2R and mechanical ventilation. Besides providing adequate gas exchange, extracorporeal assist devices may be helpful in ameliorating right ventricular dysfunction during ARDS.

PMID
26643882 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26643882]
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Publisher
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237.

Extracorporeal lung support in hypercapnic respiratory failure. Extrakorporale Lungenunterstutzung beim hyperkapnischen Lungenversagen <Extrakorporale Lungenunterstutzung beim hyperkapnischen Lungenversagen.>
Lebiedz P., Kluge S., Braune S.
Pneumologe. 13 (6) (pp 406-412), 2016. Date of Publication: 01 Nov 2016.
AN: 612097801
In recent years the use of extracorporeal lung assist devices has rapidly increased in intensive care medicine. While venovenous extracorporeal membrane oxygenation (vv-ECMO) is applied as rescue therapy in patients with severe hypoxemic respiratory failure, extracorporeal CO2 removal (ECCO2R) can be applied in patients with hypercapnic respiratory failure. Especially in patients with acute on chronic hypercapnic respiratory failure treated with invasive mechanical ventilation, ventilator-associated side effects can lead to a poorer outcome. In these patients extracorporeal lung assist often enables lung protective ventilation and potentially ameliorates ventilator-associated side-effects. Moreover, by reducing the load on the respiratory muscle pump ECCO2R may facilitate weaning from the ventilator and in individual patients with failure of non-invasive ventilation (NIV) may even help to avoid intubation. In selected patients with chronic lung disease listed for lung transplantation, the avoidance of invasive mechanical ventilation for acute decompensation by means of extracorporeal lung support may help to maintain the option for transplantation. The potential advantages of ECCO2R must be weighed against the risks and complications.

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Publisher

238.

Early experience of a new extracorporeal carbon dioxide removal device for acute hypercapnic respiratory failure.
Tiruvoipati R., Buscher H., Winearls J., Breeding J., Ghosh D., Chaterjee S., Braun G., Paul E., Fraser J.F., Botha J.
Critical care and resuscitation : journal of the Australasian Academy of Critical Care Medicine. 18 (4) (pp 261-269), 2016. Date of Publication: 01 Dec 2016.
AN: 617669697
BACKGROUND: Recent advances in the technology of extracorporeal respiratory assist systems have led to a renewed interest in extracorporeal carbon dioxide removal (ECCOR). The Hemolung is a new, low-flow, venovenous, minimally invasive, partial ECCOR device that has recently been introduced to clinical practice to aid in avoiding invasive ventilation or to facilitate lung-protective ventilation.
OBJECTIVE: We report our early experience on use, efficacy and safety of the Hemolung in three Australian intensive care units.
METHODS: Retrospective review of all patients with acute or acute-on-chronic respiratory failure (due to chronic obstructive pulmonary disease [COPD] with severe hypercapnic respiratory failure when non-invasive ventilation failed; acute respiratory distress syndrome; COPD; or asthma when lung-protective ventilation was not feasible due to hypercapnia) for whom the Hemolung was used.
RESULTS: Fifteen patients were treated with ECCOR. In four out of five patients, the aim of avoiding intubation was achieved. In the remaining 10 patients, the strategy of instituting lung-protective ventilation was successful. The median duration for ECCOR was 5 days (interquartile range, 3-7 days). The pH and PCO2 improved significantly within 6 hours of instituting ECCOR, in conjunction with a significant reduction in minute ventilation. The CO2 clearance was 90-100 mL/min. A total of 93% of patients survived to weaning from ECCOR, 73% survived to ICU discharge and 67% survived to hospital discharge.
CONCLUSION: Our data shows that ECCOR was safe and effective in this cohort. Further experience is vital to identify the patients who may benefit most from this promising therapy.
PMID
27903208 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27903208]
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239.

Successful management of acute respiratory failure in an Idiopathic Pulmonary Fibrosis patient using an extracorporeal carbon dioxide removal system.
Vianello A., Arcaro G., Paladini L., Iovino S.
Sarcoidosis, vasculitis, and diffuse lung diseases : official journal of WASOG. 33 (2) (pp 186-190), 2016. Date of Publication: 01 Aug 2016.
AN: 614893616
Patients with Idiopathic Pulmonary Fibrosis (IPF) requiring Invasive Mechanical Ventilation (IMV) following unsuccessful treatment with Non-Invasive Ventilation (NIV) have a high mortality rate. IMV is, moreover, an independent predictor of poor outcome during the post-transplantation period in patients on waiting lists for Lung Transplantation (LT). Here we describe the successful management of an IPF patient with acute respiratory failure (ARF) using a pump-assisted veno-venous system for extracorporeal CO2 removal (ECCO2R) (ProLUNG system) as an alternative to endotracheal intubation (ETI) following NIV failure. Given this positive experience, further studies are warranted focusing on the ECCO2R system's tolerability, safety, and efficacy in patients with IPF and severe ARF in whom NIV alone is ineffective.
PMID
27537725 [http://www.ncbi.nlm.nih.gov/pubmed/?term=27537725]
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240.

Role of extracorporeal membrane oxygenation in adult respiratory failure: an overview.
Anand S., Jayakumar D., Aronow W.S., Chandy D.
Hospital practice (1995). 44 (2) (pp 76-85), 2016. Date of Publication: 2016.
AN: 611705302
Extracorporeal membrane oxygenation (ECMO) provides complete or partial support of the heart and lungs. Ever since its inception in the 1960s, it has been used across all age groups in the management of refractory respiratory failure and cardiogenic shock. While it has gained widespread acceptance in the neonatal and pediatric physician community, ECMO remains a controversial therapy for Acute Respiratory Distress Syndrome (ARDS) in adults. Its popularity was revived during the swine flu (H1N1) pandemic and advancements in technology have contributed to its increasing usage. ARDS continues to be a potentially devastating condition with significant mortality rates. Despite gaining more insights into this entity over the years, mechanical ventilation remains the only life-saving, yet potentially harmful intervention available for ARDS. ECMO shows promise in this regard by offering less dependence on mechanical ventilation, thereby potentially reducing ventilator-induced injury. However, the lack of rigorous clinical data has prevented ECMO from becoming the standard of care in the management of ARDS. Therefore, the results of two large ongoing randomized trials, which will hopefully throw more light on the role of ECMO in the management of this disease entity, are keenly awaited. In this article

we will provide a basic overview of the development of ECMO, the types of ECMO, the pathogenesis of ARDS, different ventilation strategies for ARDS, the role of ECMO in ARDS and the role of ECMO as a bridge to lung transplantation.
PMID
26848884 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26848884]
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241.

Extracorporeal CO2 removal for refractory hypercapnia in acute respiratory failure: A case series.
Vianello A., Arcaro G., Iovino S., Rinaldo C., Battistella L., Pavan A., Molena B., Paladini L., Rita Marchi M., Gallan F.
European Respiratory Journal. Conference: European Respiratory Society Annual Congress 2016. United Kingdom. 48 (Supplement 60) (no pagination), 2016. Date of Publication: 01 Sep 2016.
AN: 614780732
Introduction: Although Non-Invasive Ventilation (NIV) can be effective to support the failing ventilatory pump, its failure rate remains high. Extracorporeal CO2 removal (ECCO2R) is now being increasingly suggested for the management of patients with ARF refractory to NIV to avoid utilization of Invasive Mechanical Ventilation (IMV).
Aim(s): To describe the use of a pump-assisted venovenous system for ECCO2R as a measure to avoid IMV in the event of NIV failure.
Method(s): 7 patients (4M/3F; age: 62.7+/-19.3 yrs) at high risk for NIV failure underwent ECCO2R with the [ProLUNG, Estor] system between Jan 2015 and Jan 2016. Causes of ARF that led to utilization of such device were COPD exacerbation (n=3), exacerbation of IPF (n=2), Non-Cystic Fibrosis Bronchiectasis (n=1), and a pneumothorax complicating Lymphangioleiomyomatosis (n=1) .
Conclusion(s): Preliminary data from our experience support the view that utilization of ECCO2R is feasible and effective in some severe forms of ARF refractory to NIV in which the primary problem is CO2 retention. (Table Presented).
Publisher
European Respiratory Society

Link to the Ovid Full Text or citation:
Click here for full text options

242.

Acquired coagulation disorders during extracorporeal carbon dioxide removal.
Trudzinski F., Seiler F., Fahndrich S., Kaestner F., Flaig M., Wolf T., Muellenbach R.M., Bals R., Lensch C., Lepper P.M.
European Respiratory Journal. Conference: European Respiratory Society Annual Congress 2016. United Kingdom. 48 (Supplement 60) (no pagination), 2016. Date of Publication: 01 Sep 2016.
AN: 614777222
Introduction : Bleeding and transfusion requirements are frequent complications under veno-venous extracorporeal carbon dioxide removal (ECCC2R). Data concerning coagulation in ECCC2R patients are few. We therefore aimed to analyze hemostatic changes during extracorporeal carbon dioxide removal.
Method(s): Single center analysis. 20 Patients undergoing pump-driven ECCC2R between 03/13 and 10/15 were included. According our protocol, platelet count and fibrinogen testing were performed on a daily base; factor XIII analysis was done before ECCC2R and twice a week.
Result(s): Results: 19 Patients, 11 male, mean age 50.2 +/- 13.2 were finally analyzed. ECCC2R was initiated due to AECCPD in 12 cases (60%), to chronic respiratory failure in patients waiting for lung transplantation in 7 cases (35%), to ARDS in 2 Cases (%) and to refractory status asthmaticus in one case (5%). Mean ECCC2R runtime was 9.6 +/- 7.6 days. Within the first 7 days platelet count decreased from 265.2 +/- 78.2 (N=17) to 131 +/- 48.18 (N=15) platelets/mul (P = 0.003). HIT-II Elisa was performed in 11 cases (57.9%) and was positive in one of them (9.1%). Fibrinogen decreased from 483.1 +/- 142.8 (N=18) at baseline to 364.8 +/- 95.8 mg/dl (N=15) on day 7 (P =0.002). Factor XIII measurement showed an acquired deficiency under support dropping from 84.5 +/- 14.8 (N=14) before ECCC2R to 69.9 +/- 11.7 % on day 2-5 (N= 8) (P=0.018). Four Patients received purified concentrate of blood coagulation factor XIII.
Conclusion(s): Patients on ECCC2R develop coagulation disorders analog High-flow ECMC patients. The impact on bleeding complications and thromboembolic events needs further investigation.
Publisher
European Respiratory Society

Link to the Ovid Full Text or citation:
Click here for full text options

243.

Extracorporeal low flow CO2 removal as a bridge to urgent lung transplantation: A single center experience.
Bergantino B., Ruberto F., Magnanimi E., Privato E., Zullino V., Bruno K., Pugliese F.

Intensive Care Medicine Experimental. Conference: 29th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2016. Italy. 4 (Supplement 1) (no pagination), 2016. Date of Publication: September 2016.
AN: 617991745
Introduction: Lung transplant is the last therapy for patients with end stage respiratory failure. Patients on waiting list may need mechanical ventilation and extracorporeal support right before the lung transplant, due to sudden and rapid worsening of their lung disease. In these cases an urgent lung transplantation is necessary. ECMO as a bridge to lung transplant is widely used: survival of pretransplant ECMO patients improved over the last years, but ECMO treatment is related to severe complications, such as bleeding and intracranial hemorrhages, with a decline in survival for treatments longer than 2 weeks. Today low flow venovenous extracorporeal CO2

removal (ECCO2R) devices have been available. They remove CO2 using a mini-invasive system (blood flow < 450 ml/min), requiring lower anticoagulation than ECMO and easier management.
Method(s): The study is a retrospective analysis: we analyzed all patients admitted to our Transplant Center Intensive Care Unit (ICU), listed for an urgent lung transplantation. We included patients presenting respiratory acidosis not responding to mechanical ventilation with PaCO2 > 75 mmHg and pH < 7.20, mild hypoxia and stable hemodynamic conditions, who received ECCO2R treatment (Decapsmart, or ProLung). Patients on ECMO were excluded. We analyzed ECCO2R devices feasibility as a bridge to lung transplantation, examining blood gasses values, hemodynamic parameters and mechanical ventilation setting during treatment.
Result(s): From January 2010 to March 2016, 18 patients were admitted to Transplant ICU, listed for an urgent lung transplantation. 8 patients underwent ECMO. 10 patients were supported with ECCO2R for severe respiratory acidosis, so their data were analyzed. Mean treatment duration was 76 +/- 44 hours; ECCO2R efficiently removed CO2 reducing the severe acute hypercapnia adverse events; within the 20th hour, pH and blood gasses improved, with a significant mechanical ventilation support reduction and mean tidal volume increasing. 1 patient was bridged to lung transplant successfully without ECMO. In 4 patients, because of severe hypoxia, ECCO2R treatment was rapidly replaced by veno-venous ECMO, bridging them all to transplant, too. 5 patients died in ICU waiting for an available organ.
Conclusion(s): Nowadays in Italy, the main problem for patients awaiting for a lung transplantation is the real low organ availability and the very long time on the waiting list. ECCO2R can provide further options for hypercapnic respiratory disease, but because systemic oxygenation improvement is slight and there's no hemodynamic support, actually in our experience, it cannot substitute standard ECMO as a bridge to lung transplant, especially if extracorporeal support is required for a long time. But for selected patients, its simpler management and minimal requirement for anticoagulation can allow us to gain time to avoid ECMO and its severe related complications.
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Publisher
SpringerOpen

244.

Optimization of peep for alveolar recruitment in ARDS based on inspiratory transpulmonary pressure.
Jochmans S., Chelly J., Vong L.V.P., Sy O., Serbource-Goguel J., Rolin N., Weyer C.-M., Abdallah R.I., Adrie C., Vinsonneau C., Monchi M.
Intensive Care Medicine Experimental. Conference: 29th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2016. Italy. 4 (Supplement 1) (no pagination), 2016. Date of Publication: September 2016.
AN: 617991384
Introduction: Esophageal pressure (Pes) guided setting of PEEP has been described in ARDS patients1 either to avoid expiratory alveolar collapse2 or to promote maximum inspiratory recruitment3. The proportion of ARDS patients that may benefit from maximum recruitment strategy and its effects regarding dead space (VD/VT),

shunt, driving pressure (DP), transpulmonary driving pressure (TPDP) and expiratory transpulmonary pressure (TPPexp) remain unclear.
Method(s): We included moderate and severe ARDS patients under mechanical ventilation and paralyzed, in the first 12 hours after reaching ARDS criteria. Patients were monitored with esophageal balloon catheter and ventilated with EXPRESS study settings for 1 hour after recruitment maneuver. Then PEEP was modified to obtain an inspiratory transpulmonary pressure (TPPinsp-P) based on Pes between 20 and 25 cmH2O. Increase in PEEP was limited to 25 cmH2O or less in case of severe haemodynamic failure.
Result(s): 22 ARDS patients have been included: 16 (73) male with age 56 [44-61], SAPS2 46 [34-49] and SOFA 9 [7-12]. 19 (86) had pulmonary ARDS with PaO2/FiO2 121 [100-160] at inclusion and PEEP 12 [10-12]. 21 (95) needed vasopressors, 5 (23) renal replacement therapy, 14 (64) prone position and none ECMO or ECCO2R. ICU and hospital lengths of stay were respectively 15 [9-25] and 22 [14-37]. 8 (36) patients died. Only one patient had PEEP limitation due to patent foramen ovale. Pes measurement distinguished 2 groups of patients (Table 65): in 11 (50) patients (Group A) inspiratory esophageal pressure (Pes-insp) was 4 [2-7] leading to small modifications in PEEP (< +/- 4 cmH2O). In the second half of patients Pes-insp was high 17 [14-23] allowing PEEP increase > 4 cmH2O (Group B). Higher PEEP in Group B led to higher plateau pressure and TPPinsp-P, positivation of TPPexp without increase in VD/VT (p = 0.97), shunt (p = 0.84), DP (p = 0.16), TPDP (p = 0.09) or oxygen stretch index (p = 1). However agreement between TPPinsp-P and TPPinsp calculated from respiratory motion equation and chest wall elastance (TPPinsp-E) was weak with Band-Altman bias (TPPinsp-E - TPPinsp-P) = 4.5 +/- 8.9 [95%CI -13;22].
Conclusion(s): Pes measurement in moderate to severe ARDS patients distinguishes 2 groups of patients in whom PEEP appears to be taylorized without side-effects. However physiologic studies should assess reliability of transpulmonary measurement based on either Pes or chest wall elastance. (Table Presented).
Institution
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245.

Our experience with A-V ECCO2r device (Novalung iLA) in the district general hospital setting.
Remeta P., Bishop P.
Intensive Care Medicine Experimental. Conference: 29th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2016. Italy. 4 (Supplement 1) (no pagination), 2016. Date of Publication: September 2016.
AN: 617955598
Introduction: We would like to present our experience with use of arterio-venous extracorporeal membrane carbon dioxide removal (ECCO2R) device-Novalung iLA in the District General Hospital setting.
Objective(s): We analysed our data to review our practice in use of ECCO2R in

respiratory failure.
Method(s): Over the period of 5 years we used arterio-venous ECCO2R device Novalung iLA in 10 patients, with overall 50 % mortality. We analysed retrospectively only 8 patients due to lack of complete documentation in 2 patients (survivors).
Result(s): From a reviewed sample of 8 patients three patients (37 %) survived. Most common diagnosis in our population was pneumonia (6), others were ARDS post cardiac arrest (1) and refractory asthma (1). We compared our patients in groups of survivors and nonsurvivors. Mean age of survivors was 29 (18-39) vs 70.8 (59-80) of nonsurvivors. Mean APACHE score was 13.6 vs 21. Two of three survivors had single organ failure, one required CRRT for AKI. All patients in non-surviving group had multi-organ failure. Mean time to initiation of ECCO2R support post ITU admission was 39 vs 80 hours (11-75 vs 6.5-174 hours). In all patients mean paCO2 before initiation of ECCO2R was 10.89 kPa, after the first hour 7.59 kPa and after 24 hours 5.9 kPa. No ECCO2R device associated complications in survivors dgroup, one limb ischaemia in non-survivors group.
Conclusion(s): Our analysis showed that the use of ECCO2R device significantly improved CO2 elimination in all our patients, allowed us to use lung protective ventilation strategy. Survival of 37 % in our small group is clearly influenced by selection of our patients. We tried to identify a group of patients who would most likely benefit from this invasive intervention. In our small group of patients were early initiation, lower APACHE score, single organ failure and young age factors predicting good outcome. We continue to audit use of ECCO2R device on our unit and currently using veno-venous ECCOR2 device which eliminates the risk of significant complication of A-V ECCOR2-limb ischaemia.
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Publisher
SpringerOpen

246.

Experience of extracorporeal support using pumped veno-veno extracorporeal carbon dioxide removal in ventilated patients: With severe acute respiratory failure.
Keating S., Gibson A., Gilles M., Dunn M., Price G., Young N.
Intensive Care Medicine Experimental. Conference: 29th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2016. Italy. 4 (Supplement 1) (no pagination), 2016. Date of Publication: September 2016.
AN: 617955592
Introduction: Severe acute respiratory distress syndrome (ARDS) is associated with a mortality of 46.1 %[1]. Currently only low tidal volume ventilation has been proven to reduce mortality in all patients with ARDS[2]. This is frequently difficult to achieve in the presence of hypercapnia. Decreases in ventilatory driving pressure have been strongly associated with ICU survival[3]. It has been hypothesised that ventilation combining reduced tidal volumes with extracorporeal carbon dioxide removal (ECCOR) may result in further improvements in mortality[4], and prospective randomised trials are planned [5].
Objective(s): To assess in patients with severe ARDS and acidosis secondary to hypercapnia if by using veno-veno ECCOR there can be a normalisation of pH and reduction of peak airway pressures. Secondary outcomes-survival to hospital discharge and complications of therapy.

Method(s): Data on ventilatory and arterial blood gas parameters before and during therapy was prospectively collected and entered into the Extracorporeal Life Support Organisation (ELSO) registry in line with national guidance[6]. The Hemolung RAS (A Lung technologies) was used to provide ECCOR.
Result(s): 4 patients received ECCOR using the Hemolung. All patients had an improvement in the degree of acidosis with mean hydrogen ion concentration falling from 72.65 nM (pH 7.14) to 46.59 nM (pH 7.33) over the first 24 hours, with a mean PaCO2 fall from 13.5 kPa to 8.7 kPa. Peak airway pressures dropped from 31.5 cmH2O to 29.1 cmH2O over the same time period. There were no direct complications of therapy. 3 patients survived to hospital discharge.
Discussion(s): Using ECCOR locally in patients with severe ARDS it is possible to lower the hydrogen ion concentration improving the degree of acidosis. This corresponds to a trend in lower peak airway pressures, which in this small case series does not reach statistical significance. There were no complications of the therapy and mortality was shown to be lower then quoted in other ARDS trials [1].
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Publisher
SpringerOpen

247.

In moderate to severe ARDS patients with severe respiratory acidosis, can we improve the arterial pH and make ultra-protective ventilation with the introduction of an extra-corporeal circulation CO2 removal (ECCO2r) technique.
Georger J.F., Ponthus J.P., Tchir M., Amilien V., Ayoub M., Barsam E.
Intensive Care Medicine Experimental. Conference: 29th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2016. Italy. 4 (Supplement 1) (no pagination), 2016. Date of Publication: September 2016.
AN: 617955524
Objective: In patients with moderate to severe ARDS and respiratory acidosis we can introduce ECCO2r to enable protective ventilation or ultra-protective ventilation. We don't know the results we can obtain after the introduction of ECCO2R in a population of ARDS with respiratory acidosis.The objective of this study is to describe if we can at the same time improved the blood pH and allow ultra-protective ventilation.
Method(s): We retrospectively included patients who received ECCO2r for ARDS with respiratory acidosis between august 2014 and march 2016 in our ICU. The ECCO2R was performed with ILAACTIVE device (Novalung) with a Minilung or ILA membrane. The sweep gas was oxygen at 10 l/min. The vascular access was a 24 F dual light catheter in femoral position. The blood flow in the membrane was around 1.5 l/min. The ECCO2R was introduced in patients with PaO2/FiO2 ratio between 80 and 150 and acidosis. All the patients was ventilated in controled ventilation with 6 ml/kg (PBW) of tidal volume (Vt) and a respiratory rate (RR) above 25/min. All the patient was sedated with midazolam and Sufentanyl and if necessary we used neuromuscular blocking agent. If is necessary the clinician in charge of the patient performed prone position session during 16H.We collect pH, PaCO2, the PaO2/FiO2ratio, Vt, RR, PEEPtotal and driving pressure, before ECCO2r and at 4 h the initiation of ECCO2r then at J1, J2, J3. We compared the parameters with repeated measures ANOVA test.

Result(s): We included 16 patients, 9 males and 7 females. The average for the age was 67 years (36-84), for the BMI was 32.2 (22-60). The cause of the ARDS was a pneumonia for 14 patients, a cellulitis for 1 patient and a septicemia for the last patient. On eleven patients, we performed at least one prone position session, during 16 hours, with ECCO2R. The average duration of treatment by ECCO2R was 11 days (2-28).The mortality was 50 %, none patient died by a complication of the ECCO2R. We didn't have any hemorrhage complication on the catheter for ECCO2R. The evolution of parameters was in the Table 32.
Conclusion(s): The ECCO2r for ARDS patients with respiratory acidosis helps to normalize the pH and decreased Vt and RR to make ultraprotective ventilation and decrease the driving pressure. In this type of ARDS with severe hypercapnia, others studies are necessary to know if this kind of procedure can improve the mortality of this patients.
Institution
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Publisher
SpringerOpen

248.

Experience with a veno-venous extra corporeal CO2 removal device: Easy and safe, but only modest improvement in gas exchange.
Auzinger G.
Journal of the Intensive Care Society. Conference: Intensive Care Society State-of-the-Art Meeting, ICSSOA 2016. United Kingdom. 17 (4 Supplement 1) (pp 14-15), 2016. Date of Publication: November 2016.
AN: 617401145
Introduction: Protective lung ventilation strategy in patients with adult respiratory distress syndrome (ARDS) has been shown to reduce mortality and longterm lung injury. However, this may at times be associated with rising CO2 levels with systemic effects. A new generation of veno-venous extra corporeal CO2 Removal (ECCO2R) devices have recently been introduced to support gas exchange.
Aim(s): We describe the use, effectiveness, safety and outcomes of patients with hypercapnic respiratory failure treated with the Hemolung (ALung) veno-venous device following its introduction in a general ICU at level 1 trauma center.
Method(s): Mechanically ventilated adult patients with CO2 >10 kPa and/or significant respiratory acidosis (pH<7.25) and/or persistently high peak and plateau pressures (>30 cm H2O) treated with protective lung ventilation, with no contraindication to heparinisation were considered for ECCO2R assist using the Hemolung (Alung) device. This was part of our standard of care and was replacing the AV Novalung. Following cannulation (15.5F dual lumen catheter) and connection, blood flow was increased to maximum and sweep gas flow gradually increased over 2 h to achieve maximal CO2 removal. Primary end points were pCO2, pH and ventilator parameters after starting the device, with secondary end points featuring safety and ease of use.
Result(s): The device was used in six patients with a mean age of 45. Two with severe chest injuries, one inhalational lung injury, one severe acute asthma and two with pneumonia and lung fibrosis. Tt was commenced within three days of mechanical ventilation in four patients, at day 6 and day 16 in two. The therapy

supplemented with prone position in one patient and nitric oxide in another. Four of the six patients had multiorgan failure at the time of commencement of therapy or soon after. All of these died while still on the device. Of the other two, one was successfully weaned and the other was referred for ECMO. Both were discharged home. Table 1 shows ventilator parameters and blood gas data. There were median reductions in CO2 of 10%, minute volume 28% and driving pressure 19%. Average blood flow with jugular and femoral catheters were 580 ml/min and 440 ml/ min, respectively, and CO2 removal 104 ml/min and 83 ml/min, respectively.
Conclusion(s): The Alung veno-venous ECCO2R device is easy and safe to use with no complications. It provided modest improvements in gas exchange. To maximize its potential, permissive hypercapnia should still be used. Careful selection of patients is also advised. (Table presented).
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Publisher
SAGE Publications Inc.

249.

The physiotherapy management of patients with CF on ambulatory ECMO including airway clearance therapy and early mobilization.
Button B.M.
Pediatric Pulmonology. Conference: 30th Annual North American Cystic Fibrosis Conference. United States. 51 (Supplement 45) (pp 152-154), 2016. Date of Publication: October 2016.
AN: 612358955
Awake veno-venous (VV) extra corporeal membrane oxygenation (ECMO) is a growing area in the life support of patients with respiratory failure. VV ECMO is sometimes used as a bridge to recovery in patients with acute respiratory distress syndrome and as a bridge to lung transplantation (LTx) in those with chronic lung diseases such as cystic fibrosis. The availability of dual lumen single ECMO cannulas (Avalon and Novalung Twinport) placed in the cervical region (internal jugular vein) has revolutionized 'lung bypass' as it allows patients to be awake and able to participate in physiotherapy. Patients are able to carry out airway clearance therapy (ACT) and physical exercise and are often able to be upright and walking while waiting for LTx. Preserving muscle mass and general physical condition has been associated with better long terms outcomes after LTx. ECMO involves gas exchange and oxygenation of blood outside the body and can provide complete or partial support of the lungs and/or heart for patients who without this treatment are not likely to survive. An ECMO system consists of cannulas to take venous blood from the body and return oxygenated blood to the circulation. Outside the body the blood circulates through a pump, a gas exchange and temperature control device. Life-threatening complications can occur while on ECMO including bleeding, thrombus formation, recirculation and sepsis (Lindstrom et al 2009). Until relatively recently patients treated on ECMO were sedated and paralyzed in the intensive care unit, breathing with the assistance of a mechanical ventilator, tube fed and unable to participate in physical activity. This approach led to the loss of muscle mass, strength, bone density and generally debilitation resulting in poor outcomes after LTx. (Fan et al 2009). Awake ECMO may lead to better outcomes after LTx compared to traditional sedation and mechanical ventilation (Fuehner et al 2012). The published peer reviewed literature and conference presentations have been mostly based on

descriptions of local experiences in relatively small case series. Today, many ECMO units aim for safe early mobilization when all patient clinical measures are deemed to be acceptable. Generally ECMO cannula placement in the upper body is preferred when considering mobilizing patients out of bed, standing and walking. No randomized controlled trials have tested this assertion to date. The aims of physiotherapy for patients on awake VV ECMO are: (1) to clear lung secretions in those with chronic suppurative lung disease to prevent life-threatening sepsis; (2) to preserve muscle mass and strength while patients progress to recovery or bridge to LTx; and (3) to be safe in every aspect of treatment. Patients should not be mobilized out of bed if ECMO flows and oxygenation are sub-optimal, if patients are cardio-vascularly unstable, if there is bleeding from the respiratory tract or thrombus formation. All clinical parameters such as vasoactive agents, fraction of inspired oxygen (<0.6), oxygen saturations (>90), respiratory rate (<30/minute), blood pressure, heart rate, level of sedation and other considerations such as ECMO cannula placement, lines and other co-morbidities need to be considered prior to active mobilization (Hodgson et al 2014). Consultation with the medical and nursing team are essential before mobilizing patients. In researching physiotherapy practice as seven internationally recognized centres (Hannover, Germany; Paris (La Pitie Salpetriere and Hopital Foch), France; Duke University Hospital, North Carolina, USA; New York Presbyterian, New York and Toronto General Hospital, Canada and The Alfred Hospital, Melbourne, Australia) choice of airway clearance techniques (ACT) varied widely. If patients were intubated or had a tracheostomy then airway suction was employed to remove secretions. Sometimes broncho-alveolar lavage was carried out by members of the medical team for ACT and combined with airway suction. In patients not on ventilators, the range of ACT included: positive expiratory pressure therapy (PEP) with a range of devices available, oscillating positive expiratory pressure therapy (OscPEP) using numerous devices, intrapulmonary percussive ventilation (IPV); positive airway pressure (single and bi-level), assisted autogenic drainage and exercise as ACT. Patients on ECMO often have thick and viscous secretions. Adjunctive mucolytic agents such as saline (0.9%), inhaled mannitol, hypertonic saline (3-7%) and dornase alpha are sometimes used in conjunction with airway clearance therapy. Early mobilization is a high priority in all of the international units previously mentioned. Strong multidisciplinary teams have been developed in these institutions to support safe and effective early physical activity in patients who are awake and able to co-operate. Adequate resources including well-trained staff and equipment to assist patients to be upright and active while on awake ECMO are required. Before safe mobilization a muscle strength assessment is necessary to ensure the patient is capable of mobilizing out of bed. The MRC and IMS mobility scores assist in determining whether the patient is suitable for mobilization out of bed (Hodgson et al 2014). Many patients have been critically ill for a period before being placed on ECMO and may already have reduced muscle mass and strength. The patient may need a period of regular passive, assisted or active bed exercises in preparation for getting up. Some units use electrical muscle stimulation to preserve muscle mass and strength. Sitting up dangling legs over the side of the bed is followed by sitting out of bed in a chair for up to four or more hours a day. This incorporates all the benefits of being upright, including lung expansion, into the daily routine. Leg strengthening and circulatory exercises are encouraged while sitting out of bed. Standing with the assistance of a tilt table often precedes supported standing out of bed. While standing upright patients may be encouraged to do supported squats and heel raises as part of the leg strengthening program. Walking frames are often used to achieve safe exercise in standing. A team of well trained staff with one person coordinating the activity is necessary for safe mobilization. It is important that the ECMO cannula is supported by a trained professional to avoid movement and ensure optimal flows and oxygenation. Supported marching on the spot at the bedside is often the first walking exercise. When a portable treadmill is available this is placed at right angles to the patient's bed. The safe achievement of this activity requires on average 5 well-trained staff. The patient is assisted into sitting with legs dangling over the edge of the bed

and then assisted into standing on the treadmill using the handrails for support and walks at a slow steady pace aiming for up to 20-30 minutes per session. This will vary depending on the patient's physical state before ECMO commenced. Walking out of the room requires an extra person to bring a wheel chair along in case the patient needs to sit down or be transported back to bed. All equipment needs to be battery powered. For safe mobilization each member of the team needs to be well trained and is required to concentrate exclusively on the equipment and parts of the activity for which they are responsible. The patient is usually supported with a walking frame. Research to date consists mainly of outcomes in regional case series and retrospective reviews of patient charts. There is a lack of robust randomized controlled trials to determine safety, dosage, effectiveness and long term outcomes relative to ACT to prevent sepsis and exercise to prevent loss of muscle mass and general condition. Multi-centre trials are required to achieve adequate numbers in appropriate time frames to research and inform clinical practice. The Winston Churchill Foundation of Australia for a fellowship to travel to specialist international centres to research the topic.
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Publisher
John Wiley and Sons Inc.

250.

Feasibility of the implementation of a technique of extra-corporeal CO2 removal (ECCO2R) in an intensive care unit which does not use ECMO and its real utilization.

Amilien V., Ponthus J.P., Ngasseu P., Tchir M., Barsam E., Lehericey P., Georger J.F.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2016. Paris France. Conference Publication: (var.pagings). 6 (SUPPL. 1) (no pagination), 2016. Date of Publication: June 2016.
AN: 72342682
Introduction The utility and feasibility of ECCO2R in an intensive care unit (ICU) which does not use ECMO has not been described. In our general ICU of 15 beds, we do not use ECMO, and we decided to introduce ECCO2R in COPD and ARDS patients. The purpose is to describe the feasibility of this technique in our ICU and the actual uses of it. Materials and methods We chose ILA ACTIVVE device (NOVALUNG) with MINILUNG membrane and a double-line femoral catheter (NOVAPORT TWIN 24F). A training for each member of the team was conducted (physicians and nurses), and we wrote a detailed procedure between February 2014 and July 2014. We wrote a procedure for: the preparation of the device, laying the catheter, monitoring, removal of the catheter and the machine, any malfunctions, etc.). Between august 2014 and February 2015, data were collected for each patient receiving ECCO2R. Indication, mortality at J28, duration of ECCO2R, complications and success of the technique were evaluated. Results During this period, ten of the 348 patients admitted to our ICU have received ECCO2R therapy. We included five patients with ARDS (we laid the device because tidal volume (Vt) was 6 ml/kg PBW with a PaO2/FiO2 ratio between 80 and 150, after at least one prone position session, and with a plateau pressure between 25 and 30 cm of water and high level of PaCO2). We included three COPD patients in failure of non-invasive ventilation (NIV) in a hypercapnic coma, one asthmatic patient in severe respiratory acidosis

under invasive ventilation (IV) and one severe COPD patient unweaning of the IV. Patients with ARDS normalized arterial pH, and we decreased Vt (3-4 ml/kg) and respiratory rate. Three of them are alive at J28 and had received 5, 7 and 14 days of ECCO2R, and two of them died under ECCO2R after 16 and 9 days of ECCO2R. The reason of the death was nosocomial lung infection. None of the COPD patients with hypercapnic coma were intubated, and they received 5, 3 and 6 days of ECCO2R and were alive at J28. The asthmatic patient received 7 days of ECCO2R, was extubated under ECCO2R and was alive at J28. The unweaning COPD patient was extubated two times and reintubated two times due to severe neuropathy and tracheal inhalation. He was tracheotomized and weaned from the ECCO2R after 19 days, and he was alive at J28, but died at J76. There was no bleeding leading by catheter but one hemothorax requiring a blood transfusion during an overdose of heparin Conclusion The ECCO2R in a general ICU could have multiple indications in COPD and ARDS patients. These indications remain to be validated, but ECCO2R could improve the management of those patients. The implementation of ECCO2R is possible but requires a great investment, a training of the medical and the paramedical team and a written detailed procedure. Nevertheless, the installation of the device for each patient must for now be discussed in a team taking into account the risk-benefit ratio of each procedure.
Institution
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Publisher
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251.

In patients under extracorporeal CO2 removal therapy (ECCO2R) for ARDS can we do prone position? Efficiency, stability and safety of the maneuver.
Ponthus J.P., Ngasseu P., Amilien V., Barsam E., Lehericey P., Tchir M., Georger J.F.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2016. Paris France. Conference Publication: (var.pagings). 6 (SUPPL. 1) (no pagination), 2016. Date of Publication: June 2016.
AN: 72342681
Introduction The mechanical ventilation of some patients with ARDS could be facilitated by ECCO2R allowing the reduction in blood acidosis and the reduction in tidal volume for the application of the protective ventilation. Prone position (PP) could be used for some patients with PaO2/FiO2 <150. We do not know whether we could associate PP and ECCO2R in ARDS patients The aim of this study is to describe the feasibility of PP under ECCO2R, the stability of the parameters of the device and whether we have side effects of the PP under ECCO2R. Materials and methods In our intensive care unit of 15 beds with a large experience of PP, we have retrospectively included all sessions of PP (at least 16 h of PP) performed on patients under ECCO2R therapy between August 2014 and March 2015. We used ILA ACTIVVE device (NOVALUNG) with MINILUNG membrane and a double-line femoral catheter (NOVAPORT TWIN 24F). The gas flow was 10 l/min. For each session, we compared PaO2/FiO2 and the PaCO2 before and after 1H of PP. The device records the flow and pressure parameters every 10 s, and we recovered these parameters after each prone position session. For each session, we did the

mean of blood flow and drainage pressure (P1) during a length of 1 h: during the last hour before PP, the first hour after PP and the last hour before stopping PP. We compared with a Freidman's test, the mean and the coefficient of variation of each parameter to evaluate the stability of the device. We noted all the side effects of the PP (bleeding, decannulation, etc.). Results We performed nine PP sessions on five patients, one in three patients and three in two patients. The PaO2/FiO2 ratio was higher during PP [136 (78-250)] than before PP [126 (58-145)] ($p < 0.05$). There is no difference of PaCO2 before PP [55 mmHg (34-80)] than during PP [54 (34-70)]. Between before, the beginning and the end of PP, we did not find difference in blood flow, respectively, 1472 ml/min (1201- 1971), 1403 ml/min (1216-1850) and 1447 ml/min (1231-2012), and in P1, respectively, -37 mmHg (-46 to -25), -41 mmHg (-50 to -28) and -41 mmHg (-47 to -29). The coefficient of variation of the blood flow was low, and we did not find variations of it between these three moments, respectively 0.9 % (0.7-2.8), 0.7 % (0.4-2.1) and 0.6 % (0.4- 1.6). The coefficient of variation of P1 was low, and it was lower at PP than before PP ($p < 0.05$), respectively: 8.2 % (3.7-9.9), 5.6 % (2.8-6.8) and 4.2 % (2.9-5.8). We did not find side effects of the PP maneuver. There were no decannulation, bleeding and skin lesion on the tubing paths. Conclusion Prone position under ECCO2R with a femoral catheter is possible. We found no side effects of this technique. No differences in the blood flow, in the drainage pressure and in the stability of the blood flow were found. The stability of the drainage pressure is better in PP. The PaO2/FiO2 ratio is better in PP.
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Publisher
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252.

Extracorporeal dioxide carbon removal (ECCO2R), a French national survey.
Deniau B., Ricard J.-D., Messika J., Dreyfuss D., Gaudry S.
Annals of Intensive Care. Conference: French Intensive Care Society, International Congress - Reanimation 2016. Paris France. Conference Publication: (var.pagings). 6 (SUPPL. 1) (no pagination), 2016. Date of Publication: June 2016.
AN: 72342679
Introduction Extracorporeal dioxide carbon removal (ECCO2R) is an extracorporeal decarboxylation technology described in 1978. Physiological studies showed that 50 % of produced CO2 were eliminated. Potential indications are: ultra-protective mechanical ventilation for acute respiratory distress syndrome (ARDS) and hypercapnic patients at risk of non-invasive ventilation failure. Because of the lack of scientific evidence, ECCO2R is not available in the USA. We sought to assess the use of ECCO2R in France. Materials and methods This retrospective, observational study was performed in French intensive care units (ICUs) from January 2010 to January 2015. A phone interview was conducted with French ICUs affiliated to national societies and public and private hospitals registries. Data recorded were the following: use and indications of ECCO2R, type of ECCO2R, number of patients treated during the study period, complications associated with the technique, satisfaction rates (in terms of efficacy, tolerance and global) based on a scale [0 (total unsatisfaction)- 10 (total satisfaction)], and concomitant use of extracorporeal membrane oxygenation (ECMO) in the unit. Results A total of 239 French ICUs were

contacted (147 mixed, 55 medical, 25 surgical, four cardio-thoracic, six paediatric and two neurosurgical ICU). Only three refused to participate. Thirty-five (15 %) ICUs had used ECCO2R at least once in the past 5 years, in 303 patients. The most frequently used devices were: iLA (Novalung) (63 %) and Hemolung (Alung) (37 %). The median number of patients treated per ICU was 3 [1-8]. The most frequent indication was ultra-protective ventilation for ADRS (54 %). Other indications were: failure of non-invasive ventilation during chronic obstructive pulmonary disease exacerbation (30 %), weaning from invasive mechanical ventilation in chronic obstructive pulmonary disease patients (12 %) and miscellaneous (4 %). Among ICUs using ECCO2R, 22 (63 %) reported at least one complication. The most frequent complications were bleeding (45 %) and membrane failure (18 %). Satisfaction rates were: in terms of decarboxylation 7.9 +/- 2.4; tolerance 6.9 +/- 2.6; and overall satisfaction 6.8 +/- 2.2. Twenty-one (63 %) of the 35 ICUs using ECCO2R also used ECMO. The main reasons for not using ECCO2R were the lack of trained staff, unavailability of the device and the lack of scientific evidence (for, respectively, 53, 39 and 17 % of responders). Among 204 ICUs not using ECCO2R, 20 (10 %) had the project to start ECCO2R in the coming months. Conclusion These results show that ECCO2R is not widely used in French ICUs. The lack of strong scientific data on outcome is probably the main reason behind the limited use of ECCO2R. French studies currently in progress will help define indications of ECCO2R and impact on outcome. (Figure Presented).
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Publisher
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253.

Early experience of low flow extracorporeal carbondioxide removal in management of acute hypercapnic respiratory failure.
Tiruvoipati R., Buscher H., Winearls J., Breeding J., Chaterjee S., Braun G., Fraser J., Botha J.
Anaesthesia and Intensive Care. Conference: 40th Annual Scientific Meeting of the Australia and New Zealand Intensive Care Society and Australian College of Critical Care Nurses, ANZICS/ACCCN ASM 2015. Auckland New Zealand. Conference Publication: (var.pagings). 44 (2) (pp 314), 2016. Date of Publication: March 2016.
AN: 72325693
Introduction: Clinical application of extracorporeal carbon dioxide removal (ECCOR) for acute hypercapnic respiratory failure was first reported in 1986. Over the last 3 decades several advances in technology have led to development of less invasive, low flow ECCOR. Hemolung RAS is a novel low-flow, veno-venous, partial ECCOR device that was recently introduced to clinical practice. Study Objectives: To report the early experience on safety and feasibility of Hemolung in 3 Australian ICUs in patients with acute or acute on chronic hypercapnia.
Method(s): Review of ECCOR administered to COPD patients with severe hypercapnic respiratory failure who failed non-invasive ventilation and patients with ALI/ ARDS where lung protective ventilation was not feasible due to hypercapnia. Data were collected on demographics, diagnosis, indication, duration of therapy, complications of hemolung and outcomes.
Result(s): Fourteen patients were treated with ECCOR. In 5 patients (4 COPD and 1

bronchiolitis obliterans) the indication was to avoid intubation and this was achieved in 4 patients. In 9 patients (5 ALI/ARDS, 2 Asthma, 2 COPD) the indication was to institute lung protective ventilation and this strategy was successful in all cases. The mean duration of ECCOR use was 5.5 days. The pH and CO2 improved significantly within 6 hours of instituting ECCOR [(pre-pH ([Mean (SD)] 7.14 (0.12) Vs 6 hrs post-pH 7.31 (0.07); p<0.001); (pre-pCO2 ([Mean (SD)] 94.6 (47) Vs Post-CO2 57.5 (25); p= 0.006)]. 13 patients survived to weaning of ECCOR and 7 patients survived to hospital discharge, with one patient still in hospital. ECCOR use was not attributed to death in any patient. No device related complication was noted, but bleeding requiring transfusion (patient complication) was noted in 4 patients.
Conclusion(s): While ECCOR appears safe, effective and feasible, further experience is vital to identify the best cohort of patients who may benefit from this promising therapy.
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254.

Bicarbonate dialysis removes carbon dioxide in hypoventilated rodents.
Cove M.E., Vu L.H., Sen A., Federspiel W.J., Kellum J.A.
Critical Care. Conference: 36th International Symposium on Intensive Care and Emergency Medicine. Brussels Belgium. Conference Publication: (var.pagings). 20 (SUPPL. 2) (no pagination), 2016. Date of Publication: 2016.
AN: 72279056
Introduction: Low tidal volume ventilation improves outcomes in the acute respiratory distress syndrome, but may impair carbon dioxide (CO[sub]2[/sub]) clearance. Extracorporeal carbon dioxide removal (ECCO[sub]2[/sub]R) can control CO[sub]2[/sub], but existing devices are expensive and require considerable expertise to operate. Since CO[sub]2[/sub] is transported predominantly as bicarbonate, using dialysis to remove bicarbonate offers several advantages, but this approach has been limited by bicarbonate replacement problems. However, contemporary understanding of acid-base balance treats bicarbonate as an anion whose concentration is dependent on the strong ion difference (SID). We hypothesised that a novel dialysate designed to remove bicarbonate, but maintain SID, would lower CO[sub]2[/sub] with no change in pH. We tested this hypothesis in a rodent dialysis model, comparing our dialysate to a conventional solution (PrismasolTM).
Method(s): 14 Sprague-Dawley rats (400-600 g) were anaesthetised with ketamine, xylazine and butorphanol, then intubated and placed on mechanical ventilation. A femoral and jugular vein were cannulated to provide dialysis access. Ventilation rate was adjusted to create hypercapnia and dialysis commenced. Dialysis was provided using a M10 filter (Baxter, France), and the dialysate was constructed such that no bicarbonate is present, but SID was maintained. Blood gases were tested hourly (iStat, Abbott). Control dialysis experiments were performed with PrimalTM (Baxter, France). Data is reported as mean and standard deviation and differences compared using Students t-test.

Result(s): Using a blood flow and dialysate flow rate of 1 ml/min, mean pre-filter partial pressure of CO[sub]2[/sub] (PCO[sub]2[/sub]) was 78 mmHg (+/-14) whereas mean post-filter PCO[sub]2[/sub] was 70 mmHg (+/-14) using Prismasol and 12 mmHg (+/-5) using our bicarbonate free dialysate (p < 0.001). Removal of bicarbonate did not significantly affect pH across the dialysis filter (0.003, p = 0.49). This translates to the removal of 0.041 ml/min (+/-0.0019) of CO[sub]2[/ sub]. When scaled up to an adult dialysis filter of 0.9 m2, with a blood flow of 200 ml/min, it's the equivalent of removing 175 ml/min (+/-8.25) of CO[sub]2[/sub].
Conclusion(s): A bicarbonate free dialysis solution designed to maintain the SID, lowers PCO[sub]2[/sub] in post-filter blood, when compared to conventional dialysate, while maintaining pH. We estimate we could remove 175 ml/min of CO[sub]2[/sub] in adults, existing lowflow ECCO[sub]2[/sub]R devices only remove 90 ml/min.
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255.

The authors reply.
Del Sorbo L., Nava S., Ranieri V.M.
Critical Care Medicine. 43 (7) (pp e261-e262), 2015. Date of Publication: 21 Jul 2015.
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256.

A novel pump-driven veno-venous gas exchange system during extracorporeal CO2-removal.

Hermann A., Riss K., Schellongowski P., Bojic A., Wohlfarth P., Robak O., Sperr W.R., Staudinger T.
Intensive Care Medicine. 41 (10) (pp 1773-1780), 2015. Date of Publication: 22 Oct 2015.
AN: 606059304
Purpose: Pump-driven veno-venous extracorporeal CO2-removal (ECCO2-R) increasingly takes root in hypercapnic lung failure to minimize ventilation invasiveness or to avoid intubation. A recently developed device (iLA activve, Novalung, Germany) allows effective decarboxylation via a 22 French double lumen cannula. To assess determinants of gas exchange, we prospectively evaluated the performance of ECCO2-R in ten patients receiving iLA activve due to hypercapnic respiratory failure.
Method(s): Sweep gas flow was increased in steps from 1 to 14 L/min at constant blood flow (phase 1). Similarly, blood flow was gradually increased at constant sweep gas flow (phase 2). At each step gas transfer via the membrane as well as arterial blood gas samples were analyzed.
Result(s): During phase 1, we observed a significant increase in CO2 transfer together with a decrease in PaCO2 levels from a median of 66 mmHg (range 46-85) to 49 (31-65) mmHg from 1 to 14 L/min sweep gas flow ($p < 0.0001$), while arterial oxygenation deteriorated with high sweep gas flow rates. During phase 2, oxygen transfer significantly increased leading to an increase in PaO2 from 67 (49-87) at 0.5 L/min to 117 (66-305) mmHg at 2.0 L/min ($p < 0.0001$). Higher blood flows also significantly enhanced decarboxylation ($p < 0.0001$).
Conclusion(s): Increasing sweep gas flow results in effective CO2-removal, which can be further reinforced by raising blood flow. The clinically relevant oxygenation effect in this setting could broaden the range of indications of the system and help to set up an individually tailored configuration.

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26170097 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26170097]
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257.

Extracorporeal carbon dioxide removal in patients with chronic obstructive pulmonary disease: a systematic review.
Sklar M.C., Beloncle F., Katsios C.M., Brochard L., Friedrich J.O.
Intensive Care Medicine. 41 (10) (pp 1752-1762), 2015. Date of Publication: 25 Jun 2015.
AN: 605008577
Introduction: Extracorporeal carbon dioxide removal (ECCO2R) has been proposed for hypercapnic respiratory failure in chronic obstructive pulmonary disease (COPD) exacerbations, to avoid intubation or reduce length of invasive ventilation. Balance of risks, efficacy, and benefits of ECCO2R in patients with COPD is unclear.
Method(s): We systematically searched MEDLINE and EMBASE to identify all publications reporting use of ECCO2R in COPD. We looked at physiological and

clinical efficacy. A favorable outcome was defined as prevention of intubation or successful extubation. Major and minor complications were compiled.
Result(s): We identified 3123 citations. Ten studies (87 patients), primarily case series, met inclusion criteria. ECCO2R prevented intubation in 65/70 (93 %) patients and assisted in the successful extubation of 9/17 (53 %) mechanically ventilated subjects. One case-control study matching to noninvasively ventilated controls reported lower intubation rates and hospital mortality with ECCO2R that trended toward significance. Physiological data comparing pre- to post-ECCO2R changes suggest improvements for pH (0.07-0.15 higher), PaCO2 (25 mmHg lower), and respiratory rate (7 breaths/min lower), but not PaO2/FiO2. Studies reported 11 major (eight bleeds requiring blood transfusion of 2 units, and three line-related complications, including one death related to retroperitoneal bleeding) and 30 minor complications (13 bleeds, five related to anticoagulation, and nine clotting-related device malfunctions resulting in two emergent intubations).
Conclusion(s): The technique is still experimental and no randomized trial is available. Recognizing selection bias associated with case series, there still appears to be potential for benefit of ECCO2R in patients with COPD exacerbations. However, it is associated with frequent and potentially severe complications. Higher-quality studies are required to better elucidate this risk-benefit balance.

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26109400 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26109400]
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258.

Comparison of Coagulation Parameters, Anticoagulation, and Need for Transfusion in Patients on Interventional Lung Assist or Veno-Venous Extracorporeal Membrane Oxygenation.
Weingart C., Lubnow M., Philipp A., Bein T., Camboni D., Muller T.
Artificial Organs. 39 (9) (pp 765-773), 2015. Date of Publication: 01 Sep 2015.
AN: 604119605
Clinical data on anticoagulation needs of modern extracorporeal membrane oxygenation (ECMO) and its impact on coagulation are scarce. Therefore, we analyzed coagulation-related parameters, need for transfusion, and management of anticoagulation in adult patients with severe acute respiratory failure during treatment with either pumpless interventional lung assist (iLA) or veno-venous ECMO (vv-ECMO). Sixty-three patients treated with iLA and 192 patients treated with vv-ECMO at Regensburg University Hospital between January 2005 and May 2011 were analyzed. Data related to anticoagulation, transfusion, and coagulation parameters were collected prospectively by the Regensburg ECMO registry. Except for a higher, sequential organ failure assessment (SOFA) score in the ECMO group (12 [9-15] vs.

11 [7-14], P=0.007), a better oxygenation, and a lower dosage of vasopressors in the iLA patients, both groups had similar baseline characteristics. No difference was noted in terms of outcome and overall transfusion requirements. Factors of the plasmatic coagulation system were only marginally altered over time and did not differ between groups. Platelet counts in ECMO-treated patients, but not in those treated with iLA, dropped significantly during extracorporeal support. A more intense systemic anticoagulation with a mean activated partial thromboplastin time (aPTT)>53s led to a higher need for transfusions compared with the group with a mean aPTT<53s, whereas the average durability of membrane oxygenators was not affected. Need for red blood cell (RBC) transfusion was highest in patients with extrapulmonary sepsis (257mL/day), and was significantly lower in primary pulmonary adult respiratory distress syndrome (ARDS) (102mL/day). Overall, 110 (0-274) mL RBC was transfused in the ECMO group versus 146 (41-227) mL in the iLA group per day on support. The impact of modern iLA and ECMO systems on coagulation allows comparatively safe long-term treatment of adult patients with acute respiratory failure. A moderate systemic anticoagulation seems to be sufficient. Importantly, platelets are more affected by vv-ECMO compared with pumpless iLA.

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25921195 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25921195]
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259.

Assessing feasibility (and Increasing Simplicity) in extracorporeal rescue therapy for acute respiratory distress syndrome: The pulmonary and renal support in acute respiratory distress syndrome study.
Lanspa M.J., Zampieri F.G., Morris A.H.
Critical Care Medicine. 43 (12) (pp 2683-2685), 2015. Date of Publication: 01 Dec 2015.
AN: 606961424
PMID
26575659 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26575659]
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260.

Low-flow extracorporeal carbon dioxide removal moving closer to reality.
Moerer O., Brodie D., Quintel M.
American Journal of Respiratory and Critical Care Medicine. 192 (6) (pp 651-652), 2015. Date of Publication: 15 Sep 2015.
AN: 606144076
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26371808 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26371808]
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Link to the Ovid Full Text or citation:
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261.

Extracorporeal membrane oxygenation after living-related liver transplant.
Gedik E., Celik M.R., Otan E., Disli O.M., Erdil N., Bayindir Y., Kutlu R., Yilmaz S.
Experimental and Clinical Transplantation. 13 (Supplement 1) (pp 290-293), 2015. Date of Publication: 23 Jul 2015.
AN: 605757992
Various types of extracorporeal membrane oxygenation methods have been used in liver transplant operations. The main indications are portopulmonary or hepatopulmonary syndromes and other cardiorespiratory failure syndromes that are refractory to conventional therapy. There is little literature available about extracorporeal membrane oxygenation, especially after liver transplant. We describe our experience with 2 patients who had living-related liver transplant. A 69-year-old woman had refractory aspergillosis pneumonia and underwent pumpless extracorporeal lung assist therapy 4 weeks after liver transplant. An 8-month-old boy with biliary atresia underwent urgent liver transplant; he received venoarterial extracorporeal membrane oxygenation therapy on postoperative day 1. Despite our unsuccessful experience with 2 patients, extracorporeal membrane oxygenation and pumpless extracorporeal lung assist therapy for liver transplant patients may improve prognosis in selected cases.

PMID
25894176 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25894176]
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262.

A randomised controlled trial and cost-effectiveness analysis of high-frequency oscillatory ventilation against conventional artificial ventilation for adults with acute respiratory distress syndrome. The Oscar (Oscillation in ARDS) study.
Lall R., Hamilto N P., Hulme C., Hall P., Mackenzie I., Tunnicliffe W., Rowan K., Young D., Macnaughton P., Cuthbertson B., Plowright C., Tunnicliffe B., Drage S., Bellingan G., Shah S., Padkin A., Foex B., Hughes P., Elfituri K., McAuley F., Cairns C., Paddle J., Maddock H., Coleman N., Kong A., Lewis R., Bewsher M., Brodbeck A., Pogson D., Clark M., Mousdale S., Bodenham A., Cusack R., Bellamy M., Paw H., Cupitt J., Higgins D., Searl C., Wright J.
Health Technology Assessment. 19 (23) (pp 1-154), 2015. Date of Publication: 2015.
AN: 603578386
Background: Patients with the acute respiratory distress syndrome (ARDS) require artificial ventilation but this treatment may produce secondary lung damage. High-frequency oscillatory ventilation (HFOV) may reduce this damage.
Objective(s): To determine the clinical benefit and cost-effectiveness of HFOV in patients with ARDS compared with standard mechanical ventilation.
Design(s): A parallel, randomised, unblinded clinical trial.
Setting(s): UK intensive care units.
Participant(s): Mechanically ventilated patients with a partial pressure of oxygen in arterial blood/fractional concentration of inspired oxygen (P: F) ratio of 26.7 kPa (200 mmHg) or less and an expected duration of ventilation of at least 2 days at recruitment.
Intervention(s): Treatment arm HFOV using a Novalung R100 ventilator (Metran Co. Ltd, Saitama, Japan) ventilator until the start of weaning. Control arm Conventional mechanical ventilation using the devices available in the participating centres.
Main Outcome Measure(s): The primary clinical outcome was all-cause mortality at 30 days after randomisation. The primary health economic outcome was the cost per quality-adjusted life-year (QALY) gained.
Result(s): One hundred and sixty-six of 398 patients (41.7%) randomised to the HFOV group and 163 of 397 patients (41.1%) randomised to the conventional mechanical ventilation group died within 30 days of randomisation (p = 0.85), for an absolute difference of 0.6% [95% confidence interval (CI) -6.1% to 7.5%]. After adjustment for study centre, sex, Acute Physiology and Chronic Health Evaluation II score, and the initial P: F ratio, the odds ratio for survival in the conventional ventilation group was 1.03 (95% CI 0.75 to 1.40; p = 0.87 logistic regression). Survival analysis showed no difference in the probability of survival up to 12 months after randomisation. The average QALY at 1 year in the HFOV group was 0.302 compared to 0.246. This gives an incremental cost-effectiveness ratio (ICER) for the cost to society per QALY of 88,790 and an ICER for the cost to the NHS per QALY of 78,260.
Conclusion(s): The use of HFOV had no effect on 30-day mortality in adult patients undergoing mechanical ventilation for ARDS and no economic advantage. We suggest that further research into avoiding ventilator-induced lung injury should

concentrate on ventilatory strategies other than HFOV.

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25800686 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25800686]
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(Cairns) Stirling Royal Infirmary, Stirling, United Kingdom
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(Maddock) Wythenshawe Hospital, Manchester, United Kingdom
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(Cupitt) Victoria Hospital, Blackpool, United Kingdom
(Higgins) Southend Hospital, Westcliff-on-Sea, United Kingdom
(Searl) Royal Victoria Infirmary, Newcastle, United Kingdom
(Wright) James Cook University Hospital, Middlesbrough, United Kingdom
Publisher
NIHR Journals Library

263.

Extracorporeal CO2 removal as bridge to lung transplantation in life-threatening

hypercapnia.
Schellongowski P., Riss K., Staudinger T., Ullrich R., Krenn C.G., Sitzwohl C., Bojic A., Wohlfarth P., Sperr W.R., Rabitsch W., Aigner C., Taghavi S., Jaksch P., Klepetko W., Lang G.
Transplant International. 28 (3) (pp 297-304), 2015. Date of Publication: 01 Mar 2015.
AN: 601140944
In patients awaiting lung transplantation (LTX), adequate gas exchange may not be sufficiently achieved by mechanical ventilation alone if acute respiratory decompensation arises. We report on 20 patients with life-threatening hypercapnia who received extracorporeal CO2 removal (ECCO2-R) by means of the interventional lung assist (ILA, Novalung) as bridge to LTX. The most common underlying diagnoses were bronchiolitis obliterans syndrome, cystic fibrosis, and idiopathic pulmonary fibrosis, respectively. The type of ILA was pumpless arteriovenous or pump-driven venovenous (ILA activve, Novalung) in 10 patients each. ILA bridging was initiated in 15 invasively ventilated and five noninvasively ventilated patients, of whom one had to be intubated prior to LTX. Hypercapnia and acidosis were effectively corrected in all patients within the first 12 h of ILA therapy: PaCO2 declined from 109 (70-146) to 57 (45-64) mmHg, P < 0.0001; pH increased from 7.20 (7.06-7.28) to 7.39 (7.35-7.49), P < 0.0001. Four patients were switched to extracorporeal membrane oxygenation due to progressive hypoxia or circulatory failure. Nineteen patients (95%) were successfully transplanted. Hospital and 1-year survival was 75 and 72%, respectively. Bridging to LTX with ECCO2-R delivered by arteriovenous pumpless or venovenous pump-driven ILA is feasible and associated with high transplantation and survival rates.

PMID
25387861 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25387861]
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Publisher
Blackwell Publishing Ltd (E-mail: customerservices@oxonblackwellpublishing.com)

264.

Extracorporeal Co2 removal for chronic obstructive pulmonary disease: Too risky or ready for a trial?.
Beloncle F., Brochard L.
Critical Care Medicine. 43 (1) (pp 245-246), 2015. Date of Publication: 01 Jan 2015.
AN: 603431320
PMID
25514717 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25514717]
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(Brochard) Interdepartmental Division of Critical Care Medicine, University of Toronto, Toronto, ON, Canada
Publisher
Lippincott Williams and Wilkins (E-mail: LRorders@phl.lrpub.com)

265.

Novel approaches to minimize ventilator-induced lung injury.
Terragni P., Ranieri V.M., Brazzi L.
Current Opinion in Critical Care. 21 (1) (pp 20-25), 2015. Date of Publication: 13 Feb 2015.
AN: 601297026
Purpose of Review: To discuss the mechanisms of ventilator-induced lung injury and the pro and cons of the different approaches proposed by literature to minimize its impact in patients with acute respiratory distress syndrome. Recent Findings: Mechanical ventilation is indispensable to manage respiratory failure. The evolution of knowledge of the physiological principles and of the clinical implementation of mechanical ventilation is characterized by the shift of interest from its capability to restore 'normal gas exchange' to its capability of causing further lung damage and multisystem organ failure.
Summary: If one of the essential teachings to young intensivists in the 1980s was to ensure mechanical ventilation restored being able to immediately drain a pneumothorax (barotrauma), nowadays priority we teach to young intensivists is to implement 'protective' ventilation to protect the lungs from the pulmonary and systemic effects of ventilator-induced lung injury (biotrauma). At the same time, priority of clinical research shifted from the search of optimal ventilator settings (best positive end-expiratory pressure) and to the evaluation of 'super-protective' ventilation that integrating partial or total extracorporeal support tries to minimize the use of mechanical ventilation.

PMID
25546532 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25546532]
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Publisher
Lippincott Williams and Wilkins (E-mail: LRorders@phl.lrpub.com)

266.

Extra corporeal carbon dioxide removal: A reliable modality in refractory hypercapnia to prevent invasive ventilation.
Agarwal A.M., Singh T.K.
Indian Journal of Critical Care Medicine. 19 (5) (pp 286-288), 2015. Date of

Publication: 01 May 2015.
AN: 604397678
Extracorporeal carbon dioxide removal (ECCO2R) is a valid alternative to consider in hypercapnic respiratory failure in chronic obstructive pulmonary disease (COPD) patients to avoid invasive ventilation when noninvasive ventilation fails. Here we report a similar case, after obtaining informed consent, where a patient suffering from severe hypercapnic respiratory failure due to COPD, was selected for ECCO2R and improved remarkably.

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Publisher
Medknow Publications (B9, Kanara Business Centre, off Link Road, Ghatkopar (E), Mumbai 400 075, India)

267.

Leg for life? the use of sartorius muscle flap for the treatment of an infected vascular reconstructions after VA-ECMO use. A case report.
Patrut G.V., Neamtu C., Ionac M.
International Journal of Surgery Case Reports. 16 (pp 25-28), 2015. Date of Publication: 2015.
AN: 606128416
Introduction Veno-arterial extracorporeal membrane oxygenation (VA-ECMO1) systems are a life-saving option in the treatment of acute respiratory distress syndrome (ARDS2), but may be encumbered by severe vascular complications in the groin. Presentation of case A pregnant woman was admitted with respiratory failure due to H1N1 influenza. VA-ECMO was inserted percutaneously by the intensivists and then accidentally removed by the patient after 8 days. 24 h later VA-ECMO was reinstalled with surgical denudation of femoral vessels in another department. 2 h later, due to active bleeding and signs of limb ischemia, the patient was referred to our department and emergency trombectomy and patch angioplasty with PTFE were performed. Evolution was further bad with wound infection (Pseudomonas, Proteus), which imposed large debridement, replacing the PTFE patch with 2 parallel venous patches and wound reconstruction through sartorius muscle rotation. The wound underwent negative pressure therapy for 10 days and was skin grafted. The patient recovered under systemic antibiotic and virostatic therapy. Discussion Major complications of using VA-ECMO devices are related to vascular access, most common bleeding at the puncture site and acute limb ischemia. In the groin, sartorius muscle flap is the most used for vascular coverage and small tissue defect reconstruction because of the ease in harvesting and low donor-site complications. Conclusion Although ischemic complications associated with VA-ECMO are accepted by intensivists under the slogan "leg for life", for the repair of the femoral artery in the presence of groin infection the sartorius muscle remains an efficient solution for limb salvage.

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Publisher
Elsevier Ltd

268.

Thrombotic complications during interventional lung assist: Case series.
Kim E.J., Cho W.H., Ahn E.Y., Ryu D.G., Lee S.E., Jeon D.S., Kim Y.S., Son B.S., Kim D.H.
Tuberculosis and Respiratory Diseases. 78 (1) (pp 18-22), 2015. Date of Publication: 01 Jan 2015.
AN: 602795721
Interventional lung assist (iLA) effectively reduces CO2 retention and allows protective ventilation in cases of life-threatening hypercapnia. Despite the clinical efficacy of iLA, there are a few major limitations associated with the use of this approach, such as bleeding, thrombosis, and catheter-related limb ischemia. We presented two cases in which thrombotic complications developed during iLA. We demonstrated the two possible causes of thrombotic complications during iLA; stasis due to low blood flow and inadequate anticoagulation.

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Publisher
Korean National Tuberculosis Association (E-mail: knta@knta.or.kr)

269.

Outcome of extracorporeal membrane oxygenation as a bridge to lung transplantation: An institutional experience and literature review.
Inci I., Klinzing S., Schneiter D., Schuepbach R.A., Kestenholz P., Hillinger S., Benden C., Maggiorini M., Weder W.
Transplantation. 99 (8) (pp 1667-1671), 2015. Date of Publication: 01 Aug 2015.
AN: 606174059
Background. Extracorporeal life support (ECLS) as a bridge to lung transplantation (LuTx) is a promising option for patients with end-stage lung disease on the transplant waiting list. We investigated the outcome of patients bridged to lung transplantation on ECLS technologies, mainly extracorporeal membrane oxygenation

(ECMO). Methods. Between January 2007 and October 2013, ECLS was implanted in 30 patients with intention to bridge to LuTx. Twenty-six patients (26/30) were successfully bridged to LuTx on ECLS. Themost common diagnosis was cystic fibrosis (N = 12). Venovenous ECMO was used in 10, venoarterial in 4, interventional lung assist in 5, and stepwise combination of them in 7 recipients. Results. Two patients weaned from ECMO, and 2 patients died on ECMO on the waiting list. Median duration of ECLS was 21 days (1-81 years). Six patients were awake and spontaneously breathing during ECLS support. Thirty-day, 1-year, and 2-year survivals were 89%, 68%, and 53%, respectively, for bridged patients and 96%, 85%, and 79%, respectively, for control group (P = 0.001). Three months conditional survivals were 89% and 69% at 1 and 2 years for ECLS group, compared to 92% and 86% for control group (P = 0.03). Cystic fibrosis recipients had 82% survival rate at 1 and 2 years. All recipients bridged to LuTx on awake ECLS (N = 6) are alive with a median follow-up of 10.8 months (range, 6-21months). Conclusions. Our data show significantly lower survival in this high-risk group compared to patients transplanted without preoperative ECLS. Awake and ambulatory ECLS provides the best prognosis for these high-risk patients.

PMID
26308302 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26308302]
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Publisher
Lippincott Williams and Wilkins (E-mail: LRorders@phl.lrpub.com)

270.

VAD: Heart transplant: ECMO: lung transplant?.
Huddleston C.B.
Pediatric Transplantation. 19 (1) (pp 1-2), 2015. Date of Publication: 01 Feb 2015.
AN: 601076503
PMID
25546505 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25546505]
Institution
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Publisher
Blackwell Publishing Inc. (E-mail: subscrip@blackwellpub.com)

271.

Extracorporal carbon dioxide removal (ECCO2R) in a near fatal asthma attack.
Extrakorporale Dekarboxylierung (ECCO2R) zur Behandlung eines therapierefraktaren Status asthmaticus <Extrakorporale Dekarboxylierung (ECCO2R) zur Behandlung eines therapierefraktaren Status asthmaticus.>
Schneider T.-M., Hamm H., Eife C., Brettner F.
Anasthesiologie und Intensivmedizin. 56 (9) (pp 559-561), 2015. Date of Publication: October 2015.
AN: 606472520
Despite an intensified conventional therapy and highly invasive mechanical ventilation, conditions of a 47-year-old male patient suffering a fatal asthma attack deteriorated. Pump-assisted venovenous extracorporal carbon dioxide removal (vv-ECCO2R) therapy was started shortly after admission to the ICU. As a result, mechanical ventilation could be reduced to a lung-protective minimum. On day 3, sufficient breathing allowed weaning from the ventilator and subsequent ECCO2R. On day 5, the patient was ready to be transferred from the ICU. This case shows the efficacy of ECCO2R in severe, therapy-refractory asthma attacks, allowing a lung-protective ventilation.

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272.

Extracorporeal Co2 removal in hypercapnic patients at risk of noninvasive ventilation failure: A matched cohort study with historical control.
Del Sorbo L., Pisani L., Filippini C., Fanelli V., Fasano L., Terragni P., Dell'Amore A., Urbino R., Mascia L., Evangelista A., Antro C., D'Amato R., Sucre M.J., Simonetti U., Persico P., Nava S., Ranieri V.M.
Critical Care Medicine. 43 (1) (pp 120-127), 2015. Date of Publication: 01 Jan 2015.
AN: 600660695
Objectives: To assess efficacy and safety of noninvasive ventilation- plus-extracorporeal Co2 removal in comparison to noninvasive ventilation-only to prevent endotracheal intubation patients with acute hypercapnic respiratory failure at risk of failing noninvasive ventilation.
Design(s): Matched cohort study with historical control.
Setting(s): Two academic Italian ICUs.
Patient(s): Patients treated with noninvasive ventilation for acute hypercapnic respiratory failure due to exacerbation of chronic obstructive pulmonary disease (May 2011 to November 2013).
Intervention(s): Extracorporeal Co2 removal was added to noninvasive ventilation when noninvasive ventilation was at risk of failure (arterial pH <= 7.30 with arterial Pco2 > 20% of baseline, and respiratory rate >= 30 breaths/min or use of accessory muscles/ paradoxical abdominal movements). The noninvasive ventilationonly group was created applying the genetic matching technique (GenMatch) on a dataset including patients enrolled in two previous studies. Exclusion criteria for both groups

were mean arterial pressure less than 60 mm Hg, contraindications to anticoagulation, body weight greater than 120 kg, contraindication to continuation of active treatment, and failure to obtain consent.
Measurements and Main Results: Primary endpoint was the cumulative prevalence of endotracheal intubation. Twenty-five patients were included in the noninvasive ventilation-plus-extracorporeal Co2 removal group. The GenMatch identified 21 patients for the noninvasive ventilation-only group. Risk of being intubated was three times higher in patients treated with noninvasive ventilation- only than in patients treated with noninvasive ventilationplus- extracorporeal Co2 removal (hazard ratio, 0.27; 95% CI, 0.07-0.98; p = 0.047). Intubation rate in noninvasive ventilationplus-extracorporeal Co2 removal was 12% (95% CI, 2.5-31.2) and in noninvasive ventilation-only was 33% (95% CI, 14.6-57.0), but the difference was not statistically different (p = 0.1495). Thirteen patients (52%) experienced adverse events related to extracorporeal Co2 removal. Bleeding episodes were observed in three patients, and one patient experienced vein perforation. Malfunctioning of the system caused all other adverse events.
Conclusion(s): These data provide the rationale for future randomized clinical trials that are required to validate extracorporeal Co2 removal in patients with hypercapnic respiratory failure and respiratory acidosis nonresponsive to noninvasive ventilation.
PMID
25230375 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25230375]
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Publisher
Lippincott Williams and Wilkins (E-mail: LRorders@phl.lrpub.com)

273.

How should I ventilate a patient on ECMO or ECCO2R?. Comment ventiler un patient sous ECMO ou ECCO2R ? <Comment ventiler un patient sous ECMO ou ECCO2R ?.>
Schmidt M., Combes A.
Reanimation. 24 (2) (pp 344-351), 2015. Date of Publication: 2015.
AN: 602119468

The timing and the outcome of extracorporeal membrane oxygenation (ECMO) for acute respiratory distress syndrome (ARDS) have received considerable attention, but very little has been given to mechanical ventilation during ECMO. Although the impact of a protective ventilation has been markedly demonstrated for non-ECMO-supported ventilated patients, there is no consensus with ECMO yet. Consequently, ventilation management during ECMO is based on clinician preference, experience of centers with high case volumes, and local resource availability. Nevertheless, there is a physiological rationale, mainly based on animal studies, to advise an "ultraprotective" ventilation strategy with ECMO. This strategy will combine a tidal volume reduction (< 6 ml/ kg predicted body weight) and a plateau pressure reduction (<= 25 cmH2O) with high positive end-expiratory pressure level to provide lung recruitment (> 10 cmH2O). Future studies are urgently required to determine the best practice of mechanical ventilation during ECMO and its impact on patient-centered outcomes.

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Publisher
Springer-Verlag France (22, Rue de Palestro, Paris 75002, France. E-mail: york@springer-paris.fr)

274.

Prolonged Use of the Hemolung Respiratory Assist System as a Bridge to Redo Lung Transplantation.
Bermudez C.A., Zaldonis D., Fan M.-H., Pilewski J.M., Crespo M.M.
Annals of Thoracic Surgery. 100 (6) (pp 2330-2333), 2015. Date of Publication: 2015.

AN: 611183647
Although extracorporeal membrane oxygenation (ECMO) has been used frequently as a bridge to primary lung transplantation, active centers are conservative with this approach in patients requiring redo lung transplantation. We report the use of extracorporeal carbon dioxide removal, using the Hemolung respiratory assist system, as a prolonged bridge to lung transplantation, and the first use of the Hemolung as a bridge to redo lung transplantation. Hemolung support improved the patient's clinical status and allowed redo lung transplantation.

PMID
26652524 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26652524]
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Publisher
Elsevier USA

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275.

High-frequency oscillation ventilation for hypercapnic failure of conventional ventilation in pulmonary acute respiratory distress syndrome.
Friesecke S., Stecher S.-S., Abel P.
Critical Care. 19 (1) (no pagination), 2015. Article Number: 201. Date of Publication: May 01, 2015.
AN: 604437961
Introduction: High-frequency oscillation ventilation (HFOV) is regarded as particularly lung protective. Recently, HFOV has been shown to be not beneficial for acute respiratory distress syndrome (ARDS) patients in general. Due to its special physical effects, it could be beneficial, however, in inhomogeneous ARDS. This study evaluates the effect of HFOV on PaCO2 removal in hypercapnic patients with ARDS of pulmonary origin.
Method(s): Between October 2010 and June 2014 patients with ARDS of pulmonary origin with PaO2/FiO2 ratio >60 mmHg, but respiratory acidosis (pH <7.26) under optimized protective ventilation were switched to HFOV, using moderate airway pressure (adopting the mean airway pressure of the prior ventilation). Data from these patients were analyzed retrospectively; PaCO2 and pH before, 1 h and 24 h after the start of HFOV were compared.
Result(s): Twenty-six patients with PaO2/FiO2 ratio 139 +/- 49 and respiratory acidosis (PaCO2 68 +/- 12 mmHg) were put on HFOV after 17 +/- 22 h of conventional ventilation. Mean airway pressure was 19 cm H2O (15 to 28). PaCO2 decreased significantly: after 1 hour the mean difference was -14 +/- 10 mmHg; P <0.01 and after 24 hours -17 +/- 12 mmHg; P <0.01; n = 24. CO2 clearance improved in all but two patients; in those, extracorporeal lung support was initiated. Oxygenation remained unchanged after 1 h and slightly increased after 24 h. No complications related to HFOV were observed. Twenty-two patients improved and could be weaned from HFOV. Twenty patients (77%) were alive on day 30.
Conclusion(s): HFOV could be a useful alternative in patients with ARDS of pulmonary origin with hypercapnic failure of lung-protective conventional ventilation.

PMID
25929255 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25929255]
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BioMed Central Ltd. (E-mail: info@biomedcentral.com)

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276.

Novel Uses of Extracorporeal Membrane Oxygenation in Adults.

Abrams D., Brodie D.
Clinics in Chest Medicine. 36 (3) (pp 373-384), 2015. Date of Publication: 01 Sep 2015.
AN: 605028472
PMID
26304275 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26304275]
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Publisher
W.B. Saunders

277.

Veno-veno-arterial extracorporeal membrane oxygenation for respiratory failure with severe haemodynamic impairment: Technique and early outcomes.
Ius F., Sommer W., Tudorache I., Avsar M., Siemeni T., Salman J., Puntigam J., Optenhoefel J., Greer M., Welte T., Wiesner O., Haverich A., Hoeper M., Kuehn C., Warnecke G.
Interactive Cardiovascular and Thoracic Surgery. 20 (6) (pp 761-767), 2015. Date of Publication: 01 Jun 2015.
AN: 604815300
OBJECTIVES Patients with respiratory failure may benefit from veno-venous and veno-arterial extracorporeal membrane oxygenation (ECMO) support. We report on our initial experience of veno-veno-arterial (v-v-a) ECMO in patients with respiratory failure. METHODS Between January 2012 and February 2014, 406 patients required ECMO support at our institution. Here, we retrospectively analysed the characteristics and outcomes of patients commenced on either veno-venous or veno-arterial ECMO due to respiratory failure, and then switched to v-v-a ECMO. RESULTS Ten (2%) patients proceeded to v-v-a ECMO. The underlying conditions were acute respiratory distress syndrome (n = 3), end-stage pulmonary fibrosis (n = 5) and respiratory failure after major thoracic surgery (n = 1) and Caesarean section (n = 1). In all of these patients, ECMO was initially started as veno-venous (n = 9) or veno-arterial (n = 1) ECMO but was switched to a veno-veno-arterial (v-v-a) approach after a mean of 2 (range, 0-7) days. Reasons for switching were: haemodynamic instability (right heart failure, n = 5; pericardial tamponade, n = 1; severe mitral valve regurgitation, n = 1; haemodynamic instability following cardiopulmonary resuscitation, n = 1 and evidence of previously unknown atrial septal defect with pulmonary hypertension and Eisenmenger syndrome, n = 1) and upper-body hypoxaemia (n = 1). ECMO-related complications were bleeding (n = 3) and leg ischaemia (n = 2). Seven patients were successfully taken off ECMO with 4 being bridged to recovery and a further 3 to lung transplantation after a mean of 11 (range, 9-18) days. Five patients survived until hospital discharge and all of them were alive at the end of the follow-up. CONCLUSIONS Veno-veno-arterial ECMO is a technically feasible rescue strategy in treating patients presenting with combined respiratory and haemodynamic failure.

PMID
25736272 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25736272]

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Publisher
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278.

Noninvasive Ventilation Plus Extracorporeal C o 2 Removal in High-Risk Conditions: A Forthcoming Tool?.
Esquinas A.M., Peris A., Gifford A.H.
Critical Care Medicine. 43 (9) (pp e390), 2015. Date of Publication: 01 Sep 2015.
AN: 608983431
PMID
26274722 [http://www.ncbi.nlm.nih.gov/pubmed/?term=26274722]
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Publisher
Lippincott Williams and Wilkins (E-mail: kathiest.clai@apta.org)

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279.

Effects of extracorporeal CO2 removal on inspiratory effort and respiratory pattern in patients who fail weaning from mechanical ventilation.
Pisani L., Fasano L., Corcione N., Comellini V., Guerrieri A., Nava S., Ranieri M.V.
American Journal of Respiratory and Critical Care Medicine. 192 (11) (pp 1392-1394), 2015. Date of Publication: 01 Dec 2015.
AN: 607167049
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(Ranieri) Universita la Sapienza di Roma, Rome, Italy
Publisher
American Thoracic Society (E-mail: malexander@thoracic.org)

280.

Update on the role of extracorporeal CO2 removal as an adjunct to mechanical ventilation in ARDS.
Morimont P., Batchinsky A., Lambermont B.
Critical Care. 19 (1) (no pagination), 2015. Article Number: 117. Date of Publication: March 16, 2015.
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281.

Safety and efficacy of combined extracorporeal Co2 removal and renal replacement therapy in patients with acute respiratory distress syndrome and acute kidney injury: The pulmonary and renal support in acute respiratory distress syndrome study.
Allardet-Servent J., Castanier M., Signouret T., Soundaravelou R., Lepidi A., Seghboyan J.-M.
Critical Care Medicine. 43 (12) (pp 2570-2581), 2015. Date of Publication: 01 Dec 2015.
AN: 606579909
Objective: To assess the safety and efficacy of combining extracorporeal Co2 removal with continuous renal replacement therapy in patients presenting with acute respiratory distress syndrome and acute kidney injury.
Design(s): Prospective human observational study.
Setting(s): Patients received volume-controlled mechanical ventilation according to the acute respiratory distress syndrome net protocol. Continuous venovenous hemofiltration therapy was titrated to maintain maximum blood flow and an effluent flow of 45 mL/kg/h with 33% predilution.
Patient(s): Eleven patients presenting with both acute respiratory distress syndrome and acute kidney injury required renal replacement therapy.
Intervention(s): A membrane oxygenator (0.65 m2) was inserted within the

hemofiltration circuit, either upstream (n = 7) or downstream (n = 5) of the hemofilter. Baseline corresponded to tidal volume 6 mL/kg of predicted body weight without extracorporeal Co2 removal. The primary endpoint was 20% reduction in Paco2 at 20 minutes after extracorporeal Co2 removal initiation. Tidal volume was subsequently reduced to 4 mL/kg for the remaining 72 hours.
Measurements and Main Results: Twelve combined therapies were conducted in the 11 patients. Age was 70 +/- 9 years, Simplified Acute Physiology Score II was 69 +/- 13, Sequential Organ Failure Assessment score was 14 +/- 4, lung injury score was 3 +/- 0.5, and Pao2/Fio2 was 135 +/- 41. Adding extracorporeal Co2 removal at tidal volume 6 mL/kg decreased Paco2 by 21% (95% CI, 17-25%), from 47 +/- 11 to 37 +/- 8 Torr ($p < 0.001$). Lowering tidal volume to 4 mL/kg reduced minute ventilation from 7.8 +/- 1.5 to 5.2 +/- 1.1 L/min and plateau pressure from 25 +/- 4 to 21 +/- 3 cm H2O and raised Paco2 from 37 +/- 8 to 48 +/- 10 Torr (all $p < 0.001$). On an average of both positions, the oxygenator's blood flow was 410 +/- 30 mL/min and the Co2 removal rate was 83 +/- 20 mL/min. The oxygenator blood flow ($p <0.001$) and the Co2 removal rate ($p = 0.083$) were higher when the membrane oxygenator was placed upstream of the hemofilter. There was no safety concern.
Conclusion(s): Combining extracorporeal Co2 removal and continuous venovenous hemofiltration in patients with acute respiratory distress syndrome and acute kidney injury is safe and allows efficient blood purification together with enhanced lung protective ventilation.

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282.

The use of extracorporeal carbon dioxide removal to avoid intubation in patients failing non-invasive ventilation - a cost analysis.
Braune S., Burchardi H., Engel M., Nierhaus A., Ebelt H., Metschke M., Rosseau S., Kluge S.
BMC Anesthesiology. 15 (1) (no pagination), 2015. Article Number: 160. Date of Publication: November 04, 2015.
AN: 606719061
Background: To evaluate the economic implications of the pre-emptive use of extracorporeal carbon dioxide removal (ECCO2R) to avoid invasive mechanical ventilation (IMV) in patients with hypercapnic ventilatory insufficiency failing non-invasive ventilation (NIV).
Method(s): Retrospective ancillary cost analysis of data extracted from a recently published multicentre case-control-study (n = 42) on the use of arterio-venous ECCO2R to avoid IMV in patients with acute on chronic ventilatory failure. Cost calculations were based on average daily treatment costs for intensive care unit (ICU) and normal medical wards as well as on the specific costs of the ECCO2R system.
Result(s): In the group treated with ECCO2R IMV was avoided in 90 % of cases and mean hospital length of stay (LOS) was shorter than in the matched control group treated with IMV (23.0 vs. 42.0 days). The overall average hospital treatment costs

did not differ between the two groups (41.134 vs. 39.366 , p = 0.8). A subgroup analysis of patients with chronic obstructive pulmonary disease (COPD) revealed significantly lower median ICU length of stay (11.0 vs. 35.0 days), hospital length of stay (17.5 vs. 51.5 days) and treatment costs for the ECCO2R group (19.610 vs. 46.552 , p = 0.01).
Conclusion(s): Additional costs for the use of arterio-venous ECCO2R to avoid IMV in patients with acute-on-chronic ventilatory insufficiency failing NIV may be offset by a cost reducing effect of a shorter length of ICU and hospital stay.

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283.

Extracorporeal decarboxylation in patients with severe traumatic brain injury and ARDS enables effective control of intracranial pressure.
Munoz-Bendix C., Beseoglu K., Kram R.
Critical Care. 19 (1) (no pagination), 2015. Article Number: 381. Date of Publication: October 30, 2015.
AN: 606639170
Introduction: Acute respiratory distress syndrome (ARDS) with concomitant impairment of oxygenation and decarboxylation represents a complex problem in patients with increased intracranial pressure (ICP). Permissive hypercapnia is not an option to obtain and maintain lung-protective ventilation in the presence of elevated ICP. Pumpless extracorporeal lung assist (pECLA) devices (iLA Membrane Ventilator; Novalung, Heilbronn, Germany) can improve decarboxylation without aggravation associated with invasive ventilation. In this pilot series, we analyzed the safety and efficacy of pECLA in patients with ARDS and elevated ICP after severe traumatic brain injury (TBI).
Method(s): The medical records of ten patients (eight male, two female) with severe ARDS and severe TBI concurrently managed with external ventricular drainage in the neurointensive care unit (NICU) were retrospectively analyzed. The effect of pECLA on enabling lung-protective ventilation was evaluated using the difference between plateau pressure and positive end-expiratory pressure, defined as driving pressure (DELTAP), during the 3 days preceding the implant of pECLA devices until 3 days afterward. The ICP threshold was set at 20 mmHg. To evaluate effects on ICP, the volume of daily cerebrospinal fluid (CSF) drainage needed to maintain the set ICP threshold was compared pre- and postimplant.
Result(s): The DELTAP values after pECLA implantation decreased from a mean 17.1 +/- 0.7 cm/H2O to 11.9+/-0.5 cm/H2O (p = 0.011). In spite of this improved lung-protective ventilation, carbon dioxide pressure decreased from 46.6 +/- 3.9 mmHg to 39.7 +/- 3.5 mmHg (p = 0.005). The volume of daily CSF drainage needed to

maintain ICP at 20 mmHg decreased significantly from 141.5 +/- 103.5 ml to 62.2 +/- 68.1 ml (p = 0.037).
Conclusion(s): For selected patients with concomitant severe TBI and ARDS, the application of pECLA is safe and effective. pECLA devices improve decarboxylation, thus enabling lung-protective ventilation. At the same time, potentially detrimental hypercapnia that may increase ICP is avoided. Larger prospective trials are warranted to further elucidate application of pECLA devices in NICU patients.

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284.

Pharmacobiological approach for the clinical development of ruxolitinib in myeloproliferative neoplasms. Miyeloproliferatif neoplazilerde ruxolitinib Ilacinin klinik gelistirilmesine farmakobiyolojik yaklasim <Miyeloproliferatif neoplazilerde ruxolitinib Ilacinin klinik gelistirilmesine farmakobiyolojik yaklasim.>
Eliacik E., Isik A., Aksu S., Uner A., Buyukasik Y., Sayinalp N., Goker H., Ozcebe O.I., Haznedaroglu I.C.
Turkish Journal of Hematology. 32 (2) (pp 163-167), 2015. Date of Publication: 2015.

AN: 604812436
Ruxolitinib, a JAK1 and JAK2 inhibitor drug, has recently been approved for the treatment of patients with high- or intermediaterisk myelofibrosis with symptomatic splenomegaly. Ruxolitinib is the first clinically useful targeted therapy in Philadelphia chromosome-negative myeloproliferative neoplasms (MPns). The aim of this paper is to indicate pharmacobiological aspects of ruxolitinib within the potential context of MPns. Pharmacobiological assessments, in addition to knowledge of the risk profile for ruxolitinib in MPns, are required. We propose hypotheses based on our experience in a splenectomized MPn patient with hyperproliferative bone marrow and moderate fibrosis receiving ruxolitinib. We believe that a true clinical development approach for this drug should include pharmacobiological assessments for ruxolitinib in addition to the disease risk profile of MPns.

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285.

Factors of tidal volume variation during augmented spontaneous ventilation in patients on extracorporeal carbon dioxide removal. A multivariate analysis.
Bein T., Muller T., Graf B.M., Philipp A., Zeman F., Schultz M.J., Slutsky A.S., Weber-Carstens S.
Minerva Anestesiologica. 81 (1) (pp 28-32), 2015. Date of Publication: 01 Jan 2015.
AN: 603336445
Background. Extracorporeal carbon dioxide removal (ECCO2-R) allows lung protective ventilation using lower tidal volumes (VT) in patients with acute respiratory failure. The dynamics of spontaneous ventilation under ECCO2-R has not been described previously. This retrospective multivariable analysis examines VT patterns and investigates the factors that influence VT, in particular sweep gas flow and blood flow through the artificial membrane. Methods. We assessed VT, respiratory rate (RR), minute ventilation (MV), and levels of pressure support (0-24 cm H2O), sweep gas flow (0-14 L/min) and blood flow through the membrane (0.8-1.8 L/min) in 40 patients from the moment they were allowed to breathe spontaneously. Modest hypercapnia was accepted. Results. Patients tolerated moderate hypercapnia well. In a generalized linear model the increase in sweep gas flow (P<0.001), a low PaCO2 (P=0.029), and an increased breathing frequency (P<0.001) were associated with lower VT. Neither blood flow through the membrane (P=0.351) nor the level of pressure support (P=0.595) influenced VT size. Conclusion. Higher sweep gas flow is associated with low VT in patients on extracorporeal lung assist and augmented spontaneous ventilation. Such a technique can be used for prolonged lung protective ventilation even in the patient's recovery period.

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286.

Relative low flow extra corporeal CO2-removal in ards patients: A pilot study.
Peperstraete H., Eloot S., Depuydt P., Roosens C., De Somer F., Hoste E.
Intensive Care Medicine Experimental. 3 (Supplement 1) (no pagination), 2015.
Article Number: A513. Date of Publication: 01 Oct 2015.
AN: 611852846

Introduction Mechanical ventilation (MV) of patients with Acute Respiratory Distress Syndrome (ARDS) should be performed with a lung protective strategy, since this is associated with better clinical outcomes. Lung protective MV contains the lowering of the plateau pressure (PPLAT) and the tidal volume (VT). Physician's choice for lung protective MV can be hindered by the consequence of decreased CO2 clearance, i.e. respiratory acidosis. Veno-venous extracorporeal CO2-removal (ECCO2-R) is a recent therapy allowing extracorporeal CO2 clearance and normalisation of pH. Objectives The aim of this pilot study was to evaluate whether ECCO2-R using relative low blood flow was able to treat respiratory acidosis in ARDS patients treated with lung protective MV, so that further reduction of PPLAT and VT was feasible. Methods This is a single centre trial in which patients who met the Berlin definition of ARDS with a PaO2/FiO2 < 150mmHg and who had respiratory acidosis were included. The first 2 hours of therapy blood flow was 300ml/min, after which it was increased to 400ml/min. During the ECCO2-R we aimed at lowering PPLAT and VT. For every patient we used the Abylcap device (Bellco, Italy) with either the Lynda machine (8 patients) or the AmplyaTM (1 patient). Every patient was heparinized to prevent clotting of the circuit and oxygenator. During the complete study period, ventilator settings and results of blood gases were recorded. Data are reported as median [interquartile range] or n (%). Results We included 9 patients, 4 female, with a median age of 50 y [22.8, 66.5]. All patients showed a decrease of pCO2 after 2 hours of treatment with median reduction of 28.2% [11.6, 31.0; p = 0.008]; five patients (56%) had a decrease in pCO2 of more than 20%. The median reduction in PPLAT after 5 days (D5) of treatment was 8.5cmH2O (5.3, 12.5; p = 0.012). Median reduction in VT at D5 was 1.52ml/kg predicted body weight (0.65, 1.85; p = 0.017). In all patients pH could be corrected to normal range values with an increase of median pH from 7.17 (7.11, 7.21) at inclusion to 7.42 (7.40,7.44) (p = 0.012) at D5. ECCO2-R was hemodynamically well tolerated. Three patients needed a blood transfusion because of bleeding. Two patients needed a circuit renewal earlier than scheduled because of clotting of the circuit or oxygenator, both patients were treated with the Lynda machine. Conclusions In patients with moderate ARDS, veno-venous ECCO2-R using relative low blood flow is a promising extracorporeal technique allowing removal of CO2, thus allowing MV with lower PPLAT and VT. An explanation for the inter-patient variation in efficiency of CO2 removal could not be found in our patient cohort.

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287.

Coagulation disorders in subjects undergoing pump-driven veno-venous ECCO2-r for severe acute hypercapnic respiratory failure - a single center experience.

Harler U., Lehner G.F., Hasslache J., Joannidis M.
Intensive Care Medicine Experimental. 3 (Supplement 1) (no pagination), 2015.
Article Number: A512. Date of Publication: 01 Oct 2015.
AN: 611852845
Introduction Recent evidence suggests low-flow extracorporeal CO2 removal (ECCO2-R) systems as safe and promising adjunctive therapy to avoid endotracheal intubation and the related negative consequences in subjects with severe hypercapnic respiratory failure [1]. In high-flow extracorporeal membrane oxygenation systems heterogeneous coagulation disorders are a well-known complication. However, to date there is little evidence for the influence of pump-driven low-flow veno-venous ECCO2-R on the coagulation system. Objectives This study is a retrospective analysis of four subjects developing coagulation disorders with bleeding complications while undergoing ECCO2-R. Methods Four subjects treated with a pump-driven veno-venous ECCO2-R (system: iLA Activve; membrane ventilator: Minilung; Novalung GmbH, Talheim, Germany) for severe hypercapnic respiratory failure due to acute exacerbation of COPD were included in this study. Unfractionated heparin was used for anticoagulation with a target aPTT of 45-55 sec. Coagulation parameters i.e. hemoglobin, platelets, fibrinogen, antithrombin and D-DIMER were retrieved from the charts at treatment initiation and during the time range starting 72 hours before and ending at the clinical onset of the bleeding complication. Results Mean application time of ECCO2-R was 196.5 h (+/- 77.4) with an average blood flow of 1.1 l/min (+/- 0.2). Bleeding events consisted of two pulmonary bleedings, one large soft tissue hematoma and one hemothorax. Coagulation parameters are depicted below in Table 1. ECCO2-R was removed in all subjects after onset of the bleeding complication resulting in stabilization of the coagulation state. Conclusions Despite adequate anticoagulation subjects undergoing pump-driven veno-venous ECCO2-R developed coagulation disorders similar to disseminated intravascular coagulation with concomitant bleeding complications. The underlying mechanism remains to be clarified.

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288.

In patients under extracorporeal CO2 removal therapy (ECCO2R) for ards can we do prone position? efficiency, stability and safety of the maneuver.
Ngasseu P., Ponthus J.P., Amilien V., Tchir M., Georger J.F.
Intensive Care Medicine Experimental. 3 (Supplement 1) (no pagination), 2015.
Article Number: A511. Date of Publication: 01 Oct 2015.
AN: 611852844
Introduction The mechanical ventilation of some patients with ARDS could be facility by ECCO2R allowing the reduction of blood acidosis and the reduction of tidal volume for the application of the protective ventilation. Prone position (PP) could be used for some patients with PaO2/FiO2 < 150. We don't know if we could associate PP and ECCO2R in ARDS patients Objectives The aim of this study is to describe the feasibility of PP under ECCO2R, the stability of the parameters of the device and

if we have side effect of the PP under ECCO2R. Methods In our intensive care unit of 15 beds with a large experience of PP, we have retrospectively included all sessions of PP (at least 16 hours of PP) performed on patients under ECCO2R therapy between august 2014 and march.2015. We used ILA ACTIVVE device (NOVALUNG) with MINILUNG membrane and a double line femoral catheter (NOVAPORT TWIN 24F). The gas flow was 10l/ min. For each session we compared PaO2/FiO2 and the PaCO2 before and after 1H of PP. For each session, we did the mean of blood flow and drainage pressure (P1) during a length of one hour: during the last hour before PP, the first hour after PP and the last hour before stopping PP. We compared with a Friedman's test, the mean and the coefficient of variation of each parameter to evaluate the stability of the device. We noted all the side effects of the PP (bleeding, decanulation, etc.). Results We performed 9 PP sessions on 5 patients, 1 in 3 patients and 3 in 2 patients. The PaO2/FiO2 ratio was higher during PP (136(78-250) than before PP (126(58-145)). Between before, the beginning and the end of PP we didn't found difference in blood flow, respectively 1472ml/min (1201-1971), 1403ml/min (1216 - 1850), 1447ml/min (1231 - 2012), and in P1, respectively -37mmHg (-46- -25), -41mmHg (-50 - -28), -41mmHg (-47- -29).. The coefficient of variation of the blood flow was low and we didn't found variations of it between these 3 moments, respectively (0.9% (0.7 - 2.8), 0.7% (0.4- 2.1), 0.6% (0.4 - 1.6). The coefficient of variation of P1 was low and it was lower at PP than before PP($p < 0.05$), respectively: 8.2% (3.7 - 9.9), 5.6% (2.8 - 6.8), 4.2% (2.9 - 5.8). We didn't found side effects of the PP maneuver. Conclusions Prone position under ECCO2R with a femoral catheter is possible. We found no side effect of this technique. None difference in the blood flow, in the drainage pressure and in the stability of the blood flow were found. The stability of the drainage pressure is better in PP. The PaO2/FiO2 ratio is better on PP.

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289.

Ultra-low tidal volumes and extracorporeal carbon dioxide removal (Hemolung RAS) in ards patients. a clinical feasibility study.
Parrilla F.J., Bergesio L., Aguirre-Bermeo H., Suarez J.C., Lopez P., Moran I., Mancebo J.
Intensive Care Medicine Experimental. 3 (Supplement 1) (no pagination), 2015. Article Number: A7. Date of Publication: 2015.
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290.

ECCO2R, a French national survey.
Deniau B., Ricard J.D., Messika J., Dreyfuss D., Gaudry S.
Intensive Care Medicine Experimental. 3 (Supplement 1) (no pagination), 2015.
Article Number: A679. Date of Publication: 2015.
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291.

Veno-venous ECCO2-removal: A pilot study.
Peperstraete H., Eloot S., De Puydt P., Roosens C., Dhondt A., Claus S., De Rudder J., Hoste E.
International Journal of Artificial Organs. Conference: 42nd Annual European Society for Artificial Organs, ESAO Congress. Belgium. 38 (7) (pp 373-374), 2015. Date of Publication: July 2015.
AN: 614837592
Introduction: Patients with Acute Respiratory Distress Syndrome (ARDS), should be treated with lung protective mechanical ventilation (MV). Lung protective MV includes lowering of tidal volume (VT) and plateau pressure (PPLAT). It is less harmful for the lungs and associated with better outcomes. However, it is also associated with decreased lung clearance of CO2, resulting in respiratory acidosis. Extracorporeal CO2-removal (ECCO2-R) is a new veno-venous therapy allowing CO2 clearance. The aim of this pilot study was to evaluate whether this therapy was able to treat respiratory acidosis allowing reduction of PPLAT and VT.
Material(s) and Method(s): In this single centre trial, we included patients who met the Berlin definition of ARDS and who had respiratory acidosis. The first 2 hours blood flow was at 300 ml/min, after which it was increased to 400 ml/min. During ECCO2-R (Abylcap, Bellco) we aimed at lowering PPLAT and VT.
Result(s): We included 9 patients, 4 female, with a median age of 50 y [22.8; 66.5]. All patients showed a decrease of pCO2 after 2 hours of treatment, median reduction was 28.2% [11. 6; 31.0]; p = 0.008. Five patients (56%) achieved a decrease in pCO2 of more than 20%. The median reduction in PPLAT after 5 days (D5) of treatment was 8.5 cmH2O [5.3; 12.5]; p = 0.012. Median reduction in VT at D5 was 1.52 ml/kg predicted body weight [0.65; 1.85]; p = 0.017. In all patients pH could be corrected to normal range values, the median difference of pH at D5 was 0.23 [0.21; 0.27]; p = 0.012. Three patients needed a blood transfusion because of bleeding.
Discussion(s): Veno-venous ECCO2-R is a very promising extracorporeal technique to remove CO2, allowing MV of ARDS patients with lung protective strategies. An explanation for the inter-patient variation in efficiency of CO2 removal could not be

found in our patient cohort.
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292.

Extracorporeal carbon dioxide removal in patients with chronic obstructive pulmonary disease: A systematic review.
Sklar M.C., Beloncle F., Friedrich J.O., Wald R., Brochard L.J.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2015. Denver, CO United States. Conference Publication: (var.pagings). 191 (MeetingAbstracts) (no pagination), 2015. Date of Publication: 2015.
AN: 72052435
Introduction Extracorporeal carbon dioxide removal (ECCO2R) devices have been proposed as an adjunct to mechanical ventilation in patients with hypercapnic acute respiratory failure, in particular, in cases of chronic obstructive pulmonary disease (COPD) exacerbations, to avoid intubation or reduce the length of invasive ventilation. The general principle consists of an extracorporeal circuit similar to a continuous veno-venous hemofiltration circuit but with a membrane allowing the elimination of carbon dioxide (CO2) from the blood. However, because of a high risk of clotting, full anticoagulation is needed. Thus the balance of risks and benefits of ECCO2R in patients with COPD exacerbations is unknown. Methods We conducted a systematic review to identify all publications implementing ECCO2R devices in patients with exacerbations of COPD. We searched Medline and Embase for works published before August 2014 using the following keywords: ECCOR, ECCO2R, CO2 removal and extracorporeal. We included a study if at least 1 patient with COPD was treated by ECCO2R. A favorable outcome was defined by prevention of intubation in patients receiving non-invasive ventilation, or successful extubation when the device was implemented after intubation. Complications were classified as severe adverse events (death or life threatening conditions related to a device complication, transfusion of >2 units PRBC or open surgery) or adverse events (bleeding requiring <2 units PRBC, transient thrombocytopenia or non-life threatening event related to catheter insertion). Results We identified 3123 citations. Nine articles met inclusion criteria and were analyzed in detail. In total, 81 patient cases were analyzed. Non-invasive ventilation was used in 64 cases (79%) and invasive ventilation in 17 cases (21%). A veno-venous system was used in 60 patients (74%) and an arterio-venous device in 21 patients (26%). A heparin infusion was used in all cases. The outcome was favourable in 68 patients (84%). Total rate of complication was 69%. Complications were considered severe in 11 cases (14%) and non-severe in 45 cases (55%). Bleeding occurred in 19 cases (23%). Five (6%) cases of thrombocytopenia were reported. A complication related to the catheter insertion was observed in 6 cases (7%). Conclusion Although a selection bias towards favorable outcomes in case series cannot be ruled out, there is potential for significant therapeutic benefit of ECCO2R in patients with COPD exacerbations. However it is associated with frequent and potentially severe complications. These risks have to be taken into account especially when considering the adjunctive nature of this technique in this group of patients.

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293.

Evolution of complications of extracorporeal life support for respiratory failure. Preliminary results of a systematic review.
Vaquer S., Peruga P., De Haro C., Oliva J., Combes A., Artigas A.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2015. Denver, CO United States. Conference Publication: (var.pagings). 191 (MeetingAbstracts) (no pagination), 2015. Date of Publication: 2015.
AN: 72052434
Rationale: Evidence suggests that in severe and refractory ARF (Acute Respiratory Failure), extracorporeal life support (ECLS) could be beneficial. However, it is associated with potentially severe complications. Technological improvements have been postulated to reduce the ratio of complications and have permitted its expansion, however, as recently reported, the rate of complications remains high. A systematic review of published literature was performed to confirm that ECLS represents a safe therapeutic alternative and that associated complications have decreased in time.
Method(s): MEDLINE was searched to find articles reporting complications of VV-ECMO or Extracorporeal CO2 Removal (V-V or A-V) use in any form of refractory ARF. Meta-Analysis, Systematic Reviews and reports base on international or national databases were excluded to avoid overlapping of patients. Case reports and series reporting less than 5 patients were excluded to minimize publication bias. Only articles written in English were included. Studies were evaluated according to their realization time and grouped according to centre experience (cases/year). Spearman correlation and Mann-Whitney U were used to compare variables. Results and Conclusion(s): Database search returned 762 potential articles. Sixty-six fulfilled inclusion criteria representing 1654 patients with ARF. Medical complications per patient remained stable in time (mean = 0.58, Rho = - 0.012, p = 0.924), however associated mortality decreased (Rho = -0.272, p = 0.039). Frequency of mechanical complications per patient was constant (mean = 0.39, Rho = -0.1, p = 0.569) however hollow-fibre membranes were associated with a decrease in mortality due to major bleeding (mean = 0.12 vs. 0.04, U = 8, p = 0.022) compared to spiral membranes. The occurrence of multiple organ failure (MOF) per patient during ECLS and mortality due to MOF decreased in experienced centres (0.1 vs. 0.05, p = 0.009 & 0.29 vs. 0.15, p = 0.009). Maximum cannula size increased during the studied period (mean = 23.4 French, Rho = 0.363, p = 0.013) and correlated with mortality due to major bleeding (Rho = 0.582, p = 0.004), mortality caused by MOF (Rho = 0.545, p = 0.019) and transfusion requirements (Rho = 0.819, p < 0.001). In conclusion, medical complications are frequent during respiratory ECLS, but associated mortality has decreased since first ECMO reports. Higher experience in ECLS, in combination with improved membrane technology seems to be determinant. Additionally, the use of high borne cannulas is expanding, however it use should be carefully weighted against its associated risks.
Institution

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Publisher
American Thoracic Society

294.

Ultraprotective mechanical ventilation without extracorporeal CO2 removal: Case report.
Alnijoumi M., Whitacre T., Collins J.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2015. Denver, CO United States. Conference Publication: (var.pagings). 191 (MeetingAbstracts) (no pagination), 2015. Date of Publication: 2015.
AN: 72050974
INTRODUCTION: Mechanical ventilation has been utilized since the polio epidemic1. It can induce a plethora of complications - barotrauma, multi-organ dysfunction, cardiovascular compromise, lung injury, and diaphragmatic dysfunction. Low tidal volume ventilation (6 ml/kg) was shown to improve mortality when compared with conventional mechanical ventilation (12 ml/kg)2 in Acute Respiratory Distress Syndrome (ARDS). One recent study discussed the benefit of ultraprotective mechanical ventilation (UPMV) using 3 ml/kg predicted body weight (PBW) combined with extracorporeal CO2 removal (ECCO2-R) in ARDS patients . We present a case of UPMV utilizing 2-3 ml/kg PBW without 3 ECCO2-R. CASE PRESENTATION: A 36 y/o female attempted suicide by intentional ingestion and was intubated for hypoxemia. She had a leukocytosis, elevated serum osmolality, and elevated blood alcohol level. Arterial blood gas revealed hypercapneic and hypoxemic respiratory failure - PaO2/FiO2 ratio of 125. Chest radiography demonstrated bilateral diffuse airspace opacities. Tidal volumes (TV) of 6ml/kg PBW were achieved at approximately 400ml's +/-10%. Her course was complicated by progressive hypoxemia, requiring increased PEEP and neuromuscular blocking agents. Plateau pressure (Pplat) was consistently >=30 cmH2O so TV goal was titrated downward to 2 ml/kg PBW and sustained over 5 days (see figure). On day 8 continuous positive airway pressure (CPAP) was utilized as oxygenation and lung compliance improved. Extubation was attempted on day 11, however she was reintubated for refractory stridor but successfully extubated 6 days later. Patient was discharged home on day 20 with no evidence of muscular weakness. DISCUSSION: ARDSnet trial2 demonstrated that protective mechanical ventilation with low TV improves mortality. Injury as a result of positive pressure is thought to take place from increased distending pressures on the lung parenchyma resulting in regional overdistention4. If Pplat remains high, decreasing TV may mitigate harm3. This is the first case describing UPMV without the use of ECCO2-R employed by Bein et al.3. Higher levels of PaCO2 and lower blood pH were accepted facing elevated and increasing Pplat. No significant cardiovascular or hemodynamic compromise was noted. Oxygen requirement continued to decrease, consistent with animal studies showing no change in oxygen requirement during lower tidal volume targets with mechanical ventilation5.
CONCLUSION(S): UPMV (<= 4ml/kg PBW) without ECCO2-R could be attempted in ARDS with high Pplat. Acceptable levels of hypercarbia and acidosis would need to be discussed with bedside clinicians. Further study evaluating the effect(s) of UPMV

is needed before this strategy can be recommended for widespread use.
Institution
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Publisher
American Thoracic Society

295.

Ards treatment strategies and protocols: Availability in 25 tertiary care ICUS.
Duan E., Adhikari N., D'Aragon F., Hand L., Austin P., Al-Hazzani W., Fox-Robichaud A., Cook D.J., Ferguson N.D., Meade M.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2015. Denver, CO United States. Conference Publication: (var.pagings). 191 (MeetingAbstracts) (no pagination), 2015. Date of Publication: 2015.
AN: 72050971
Rationale: Clinicians' use of acute respiratory distress syndrome (ARDS) treatment strategies is determined by a combination of factors including availability, established and emerging clinical research and knowledge translation. The objective of this study is to describe the availability of ARDS treatment strategies and protocols in 25 tertiary care ICUs.
Method(s): Nested within an ongoing observational trial of ARDS management, we surveyed 25 ICUs (24 from Canada and 1 from Saudi Arabia) that participated in Oscillation for ARDS Treated Early (OSCILLATE), a trial of early high frequency oscillation for moderate-to-severe ARDS. We asked clinical research coordinators and physician leaders to report on the current availability of various conventional and advanced ventilation technologies, respiratory adjuncts and local protocols to guide implementation. We distributed an electronic, self-administered questionnaire to research coordinators and sought consultation with physician leaders by email if clarification was needed.
Result(s): All 25 ICUs responded. The median (IQR) number of beds was 23.5 (16, 30). Among these 25 ICUs, 24 have rotating residents, 23 have critical care fellows and 21 have research coordinators. ardsauditsitesnov3. png The most commonly available adjuncts to ARDS management (Figure 1) were airway pressure release ventilation (96%), pulmonary vasodilators (96%), high frequency oscillation (92%) and esophageal pressure monitoring (64%). Extracorporeal life support (ECLS) was only available in 44% of centers, but 96% of centers indicated they could access ECLS at a nearby center. In the 11 centers with ECLS, Novalung iLA was available in 8 centers, extracorporeal membrane oxygenation in 8 centers, and Hemolung RAS in 2 centers. The most commonly available protocols (Figure 1) were for low tidal volume ventilation (84%), high frequency oscillation (80%), pulmonary vasodilators (76%), prone positioning (72%) and PEEP/FiO2 table (68%). Protocols for neuromuscular blockers were only available in 24% of centers.
Conclusion(s): Amongst the 25 tertiary care ICUs surveyed, the most available respiratory adjuncts for ARDS are airway pressure release ventilation and pulmonary vasodilators, both of which have a physiologic rationale but are without proven mortality benefit. The most common protocol focus at these centers is for low tidal volume ventilation, an evidence-based ventilation strategy shown to reduce mortality in ARDS. Availability of ARDS adjuncts and knowledge translation tools such as protocols do not imply frequent use at each site; further study is ongoing to determine

actual utilization.
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Publisher
American Thoracic Society

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Click here for full text options

296.

Safety and efficacy of extracorporeal CO2 removal combined with continuous renal replacement therapy in patients presenting both acute respiratory distress syndrome and acute kidney injury.
Allardet-Servent J., Castanier M., Signouret T., Lepidi A., Soundaravelou R., Seghboyan J.
Critical Care. Conference: 35th International Symposium on Intensive Care and Emergency Medicine. Brussels Belgium. Conference Publication: (var.pagings). 19 (SUPPL. 1) (pp S96-S97), 2015. Date of Publication: 16 Mar 2015.
AN: 71938679
Introduction Pulmonary overdistension has been observed in 33% of patients with acute respiratory distress syndrome (ARDS) despite low tidal volume (6 ml/kg ideal body weight) ventilation [1]. Tidal volume (VT) reduction from 6 to 4 ml/kg attenuates overdistension but is associated with hypercarbia [2]. We thought to combine extracorporeal CO2 removal (ECCO2 R) with continuous renal replacement therapy (CRRT) through the insertion of an oxygenator membrane within the hemofiltration circuit in patients presenting both ARDS and acute kidney injury (AKI). Methods A first set of measurement was performed at 6 ml/kg before and after ECCO2 R. Twenty minutes later, VT was reduced to 4 ml/kg for the remainder of the study period (72 hours). Ventilator settings were those of the ARMA trial. The CRRT mode was hemofiltration with 33% of predilution. Ultrafiltration was adjusted to achieve a filtration fraction of 15%. Sweep gas flow was constant at 8 l/minute. The primary endpoint was a 20% reduction of PaCO2 at 20 minutes after initiation of ECCO2 R. Results Eight patients were studied. Age was 69 +/- 11 years, SAPS II was 68 +/- 9 and SOFA score was 13 +/- 4 at inclusion. Blood flow, at the inlet of the oxygenator membrane, was 400 +/- 4 ml/minute. CO2 removal rate was 84 +/- 4 ml/minute. Initiating ECCO2 R, at 6 ml/kg, induced a mean PaCO2 reduction of 17% (41 +/- 5.5 to 33.9 +/- 5.6 mmHg, P <0.001). Then, lowering the VT to 4 ml/kg induced a mean PaCO2 increase of 25% (33.9 +/- 5.6 to 42.6 +/- 8 mmHg) and a mean PaO2 /FIO2 ratio increase of 8% (176 +/- 63 to 190 +/- 61). Minute ventilation decrease from 7.4 +/- 1.6 to 5 +/- 1.2 l/minute. Respiratory system compliance did not vary. No major complications were observed. Conclusion Combining ECCO2 R and CRRT in patients with ARDS and AKI is safe and feasible through the insertion of an oxygenator membrane within a RRT circuit.
Institution
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Publisher
BioMed Central Ltd.

297.

Determinants of gas exchange during extracorporeal CO2 removal using a novel pump-driven venovenous gas exchange system in a minimally invasive setting.
Hermann A., Riss K., Schellongowski P., Bojic A., Wohlfarth P., Robak O., Sperr W., Staudinger T.
Critical Care. Conference: 35th International Symposium on Intensive Care and Emergency Medicine. Brussels Belgium. Conference Publication: (var.pagings). 19 (SUPPL. 1) (pp S96), 2015. Date of Publication: 16 Mar 2015.
AN: 71938678
Introduction Pump-driven venovenous extracorporeal CO2 removal (ECCO2 -R) increasingly takes root in hypercapnic lung failure to minimize ventilation invasiveness or to avoid intubation. A recently developed miniaturized device consisting of a centrifugal pump and a membrane ventilator (iLA Activve; Novalung, Germany) allows effective decarboxylation via a jugular double lumen cannula. So far no data on gas exchange in this setting exist to date. Methods We included 10 patients receiving iLA Activve due to hypercapnic respiratory failure as bridge-to-transplant or obstructive lung disease. Sweep gas flow was increased in steps from 1 to 14 l/ minute at constant blood flow (phase 1). Similarly, blood flow was gradually increased at constant sweep gas flow (phase 2). At each step, gas transfer via the membrane as well as arterial blood gas samples were obtained. Results During phase 1, we observed a significant increase in CO2 transfer together with a decrease in PaCO2 levels from a median of 66 mmHg (range 46 to 85) to 49 (31 to 65) mmHg from 1 to 14 l/ minute sweep gas flow, while arterial oxygenation deteriorated with high sweep gas flow rates. During phase 2, oxygen transfer significantly increased leading to an increase in PaO2 from 67 (49 to 87) at 0.5 l/ minute to 117 (66 to 305) mmHg at 2.0 l/minute. Higher blood flow rates also significantly enhanced decarboxylation. Increasing blood flow to 2.0 l/minute led to negative suction pressures of more than -100 mmHg and signs of hemolysis. See Figure 1. Conclusion Increasing sweep gas flow results in effective CO2 removal which can be further reinforced by raising blood flow. The clinically relevant oxygenation effect even in this setting of low invasivity could broaden the range of indications towards hypercapnic lung failure with mild to moderate hypoxia.
Institution
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Publisher
BioMed Central Ltd.

298.

Technical complications during veno-venous extracorporeal membrane oxygenation and their relevance predicting a system-exchange - Retrospective analysis of 265 cases.
Lubnow M., Philipp A., Foltan M., Enger T.B., Lunz D., Bein T., Haneya A., Schmid

C., Riegger G., Muller T., Lehle K.
PLoS ONE. 9 (12) (no pagination), 2014. Article Number: e112316. Date of Publication: 02 Dec 2014.
AN: 600627251
Objectives: Technical complications are a known hazard in veno-venous extracorporeal membrane oxygenation (vvECMO). Identifying these complications and predictive factors indicating a developing system-exchange was the goal of the study.
Method(s): Retrospective study on prospectively collected data of technical complications including 265 adult patients (Regensburg ECMO Registry, 2009-2013) with acute respiratory failure treated with vvECMO. Alterations in blood flow resistance, gas transfer capability, hemolysis, coagulation and hemostasis parameters were evaluated in conjunction with a system-exchange in all patients with at least one exchange (n=83).
Result(s): Values presented as median (interquartile range). Patient age was 50(36-60) years, the SOFA score 11(8-14.3) and the Murray lung injury Score 3.33(3.3-3.7). Cumulative ECMO support time 3411 days, 9(6-15) days per patient. Mechanical failure of the blood pump (n=5), MO (n=2) or cannula (n=1) accounted for 10% of the exchanges. Acute clot formation within the pump head (visible clots, increase in plasma free hemoglobin (frHb), serum lactate dehydrogenase (LDH), n=13) and MO (increase in pressure drop across the MO, n=16) required an urgent system-exchange, of which nearly 50% could be foreseen by measuring the parameters mentioned below. Reasons for an elective system-exchange were worsening of gas transfer capability (n=10) and device-related coagulation disorders (n=32), either local fibrinolysis in the MO due to clot formation (increased D-dimers [DD]), decreased platelet count; n=24), or device-induced hyperfibrinolysis (increased DD, decreased fibrinogen [FG], decreased platelet count, diffuse bleeding tendency; n=8), which could be reversed after system-exchange. Four MOs were exchanged due to suspicion of infection.
Conclusion(s): The majority of ECMO system-exchanges could be predicted by regular inspection of the complete ECMO circuit, evaluation of gas exchange, pressure drop across the MO and laboratory parameters (DD, FG, platelets, LDH, frHb). These parameters should be monitored in the daily routine to reduce the risk of unexpected ECMO failure.

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25464516 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25464516]
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Publisher
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299.

Partial extracorporeal carbon dioxide removal using a standard continuous renal

replacement therapy device: A preliminary study.
Quintard J.-M., Barbot O., Thevenot F., De Matteis O., Benayoun L., Leibinger F.
ASAIO Journal. 60 (5) (pp 564-569), 2014. Date of Publication: September-October 2014.
AN: 53229414
To test the feasibility, safety, and efficacy of partial extracorporeal CO2 removal (PECCO2R) using a standard continuous renal replacement (CRRT) device with a pediatric oxygenation membrane introduced into the circuit in a serial manner. In this retrospective single-center study, we have studied mechanically ventilated patients with persistent significant respiratory acidosis and acute renal failure requiring ongoing CRRT. Sixteen patients were treated with our PECCO2R device. PaCO2 and arterial pH were measured before as well as at 6 and 12 hours after PECCO 2R implementation. Hemodynamic parameters were continuously monitored. Our PECCO2R system was efficient to significantly reduce PaCO2 and increase arterial pH. The median PaCO2 before treatment was 77 mm Hg (59-112) with a median reduction of 24 mm Hg after 6 hours and 30 mm Hg after 12 hours (31% and 39%, respectively). The median pH increase was 0.16 at 6 hours and 0.23 at 12 hours. Partial extracorporeal CO2 removal treatment had no effect on oxygenation. No complication was observed. Our PECCO2R approach based on the simple introduction of a pediatric extracorporeal membrane oxygenation membrane into the circuit of a standard CRRT device is easy to implement, safe, and efficient to improve respiratory acidosis. Copyright © 2014 by the American Society for Artificial Internal.
PMID
25000386 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25000386]
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Publisher
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300.

Effects of venovenous extracorporeal membrane oxygenation on cerebral oxygenation in hypercapnic ARDS.
Muellenbach R.M., Kilgenstein C., Kranke P., Kustermann J., Kredel M., Roewer N., Ernestus R.I., Westermaier T.
Perfusion (United Kingdom). 29 (2) (pp 139-141), 2014. Date of Publication: 2014.
AN: 605504364
Extracorporeal membrane oxygenation (ECMO) is increasingly used in ARDS patients with hypoxemia and/or severe hypercapnia refractory to conventional treatment strategies. However, it is associated with severe intracranial complications, e.g. ischemic or hemorrhagic stroke. The arterial carbon dioxide partial pressure (PaCO2) is one of the main determinants influencing cerebral blood flow and oxygenation. Since CO2 removal is highly effective during ECMO, reduction of CO2 may lead to alterations in cerebral perfusion. We report on the variations of cerebral oxygenation during the initiation period of ECMO treatment in a patient with hypercapnic ARDS, which may partly explain the findings of ischemic and/or hemorrhagic complications in conjunction with ECMO.
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Publisher
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301.

Concurrent treatment with a tumor necrosis factor-alpha inhibitor and veno-venous extracorporeal membrane oxygenation in a post-hematopoietic stem cell transplant patient with idiopathic pneumonia syndrome: A case report.
Koinuma T., Nunomiya S., Wada M., Koyama K., Suzuki T.
Journal of Intensive Care. 2 (1) (no pagination), 2014. Article Number: 48. Date of Publication: August 22, 2014.
AN: 603848722
Idiopathic pneumonia syndrome (IPS) is a fatal non-infectious respiratory complication that develops after hematopoietic stem cell transplantation (HSCT). Because of the poor prognosis of post-HSCT patients with IPS requiring mechanical ventilatory support, performing extracorporeal membrane oxygenation (ECMO) has been regarded as relatively contraindicated in these patients. A tumor necrosis factor-alpha inhibitor, etanercept, has been reported to be a promising treatment option for post-HSCT patients with IPS; however, the phase III clinical trial of etanercept has recently been terminated without definitive conclusion. If post-HSCT patients with IPS really benefit from etanercept, mechanical ventilation (MV)-dependent IPS patients might be worth receiving ECMO treatment in line with the protective lung strategy. We therefore performed veno-venous ECMO (VV-ECMO), which substantially acted as an extracorporeal carbon dioxide removal, on a 56-year-old post-HSCT male with severe MV-dependent IPS due to graft-versus-host disease. Although a serious bleeding complication due to post-HSCT thrombocytopenia occurred, the VV-ECMO was continued for 11 days. The patient successfully entered remission of the IPS and was finally extubated on the 12th MV day. However, the patient soon complained of dyspnea, probably due to cytomegalovirus infection and/or exacerbation of the IPS, and was reintubated after 3 days of extubation. The patient then rapidly developed irreversible type II respiratory failure despite the administration of etanercept and an anti-cytomegalovirus agent and died on the eighth re-MV day. The autopsy findings of the patient revealed diffuse alveolar damage and alveolar hemorrhage, accompanied with bronchitis obliterans in his lungs, as well as whole body cytomegalovirus infection, which were compatible with the clinical diagnosis of the patient. We think that the legitimacy of this treatment strategy is dependent on the overall prognosis of IPS, which is influenced by the complications induced by immunosuppressants and ECMO, especially infections and bleeding.

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Publisher

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302.

Extracorporeal circulatory approaches to treat acute respiratory distress syndrome.
Abrams D., Brodie D.
Clinics in Chest Medicine. 35 (4) (pp 765-779), 2014. Date of Publication: 01 Dec 2014.
AN: 600449745
The early history of extracorporeal membrane oxygenation (ECMO) for adult patients with the acute respiratory distress syndrome (ARDS) evolved slowly over decades, a consequence of extracorporeal technology with high risk and unclear benefit. However, advances in component technology, accumulating evidence, and growing experience in recent years have resulted in a resurgence of interest in ECMO. Extracorporeal support, though currently lacking high-level evidence, has the potential to improve outcomes, including survival, in ARDS. In the near future, novel extracorporeal management strategies may, in fact, lead to a new paradigm in the approach to certain patients with ARDS.

PMID
25453424 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25453424]
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Publisher
W.B. Saunders

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303.

Extracorporeal support for severe acute respiratory failure.
Fanelli V., Costamagna A., Ranieri V.M.
Seminars in Respiratory and Critical Care Medicine. 35 (4) (pp 519-527), 2014. Date of Publication: August 2014.
AN: 373751983
Extracorporeal membrane oxygenation (ECMO) and extracorporeal CO 2 removal (ECCO2R) techniques have increasingly been applied in patients with severe acute lung injury refractory to conventional mechanical ventilatory support. The objectives of this article are to review current concepts of extracorporeal life support techniques (ECMO and ECCO 2R systems) and provide the rationale for their application in patients with acute respiratory distress syndrome, chronic obstruction pulmonary disease, and as adjunctive therapy for bridging patients to lung transplantation. © 2014 by Thieme Medical Publishers, Inc.
PMID

25111648 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25111648]
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304.

Acute respiratory distress syndrome in the pediatric age: An update on advanced treatment.
Marraro G.A., Chen C., Piga M.A., Qian Y., Spada C., Genovese U.
Chinese Journal of Contemporary Pediatrics. 16 (5) (pp 437-447), 2014. Date of Publication: 15 May 2014.
AN: 373335073
Acute respiratory distress syndrome (ARDS) is a heterogeneous syndrome that lacks definitive treatment. The cornerstone of management is sound intensive care treatment and early anticipatory ventilation support. A mechanical ventilation strategy aiming at optimal alveolar recruitment, judicious use of positive end-respiratory pressure (PEEP) and low tidal volumes (VT) remains the mainstay for managing this lung disease. Several treatments have been proposed in rescue settings, but confirmation is needed from large controlled clinical trials before they be recommended for routine care. Non-invasive ventilation (NIV) is suggested with a cautious approach and a strict selection of candidates for treatment. Mild and moderate cases can be efficiently treated by NIV, but this is contra-indicated with severe ARDS. The extra-corporeal carbon dioxide removal (ECCO2 R), used as an integrated tool with conventional ventilation, is playing a new role in adjusting respiratory acidosis and CO 2. The proposed benefits of ECCO2 R over extra-corporeal membrane oxygenation (ECMO) consist in a reduction of artificial surface contact, avoidance of pumprelated side effects and technical complications, as well as lower costs. The advantages and disadvantages of inhaled nitric oxide (iNO) are better recognized today and iNO is not recommended for ARDS and acute lung injury (ALI) in children and adults because iNO results in a transient improvement in oxygenation but does not reduce mortality, and may be harmful. Several trials have found no clinical benefit from various surfactant supplementation methods in adult patients with ARDS. However, studies which are still controversial have shown that surfactant supplementation can improve oxygenation and decrease mortality in pediatric and adolescent patients in specific conditions and, when applied in different modes and doses, also in neonatal respiratory distress syndrome (RDS) of preemies. Management of ARDS remains supportive, aimed at improving gas exchange and preventing complications. Progress in the treatment of ARDS must be addressed toward the new paradigm of the disease pathobiology to be applied to the disease definition and to predict the treatment outcome, also with the perspective to develop predictive and personalized medicine that highlights new and challenging opportunities in terms of benefit for patient's safety and doctor's responsibility, with further medicolegal implication.
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24856990 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24856990]
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305.

Effects of venovenous extracorporeal membrane oxygenation on cerebral oxygenation in hypercapnic ARDS.
Muellenbach R.M., Kilgenstein C., Kranke P., Kustermann J., Kredel M., Roewer N., Ernestus R.I., Westermaier T.
Perfusion (United Kingdom). 29 (2) (pp 139-141), 2014. Date of Publication: March 2014.
AN: 372497610
Extracorporeal membrane oxygenation (ECMO) is increasingly used in ARDS patients with hypoxemia and/or severe hypercapnia refractory to conventional treatment strategies. However, it is associated with severe intracranial complications, e.g. ischemic or hemorrhagic stroke. The arterial carbon dioxide partial pressure (PaCO2) is one of the main determinants influencing cerebral blood flow and oxygenation. Since CO2 removal is highly effective during ECMO, reduction of CO2 may lead to alterations in cerebral perfusion. We report on the variations of cerebral oxygenation during the initiation period of ECMO treatment in a patient with hypercapnic ARDS, which may partly explain the findings of ischemic and/or hemorrhagic complications in conjunction with ECMO. © The Author(s) 2013.
PMID
23887087 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23887087]
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306.

Combination of positioning therapy and venovenous extracorporeal membrane oxygenation in ARDS patients.
Kredel M., Bischof L., Wurmb T.E., Roewer N., Muellenbach R.M.
Perfusion (United Kingdom). 29 (2) (pp 171-177), 2014. Date of Publication: March 2014.
AN: 372497604
Positioning therapy may improve lung recruitment and oxygenation and is part of the standard care in severe acute respiratory distress syndrome (ARDS). Venovenous

extracorporeal membrane oxygenation (vvECMO) is a rescue strategy that may ensure sufficient gas exchange in ARDS patients failing conventional therapy. The aim of this case series was to describe the feasibility and pitfalls of combining positioning therapy and vvECMO in patients with severe ARDS.A retrospective cohort of nine patients is described. The patients received 20 (15-86) hours (median, 25th and 75th percentile) of positioning therapy while being treated with vvECMO. The initial PaO2/FiO2 index was 64 (51-67) mmHg and the arterial carbon dioxide tension was 60 (50-71) mmHg. Positioning therapy included 135 degrees prone, prone positioning and continuous lateral rotational therapy. During the first three days, the oxygenation index improved from 47 (41-47) to 12 (11-14) cmH2O/mmHg. The lung compliance improved from 20 (17-28) to 42 (27-43) ml/cmH2O. Complications related to positioning therapy were facial oedema (n=9); complications related to vvECMO were entrance of air (n=1) and pump failure (n=1). However, investigation of root causes revealed no association with the positioning therapy and had no documented effect on the outcome.The reported cases suggest that positioning therapy can be performed safely in ARDS patients treated with vvECMO, providing appropriate precautions are in place and a very experienced team is present. © The Author(s) 2013.
PMID
23985422 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23985422]
Institution
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Publisher
SAGE Publications Ltd (55 City Road, London EC1Y 1SP, United Kingdom)

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307.

Elevation of procalcitonin after implantation of an interventional lung assist device in critically ill patients.
Kott M., Bewig B., Zick G., Schaedler D., Becher T., Frerichs I., Weiler N.
ASAIO Journal. 60 (2) (pp 249-253), 2014. Date of Publication: March-April 2014.
AN: 52949112
A pumpless interventional arteriovenous lung assist device (iLA) facilitates the removal of carbon dioxide from the blood and is used as part of the lung-protective ventilation strategy in patients with acute respiratory distress syndrome (ARDS). In case of bacterial infection, delayed antimicrobial therapy increases the mortality in this group of high-risk critically ill patients, whereas overtreatment promotes bacterial resistance and leads to increased drug toxicity and costs. Besides clinical signs and symptoms, antimicrobial treatment is based on the kinetics of biomarkers such as procalcitonin (PCT). We hereby report an up to 10-fold increase in PCT serum concentrations in four mechanically ventilated patients with ARDS detected within 12-20 hours after iLA implantation in the absence of any infection. Procalcitonin concentrations returned to nearly baseline values in all patients on the fourth day after iLA implantation. We discuss the possible mechanisms of PCT induction in this specific patient population and recommend the onset of antibiotics administration after iLA implantation to be carefully considered in the context of other clinical findings and not solely based on the PCT kinetics. Repeated PCT measurements in short time intervals should be performed in these patients. Copyright © 2014 by the American Society for Artificial Internal Organs.
PMID

24399068 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24399068]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

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308.

Extracorporeal life support for adults with severe acute respiratory failure.
Sorbo L.D., Cypel M., Fan E.
The Lancet Respiratory Medicine. 2 (2) (pp 154-164), 2014. Date of Publication: February 2014.
AN: 372254338
Extracorporeal life support (ECLS) is an artificial means of maintaining adequate oxygenation and carbon dioxide elimination to enable injured lungs to recover from underlying disease. Technological advances have made ECLS devices smaller, less invasive, and easier to use. ECLS might, therefore, represent an important step towards improved management and outcomes of patients with acute respiratory distress syndrome. Nevertheless, rigorous evidence of the ability of ECLS to improve short-term and long-term outcomes is needed before it can be widely implemented. Moreover, how to select patients and the timing and indications for ECLS in severe acute respiratory distress syndrome remain unclear. We describe the physiological principles, the putative risks and benefits, and the clinical evidence supporting the use of ECLS in patients with acute respiratory distress syndrome. Additionally, we discuss controversies and future directions, such as novel technologies and indications, mechanical ventilation of the native lung during ECLS, and ethics considerations. © 2014 Elsevier Ltd.
PMID
24503270 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24503270]
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Publisher
Lancet Publishing Group (Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom)

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309.

Extracorporeal carbon dioxide removal for refractory status asthmaticus: Experience in distinct exacerbation phenotypes.
Brenner K., Abrams D.C., Agerstrand C.L., Brodie D.
Perfusion (United Kingdom). 29 (1) (pp 26-28), 2014. Date of Publication: January 2014.
AN: 370556338
Extracorporeal carbon dioxide removal (ECCO2R) may be indicated for refractory status asthmaticus when severe dynamic hyperinflation or life-threatening respiratory acidosis persists despite optimal medical and ventilator management. Most prior reports describe the application of ECCO2R to rapid-onset asthma exacerbation, requiring a short duration of extracorporeal support. We report two patients with refractory status asthmaticus managed with ECCO2R, emphasizing the use of modern extracorporeal technology, cannulation technique and management protocols, which may improve the risk-to-benefit profile of this strategy. This report highlights the challenges in managing patients with distinct asthma exacerbation phenotypes. The potential need for prolonged device support may alter provider expectations and offers a new perspective of the role of ECCO2R for status asthmaticus. © 2013 The Author(s).
PMID
23842616 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23842616]
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Publisher
SAGE Publications Ltd (55 City Road, London EC1Y 1SP, United Kingdom)

310.

The successful management of a patient with exacerbation of non-cystic fibrosis bronchiectasis and bilateral fibrothorax using a venovenous extracorporeal carbon dioxide removal system.
Arcaro G., Vianello A.
Respiratory Care. 59 (12) (pp e197-e200), 2014. Date of Publication: December 2014.
AN: 606770577
Following unsuccessful treatment with noninvasive ventilation (NIV), patients requiring subsequent placement on invasive mechanical ventilation have a high mortality rate. Invasive mechanical ventilation is particularly problematic in patients with acute respiratory failure due to bronchiectasis exacerbation, as it is associated with a mortality rate of 19-35% and prolonged ICU stay. Here, we describe the successful management of a patient with exacerbated non-cystic fibrosis bronchiectasis using a pump-assisted venovenous system for extracorporealCO2 removal (ProLUNG system) as an alternative to endotracheal intubation following NIV failure. The extracorporeal CO2 removal system proved to be safe and efficacious in this case study, and further studies focusing on its use in these types of cases seem warranted.

PMID

24987155 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24987155]
Institution
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Publisher
American Association for Respiratory Care

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Click here for full text options

311.

Spontaneous breathing, extrapulmonary Co2 removal, and ventilator-induced lung injury risk: Less power to the people?.
Marini J.J.
Critical Care Medicine. 42 (3) (pp 758-760), 2014. Date of Publication: March 2014.
AN: 372454810
PMID
24534976 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24534976]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

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Click here for full text options

312.

Awake extracorporeal membrane oxygenation bridging for pulmonary retransplantation provides comparable results to elective retransplantation.
Lang G., Kim D., Aigner C., Matila J., Taghavi S., Jaksch P., Murakoezi G., Klepetko W.
Journal of Heart and Lung Transplantation. 33 (12) (pp 1264-1272), 2014. Date of Publication: 01 Dec 2014.
AN: 602326140
Background Lung retransplantation became an accepted treatment for bronchiolitis obliterans syndrome (BOS). However, The value of different bridging modalities for these patients is controversial. Methods We analyzed outcomes of 39 patients listed for retransplantation between 2008 and 2012. Patients were divided in 3 groups: 23 patients without any bridge modality (elective, Group 1), 11 patients on ventilation and full sedation with or without extracorporeal membrane oxygenation (ECMO) support (sedated bridging, Group 2), and 5 patients awake on ECMO support (awake bridging, Group 3). Results Waiting list mortality was 13% in Group 1, 39% in Group 2, and 0% in Group 3. Perioperative mortality was 20% in Group 1, 29% in Group 2, and 0% in Group 3. Significant differences between Groups 1 and 2 were calculated for time on post-operative ventilation (17.4 vs 27.3 days, p = 0.022), intensive care unit stay (22.0 vs 32.9 days, p = 0.026), and hospital stay (34.7 vs 54.1 days, p =

0.013). However, there were no significant differences between Groups 1 and 3 for post-operative ventilation time (17.4 vs 13.4 days, p = 0.192), for intensive care unit stay (22.0 vs 26.4 days, p = 0.169), or for hospital stay (34.7 vs 34.8 days, p = 0.367). Survival rates at 90 days, 1 year, and 2 years were 80%, 70%, and 53% in Group 1; 71%, 43%, and 29% in Group 2; and 100%, 60%, and 60% in Group 3, respectively. Conclusion Awake ECMO bridging for retransplantation provides comparable results to elective retransplantation.

PMID
25169957 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25169957]
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(Kim) Department of Thoracic and Cardio-vascular Surgery, Veterans Health Service Medical Center, 6-2 Duncheon-dong, Kangdong-gu, Seoul, South Korea
Publisher
Elsevier USA

313.

Paracorporeal lung assist devices as a bridge to recovery or lung transplantation in neonates and young children.
Hoganson D.M., Gazit A.Z., Boston U.S., Sweet S.C., Grady R.M., Huddleston C.B., Eghtesady P.
Journal of Thoracic and Cardiovascular Surgery. 147 (1) (pp 420-426), 2014. Date of Publication: January 2014.
AN: 52851809
Objective: To evaluate paracorporeal lung assist devices to treat neonates and children with decompensated respiratory failure as a bridge to recovery or lung transplantation.
Method(s): One neonate (23 days old) and 3 young children (aged 2, 9, and 23 months) presented with primary lung disease with pulmonary hypertension, including alveolar capillary dysplasia in 2 and right pulmonary hypoplasia and primary pulmonary hypertension in 1. The patients were listed for lung transplantation but decompensated and required extracorporeal membrane oxygenation (ECMO). The patients were transitioned from ECMO to a pumpless paracorporeal lung assist device (Maquet Quadrox-iD oxygenator in 3, Novalung in 1) with inflow from the pulmonary artery and return to the left atrium.
Result(s): The patients were weaned from ECMO and supported by the device for 44 +/- 29 days (range, 5-74). Three patients were extubated while supported by the device (after 9, 15, and 72 days). One patient was bridged to lung transplant (9 months old, with alveolar capillary dysplasia, supported 5 days). One patient was bridged to recovery with maximal medical therapy (23 months old, with primary pulmonary hypertension, supported 23 days). Two patients died while awaiting a suitable lung donor after a support time of 54 and 72 days.
Conclusion(s): Pediatric patients bridged from ECMO to lung transplantation have poor results. An alternative method for longer term respiratory support was necessary as a bridge for these patients. The use of a paracorporeal lung assist device successfully supported 4 patients to recovery, lung transplantation, or past the average wait time for pediatric donor lungs (27 days). This therapy has the potential to bridge children with decompensated respiratory failure to lung transplantation.

PMID
24199759 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24199759]
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(Huddleston) Division of Pediatric Cardiothoracic Surgery, Department of Surgery, St Louis University, St Louis, MO, United States
Publisher
Mosby Inc. (11830 Westline Industrial Drive, St. Louis MO 63146, United States)

314.

Extracorporeal carbon dioxide removal as an alternative to endotracheal intubation for non-invasive ventilation failure in acute exacerbation of COPD.
Cole S., Barrett N.A., Glover G., Langrish C.I.S., Meadows C., Daly K., Agnew N., Gooby N., Ioannou N.
Journal of the Intensive Care Society. 15 (4) (pp 344-346), 2014. Date of Publication: 01 Oct 2014.
AN: 600235862
Extracorporeal carbon dioxide removal (ECCO2R) is an efficient technique used in the management of hypercapnic respiratory failure. Its application in mechanically ventilated patients has been studied for over 30 years. We describe a case of severe, acute exacerbation of chronic obstructive pulmonary disease (AECOPD) unresponsive to non-invasive ventilation (NIV), where initiation of ECCO2R was used effectively to prevent endotracheal intubation.

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Stansted News Ltd (134 South Street, Bishop's Stortford, Hertfordshire, Essex CM23 3BQ, United Kingdom. E-mail: christine@stanstednews.com)

315.

Extracorporeal life support devices and strategies for management of acute

cardiorespiratory failure in adult patients: A comprehensive review.
Shekar K., Mullany D.V., Thomson B., Ziegenfuss M., Platts D.G., Fraser J.F.
Critical Care. 18 (2) (no pagination), 2014. Article Number: 219. Date of Publication: 09 May 2014.
AN: 373042793
Evolution of extracorporeal life support (ECLS) technology has added a new dimension to the intensive care management of acute cardiac and/or respiratory failure in adult patients who fail conventional treatment. ECLS also complements cardiac surgical and cardiology procedures, implantation of long-term mechanical cardiac assist devices, heart and lung transplantation and cardiopulmonary resuscitation. Available ECLS therapies provide a range of options to the multidisciplinary teams who are involved in the time-critical care of these complex patients. While venovenous extracorporeal membrane oxygenation (ECMO) can provide complete respiratory support, extracorporeal carbon dioxide removal facilitates protective lung ventilation and provides only partial respiratory support. Mechanical circulatory support with venoarterial (VA) ECMO employed in a traditional central/peripheral fashion or in a temporary ventricular assist device configuration may stabilise patients with decompensated cardiac failure who have evidence of end-organ dysfunction, allowing time for recovery, decision-making, and bridging to implantation of a long-term mechanical circulatory support device and occasionally heart transplantation. In highly selected patients with combined severe cardiac and respiratory failure, advanced ECLS can be provided with central VA ECMO, peripheral VA ECMO with timely transition to venovenous ECMO or VA-venous ECMO upon myocardial recovery to avoid upper body hypoxia or by addition of an oxygenator to the temporary ventricular assist device circuit. This article summarises the available ECLS options and provides insights into the principles and practice of these techniques. One should emphasise that, as is common with many emerging therapies, their optimal use is currently not backed by quality evidence. This deficiency needs to be addressed to ensure that the full potential of ECLS can be achieved. © 2014 Shekar et al.; licensee BioMed Central Ltd.
PMID
25032748 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25032748]
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Publisher
BioMed Central Ltd. (34 - 42 Cleveland Street, London W1T 4LB, United Kingdom)

316.

Extracorporeal lung support for COPD reaches a crossroad.
Nava S., Ranieri V.M.
The Lancet Respiratory Medicine. 2 (5) (pp 350-352), 2014. Date of Publication: May 2014.
AN: 373042405
PMID

24815802 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24815802]
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Publisher
Lancet Publishing Group (E-mail: cususerv@lancet.com)

317.

Extracorporeal life support in critically III adults.
Ventetuolo C.E., Muratore C.S.
American Journal of Respiratory and Critical Care Medicine. 190 (5) (pp 497-508), 2014. Date of Publication: 01 Sep 2014.
AN: 604362275
Extracorporeal life support (ECLS) has become increasingly popular as a salvage strategy for critically ill adults. Major advances in technology and the severe acute respiratory distress syndrome that characterized the 2009 influenza A(H1N1) pandemic have stimulated renewed interest in the use of venovenous extracorporeal membrane oxygenation (ECMO) and extracorporeal carbon dioxide removal to support the respiratory system. Theoretical advantages of ECLS for respiratory failure include the ability to rest the lungs by avoiding injurious mechanical ventilator settings and the potential to facilitate early mobilization, which may be advantageous for bridging to recovery or to lung transplantation. The use of venoarterial ECMO has been expanded and applied to critically ill adults with hemodynamic compromise from a variety of etiologies, beyond postcardiotomy failure. Although technology and general care of the ECLS patient have evolved, ECLS is not without potentially serious complications and remains unproven as a treatment modality. The therapy is now being tested in clinical trials, although numerous questions remain about the application of ECLS and its impact on outcomes in critically ill adults.

PMID
25046529 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25046529]
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Publisher
American Thoracic Society (E-mail: malexander@thoracic.org)

318.

ECMO for adult respiratory failure: Current use and evolving applications.
Agerstrand C.L., Bacchetta M.D., Brodie D.
ASAIO Journal. 60 (3) (pp 255-262), 2014. Date of Publication: May-June 2014.
AN: 53054797
Extracorporeal membrane oxygenation (ECMO) is increasingly being used to support adults with severe forms of respiratory failure. Fueling the explosive growth is a combination of technological improvements and accumulating, although controversial, evidence. Current use of ECMO extends beyond its most familiar role in the support of patients with severe acute respiratory distress syndrome (ARDS) to treat patients with various forms of severe hypoxemic or hypercapnic respiratory failure, ranging from bridging patients to lung transplantation to managing pulmonary hypertensive crises.The role of ECMO used primarily for extracorporeal carbon dioxide removal (ECCO2R) in the support of patients with hypercapnic respiratory failure and less severe forms of ARDS is also evolving. Select patients with respiratory failure may be liberated from invasive mechanical ventilation altogether and some may undergo extensive physical therapy while receiving extracorporeal support. Current research may yield a true artificial lung with the potential to change the paradigm of treatment for adults with chronic respiratory failure. © 2014 by the American Society for Artificial Internal.
PMID
24625534 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24625534]
Institution
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Publisher
Lippincott Williams and Wilkins (E-mail: LRorders@phl.lrpub.com)

319.

A new perspective on extracorporeal ventilation.
Blum J.M.
Anesthesiology. 120 (2) (pp 266-267), 2014. Date of Publication: February 2014.
AN: 372243734
PMID
24451413 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24451413]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

320.

Extracorporeal life support for patients with acute respiratory distress syndrome: report of a Consensus Conference.
Richard C., Argaud L., Blet A., Boulain T., Contentin L., Dechartres A., Dejode J.-M., Donetti L., Fartoukh M., Fletcher D., Kuteifan K., Lasocki S., Liet J.-M., Lukaszewicz A.-C., Mal H., Maury E., Osman D., Outin H., Richard J.-C., Schneider F., Tamion F.
Annals of Intensive Care. 4 (1) (no pagination), 2014. Article Number: 15. Date of Publication: 25 Dec 2014.
AN: 605278987
The influenza H1N1 epidemics in 2009 led a substantial number of people to develop severe acute respiratory distress syndrome and refractory hypoxemia. In these patients, extracorporeal membrane oxygenation was used as rescue oxygenation therapy. Several randomized clinical trials and observational studies suggested that extracorporeal membrane oxygenation associated with protective mechanical ventilation could improve outcome, but its efficacy remains uncertain. Organized by the Societe de Reanimation de Langue Francaise (SRLF) in conjunction with the Societe Francaise d'Anesthesie et de Reanimation (SFAR), the Societe de Pneumologie de Langue Francaise (SPLF), the Groupe Francophone de Reanimation et d'Urgences Pediatriques (GFRUP), the Societe Francaise de Perfusion (SOFRAPERF), the Societe Francaise de Chirurgie Thoracique et Cardiovasculaire (SFCTV) et the Sociedad Espanola de Medecina Intensiva Critica y Unidades Coronarias (SEMICYUC), a Consensus Conference was held in December 2013 and a jury of 13 members wrote 65 recommendations to answer the five following questions regarding the place of extracorporeal life support for patients with acute respiratory distress syndrome: 1) What are the available techniques?; 2) Which patients could benefit from extracorporeal life support?; 3) How to perform extracorporeal life support?; 4) How and when to stop extracorporeal life support?; 5) Which organization should be recommended? To write the recommendations, evidence-based medicine (GRADE method), expert panel opinions, and shared decisions taken by all the thirteen members of the jury of the Consensus Conference were taken into account.

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Publisher
Springer Verlag (E-mail: service@springer.de)

321.

First experience with a new miniaturized pump-driven venovenous extracorporeal CO2 removal system (iLA Activve): A retrospective data analysis.
Hermann A., Staudinger T., Bojic A., Riss K., Wohlfarth P., Robak O., Sperr W.R., Schellongowski P.
ASAIO Journal. 60 (3) (pp 342-347), 2014. Date of Publication: May-June 2014.
AN: 53099984
iLA Activve is a new minimally invasive device for extracorporeal CO2 removal (ECCO2-R) using a miniaturized pump, a special gas exchange membrane, and a double-lumen cannula. We retrospectively analyzed our experiences in 12 patients with hypercapnic respiratory failure undergoing ECCO2-R. Indication for ECCO2-R was hypercapnia due to terminal lung failure during bridging to lung transplantation, pneumonia, and chronic obstructive lung disease or asthma. The median duration of ECCO2-R was 8 days (range 2-30). Seven patients were successfully weaned and five died. Patients with primarily hypoxic lung failure were significantly longer ventilated before ECCO2-R and had a higher mortality rate. Complications were retroperitoneal hematoma after cannulation in one patient and repeated system changes because of clotting in two patients. We observed effective CO2 removal in all patients, with significant reduction in ventilation pressures and minute volumes at median blood flow rates of 1.2-1.4 L/min. The iLA Activve system using venous double-lumen cannulas proved to be an effective method for ECCO2-R. Invasiveness of ventilation could be reduced. Additional severe impairment of oxygenation and prolonged mechanical ventilation before ECCO2-R are factors of adverse prognosis. The use of ECCO2-R should be thoroughly reconsidered in these cases. © 2014 by

the American Society for Artificial Internal.
PMID
24722345 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24722345]
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Publisher
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322.

Extracorporeal support for patients with acute respiratory distress syndrome.
Finney S.J.
European Respiratory Review. 23 (133) (pp 379-389), 2014. Date of Publication: September 2014.
AN: 373881184
Extracorporeal membrane oxygen (ECMO) has been used for many years in patients with life-threatening hypoxaemia and/or hypercarbia. While early trials demonstrated that it was associated with poor outcomes and extensive haemorrhage, the technique has evolved. It now encompasses new technologies and understanding that the lung protective mechanical ventilation it can facilitate is inextricably linked to improving outcomes for patients. The positive results from the CESAR (Conventional ventilation or ECMO for Severe Adult Respiratory failure) study and excellent outcomes in patients who suffered severe influenza A (H1N1/09) infection have established ECMO in the care of patients with severe acute respiratory distress syndrome. Controversy remains as to at what point in the clinical pathway ECMO should be employed; as a rescue therapy or more pro-actively to enable and ensure high-quality lung protective mechanical ventilation. The primary aims of this article are to discuss: 1) the types of extracorporeal support available; 2) the rationale for its use; 3) the relationship with lung protective ventilation; and 4) the current evidence for its use. © ERS 2014.
PMID
25176974 [http://www.ncbi.nlm.nih.gov/pubmed/?term=25176974]
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323.

Extracorporeal carbon dioxide removal for patients with acute respiratory failure secondary to the acute respiratory distress syndrome: A systematic review.
Fitzgerald M., Millar J., Blackwood B., Davies A., Brett S.J., McAuley D.F., McNamee J.J.

Critical Care. 18 (3) (no pagination), 2014. Article Number: 222. Date of Publication: 15 May 2014.
AN: 373077848
Acute respiratory distress syndrome (ARDS) continues to have significant mortality and morbidity. The only intervention proven to reduce mortality is the use of lung-protective mechanical ventilation strategies, although such a strategy may lead to problematic hypercapnia. Extracorporeal carbon dioxide removal (ECCO2R) devices allow uncoupling of ventilation from oxygenation, thereby removing carbon dioxide and facilitating lower tidal volume ventilation. We performed a systematic review to assess efficacy, complication rates, and utility of ECCO2R devices. We included randomised controlled trials (RCTs), case-control studies and case series with 10 or more patients. We searched MEDLINE, Embase, LILACS (Literatura Latino Americana em Ciencias da Saude), and ISI Web of Science, in addition to grey literature and clinical trials registries. Data were independently extracted by two reviewers against predefined criteria and agreement was reached by consensus. Outcomes of interest included mortality, intensive care and hospital lengths of stay, respiratory parameters and complications. The review included 14 studies with 495 patients (two RCTs and 12 observational studies). Arteriovenous ECCO2R was used in seven studies, and venovenous ECCO2R in seven studies. Available evidence suggests no mortality benefit to ECCO2R, although post hoc analysis of data from the most recent RCT showed an improvement in ventilator-free days in more severe ARDS. Organ failure-free days or ICU stay have not been shown to decrease with ECCO2R. Carbon dioxide removal was widely demonstrated as feasible, facilitating the use of lower tidal volume ventilation. Complication rates varied greatly across the included studies, representing technological advances. There was a general paucity of high-quality data and significant variation in both practice and technology used among studies, which confounded analysis. ECCO2R is a rapidly evolving technology and is an efficacious treatment to enable protective lung ventilation. Evidence for a positive effect on mortality and other important clinical outcomes is lacking. Rapid technological advances have led to major changes in these devices and together with variation in study design have limited applicability of analysis. Further well-designed adequately powered RCTs are needed. © 2014 Fitzgerald et al.; licensee BioMed Central Ltd.
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324.

Extracorporeal CO2 removal in patients with severe COPD exacerbation failing non invasive ventilation: A case control study.
Pisani L., Del Sorbo L., Filippini C., Fasano L., Ranieri V.M., Nava S.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2014. San Diego, CA United States. Conference Publication: (var.pagings). 189 (MeetingAbstracts) (no pagination), 2014. Date of Publication: 2014.
AN: 72046525
Introduction Mechanical support is often needed in patients with severe COPD

exacerbation. NIV has been studied in several randomized controlled trials, consistently providing positive results with success rates of 70-75%. When NIV fails and endotracheal intubation (ETI) is required, the risk of death increases. Recently, a new minimally invasive CO2 extracorporeal removal device (ECCO2R ,Decap;Hemodec, Salerno, Italy) consisting of a pump-driven veno-venous hemofiltration system has been developed. The main features of this system are a low extracorporeal blood flow, a small neonatal membrane lung, the use of small (14-French) double-lumen catheters, and a relatively small infusion rate of heparin. Purpose We examined the hypothesis that adding ECCO2R to NIV may reduce intubation rate in patients "at risk" of NIV failure vs an historically matched group of patients, meting the ETI criteria. Methods Fifteen patients were treated with NIV-plus-ECCO2R. Patients were included if "at risk" of NIV failure (two or more of the following for at least two hours of NIV: respiratory rate >35 breaths/min; arterial pH <= 7.30; arterial pressure of carbon dioxide (PaCO2)>10% of the baseline value; use of accessory muscles or paradoxical abdominal movements). A database including 175 patients with COPD and acute hypercapnic respiratory failure treated with NIV-only was created using previously published studies. Seventy patients were selected as "at risk" of NIV failure. A control group of 15 patients was extracted by individual case match comparing age, comorbidities, forced expiratory volume in the 1st second, simplified acute physiological score, and arterial pH before institution of NIV. Results The treatment with Decap improved gas exchange vs baseline. Patients requiring intubation were 3 2 out of 15 patients (13%) in the NIV-plus-ECCO2R and 44 38 out of 70 84 patients (63 38%) and 9 8 out of 15 (60 53%) in the control group before and after matching, respectively (P=0.0209 0.0502). ECCO2R-related complications were observed in seven patients (47%); bleeding requiring transfusion and circuit clotting requiring ECCO2R discontinuation and intubation occurred in 1 (7%) and 2 (13%) cases, respectively Conclusions This study shows that extracorporeal CO2 removal may be applied with veno-venous technique needing low blood flow and therefore can be used to avoid intubation in those patients failing an NIV attempt. Although limited, these data provide the basis for randomized clinical trials needed to confirm efficacy and safety of ECCO2R.
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325.

Lung assist device as a bridge to pediatric lung transplant.
Hayden L.P., Boyer D., Freiberger D.A., Fynn-Thompson F., Kulik T.J., McGrath M., Mulllen M.P., Thiagarajan R.R., VanderPluym C.J., Visner G.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2014. San Diego, CA United States. Conference Publication: (var.pagings). 189 (MeetingAbstracts) (no pagination), 2014. Date of Publication: 2014.
AN: 72042120
INTRODUCTION 6 year old male with history of ventricular septal defect (VSD) closure in infancy and progressive pulmonary arterial hypertension (PAH) presented for lung transplant evaluation. Cardiac catheterization demonstrated worsening right ventricular/pulmonary artery (RV/PA) pressures, up to two times systemic. He was

placed on a lung assist device (LAD), the Quadrox D oxygenator, for 2.5 months as a bridge to pulmonary transplant. DESCRIPTION The patient's VSD was closed at 8 months of age. Catheterization at 18 months diagnosed PAH. Despite medical management, his PAH was progressive, with suprasystemic pressures and deterioration of RV function. He was listed for lung transplant. One week later he developed progressive symptoms. Catheterization demonstrated RV/PA pressures up to 180 mmHG. A paracorporeal LAD was placed, with a PA to left atrium circuit and interposed oxygenator. Post-LAD ECHO demonstrated significant decrease in RV size, improved function and RV pressures 1/2 systemic. LAD placement was complicated by bleeding and hemothorax requiring chest tube. Following LAD placement he was extubated to BiPAP within two weeks and weaned gradually to room air. While on the LAD he was able to get out of bed, walk around and participate in physical therapy, including activities such as basketball and bicycle riding. He remained on the LAD for 2.5 months until bilateral lung transplant. His transplant course was complicated by bleeding and transfusion-related acute lung injury. On POD 0 he had atrial flutter with a brief cardiac arrest and was placed on ECMO for three days. His chest was closed on POD 7 and he was extubated to BiPAP on POD 8. He was discharged 6 weeks post-transplant on 1/2 liter oxygen overnight. Three months post-transplant he was doing well. Pulmonary function tests demonstrated FVC 66%, FEV1 66%, FEV1/FVC 89. He showed improving endurance on 6-minute walk test, covering 790 feet with saturation of 98%. RV function was qualitatively normal. DISCUSSION Use of a LAD has been described as a potential option for bridge to lung transplant (Fisher 2006). It has been reported that a paracorporeal LAD, the NovaLung, has been used pre-transplant in a pediatric patient with PAH (Gazit 2011). In this case, we used a similar LAD, the Quadrox D, to successfully maintain a PAH patient until lung transplant was available. This innovative use of a LAD in a pediatric patient relieved his severely elevated pulmonary pressures while allowing maintenance of pre-transplant rehabilitation and quality of life.

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326.

Extra-corporeal membrane oxygenation after living related liver transplantation.
Gedik E., Celik M.R., Otan E., Disli O.M., Erdil N., Bayindir Y., Kutlu R., Yilmaz S.
Experimental and Clinical Transplantation. Conference: 14th Congress of the Middle East Society for Organ Transplantation. Istanbul Turkey. Conference Publication: (var.pagings). 12 (SUPPL. 2) (pp 255-256), 2014. Date of Publication: September 2014.
AN: 71976531
Introduction: ECMO is a rescue therapy with indications as acute and cardiorespiratory failure, when conventional treatments fail. ECMO can be performed with either pumpless or pump. There is little literature about ECMO, especially after LT. We presented our experience of two patients. Case 1: 69 y-o woman underwent

LT due to autoimmune hepatitis. 4 weeks later, she was admitted to ICU with acute respiratory failure and sepsis. She was intubated and mechanically ventilated. Her respiratory status was compromised gradually. Acinetobacter b. and Aspergillus f. were isolated from her tracheal aspirate culture. Appropriate antibiotics were started. On the 5th day, bilateral tube drainage were inserted due to massive pleural effusion. CVVHF was initiated for AKI. Thorax CT showed that bilateral Aspergillus ball. Her ABG's and clinics were deteriorated on conventional mechanical ventilation. The rescue therapy with pumpless extracorporeal lung assist (pECLA, ILA membrane ventilator, Novalung, Germany) was planned. On the 10th day, 15F right arterial,17F left venous cannula were inserted with fluoroscopy guidance at the femoral vessels. She was anti-coagulated with UF heparin (ACT 180-200s). Her ABG's and lung mechanics were dramatically improved in 2 days. CVVHF was simultaneously continued. Therapy was continued for 7 days with lung improvement. On 27th day she was lost due to refractory septic shock. Case 2: An 8 m-o male infant underwent LT and hepaticojejunostomy due to congenital extrahepatic biliary atresia. He had an acute onset on CLF with pneumonia. On the 3rd day, after successful operation, he was admitted to ICU. The ABG's and clinical condition of baby was deteriorated suddenly on 1st day. On 3rd day, the conventional MV and maximum inotropic therapy were failed. Near cardiac arrest, we decided urgent veno-arterial ECMO therapy. Right 8F c. carotis and 16F i. juguler vein cannula were inserted. ECMO pump (Novalung, Germany) was connected to the cannulas. He was heparinized (ACT 180-200 s). With high dose inotropic support and ECMO therapy, his cardiopulmonary status was improved on 1st day. Nevertheless, he was lost on 7th day due to severe collapse.
Conclusion(s): Despite our unsuccessful experience of 2 cases, the ECMO therapy for LT patients will cause well prognosis in selected cases.
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327.

Abylcap as promising device to treat patients with acute respiratory distress syndrome (ARDS).
Peperstraete H., De Somer F., Claus S., Dhondt A., Vanholder R., Hoste E., Eloot S.
International Journal of Artificial Organs. Conference: 41st Annual European Society for Artificial Organs, ESAO Congress. Rome Italy. Conference Publication: (var.pagings). 37 (8) (pp 606), 2014. Date of Publication: August 2014.
AN: 71756244
Aim: In patients with ARDS, gas exchange is impaired and mechanical ventilation is needed. The use of low tidal volumes is more lung protective but can be associated with hypercapnia and respiratory acidosis. Extracorporeal CO2 removal (ECCO2-R) is a therapeutic option to correct pH. The aim of this study was to derive optimal working parameters for the ECCO2-R.
Method(s): A 56-year-old man with ARDS was treated 7 days by Abylcap (Bellco, Italy). The system consists of a pediatric polymethyl- pentene hollow fiber membrane oxygenator. The oxygenator and the incorporated heat exchanger are coated with a non-thrombogenic phosphorylcholine coating. Every 24 h during 5 days, blood was sampled at the Abylcap inlet and outlet under different conditions of blood (QB: 200-

400 mL/min) and 100% O2 flow (QG: 0.5-8 L/min). Blood samples were analysed for total CO2 content, partial O2 tension, O2 saturation and hemoglobin concentration on a RapidLab1265 blood gas analyser (Siemens Healthcare).
Result(s): Acidosis and oxygenation parameters gradually improved during the support period of 7 days. For a fixed QG, CO2 transfer linearly increased with QB (i.e. from 59 to 101 mL/min for QB 200-400 mL/min and QG7 L/min). For a fixed QB, CO2 transfer non-linearly increased with QG and flatted for QG>=6 L/min. Gas transfer remained constant over 5 days: for QB = 400 mL/min and QG = 6 L/min, CO2 transfer was 99 +/- 6 mL/min and O2 transfer was 45.5 +/- 0.3 mL/min.
Conclusion(s): Using optimal operating parameters with QB at 400 mL/min and QG at least 6 L/min, the ECCO2-R is a promising device when treating patients with ARDS.
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328.

Effects of different ECMO gas flows on the breathing pattern of severe ARDS patients during pressure support and NAVA.
Mauri T., Suriano G., Grasselli G., Giuffrida A., Battistini M., Bronco A., Pozzi M., Patroniti N., Bellani G., Pesenti A.
Intensive Care Medicine. Conference: 27th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2014. Barcelona Spain. Conference Publication: (var.pagings). 40 (1 SUPPL. 1) (pp S187), 2014. Date of Publication: September 2014.
AN: 71630489
INTRODUCTION. Assisted mechanical ventilation (MV) might improve respiratory muscles function and gas exchange, decrease sedation needs and weaning time in severe acute respiratory distress syndrome (ARDS) patients undergoing extracorporeal membrane oxygenation (ECMO). During assisted MV, tidal volumes (Vt) should remain in the protective range. However, in ECMO patients, they might depend from physician's setting of the ventilator as well as from the amount of CO2 removed by ECMO (1,2). OBJECTIVES. Aim of this study was to evaluate, in severe ARDS patients, tidal volumes and other respiratory parameters at different levels of extracorporeal CO2 removal by ECMO during both pressure support ventilation (PSV) and neurally-adjusted ventilatory assist (NAVA). METHODS. We performed a prospective interventional randomized cross-over study on severe ARDS patients undergoing ECMO and assisted MV. ECMO sweep gas flow (GF) was decreased from resting conditions (i.e., p0.1<2 cmH2O and RR <= 20 bpm) to 50 %- 25 %-0 % during PSV and NAVA (20 min step, random order). Support and NAVA gain were chosen to obtain, at the highest GF, similar Vt (i.e., = 6 mL/kg) and peak airway pressure (i.e.,<25 cmH2O). Continuous recording of airway pressure, flow, esophageal pressure and electrical activity of the diaphragm were recorded during all study phases and analyzed off-line by dedicated software. Variables were compared by two-way repeated measures ANOVA with GF and ventilator mode as co-variates. Data are presented as median [IQR]. RESULTS. Eight severe ARDS patients (5 male) were recruited: they were on ECMO since 20 days [14-49], age was 51 [40-54] year-old, PEEP was 14 [10-16] cmH2O and Crs 33 [26- 45] mL/cmH2O. During PSV

and NAVA, decreasing GF led to a similar decrease in the amount of CO2 removed by ECMO (Figure 1) and increase of respiratory rate, p0.1 and electrical activity of the diaphragm (p<0.001 for different GF; p = n.s. for ventilation modes and interaction). Tidal volume (Figure 2), peak airway pressure, minute ventilation and transpulmonary pressure increased at lower GF, albeit their increase was more pronounced during NAVA than during PSV (p<0.05 for different GF and ventilation modes; p = n.s. for interaction). In facts, when GF was zeroed during NAVA, Vt was > 6 mL/kg in 90 % of patients and > 8 mL/kg in 50 %. CONCLUSIONS. In severe ARDS patients undergoing assisted MV and ECMO, decreasing CO2 removal by ECMO significantly increases ventilation pressure and volume. Particular attention should be paid to NAVA settings when changing ECMO gas flow. (Figure Presented).
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329.

Outcomes of patients with chronic obstructive pulmonary disease treated with extracorporeal lung support.
Braune S.A., Fiolka M., Soeffker G., Nierhaus A., Wichmann D., Kluge S.
Intensive Care Medicine. Conference: 27th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2014. Barcelona Spain. Conference Publication: (var.pagings). 40 (1 SUPPL. 1) (pp S186), 2014. Date of Publication: September 2014.
AN: 71630488
INTRODUCTION. Patients with chronic obstructive pulmonary disease (COPD) and acute on chronic respiratory failure are at increased risk of clinical deterioration once on invasive mechanical ventilation (IMV), of prolonged IMV and of death. Extracorporeal lung assist (ECLA) in this specific patient group may serve as rescue treatment or as means to ameliorate side effects of IMV or even to avoid IMV. However, the application of an ECLA carries a substantial risk of complications. OBJECTIVES. To evaluate the clinical course and outcomes of COPD patients treated with ECLA for acute on chronic respiratory failure. METHODS. Retrospective, observational single-centre study on 38 COPD patients treated with ECLA with or without IMV in a tertiary level department of intensive care medicine from 2009 until 2013. Patients included were either treated with a pumpless arterio-venous ECLA (avECLA) for extracorporeal CO2 removal (ECCO2R) or with a pumpdriven venovenous ECLA (vvECLA), either with low blood flow (<2 L/min) for ECCO2R (vvECCO2R) or with high blood flow (> 2 L/min) for extracorporeal membrane oxygenation (vvECMO). RESULTS. The median age (IQR) was 61.5 years (55-69) and all COPD-patients had GOLD-stage 3-4. Sixteen patients (42 %) were treated with avECLA and 22 patients (58 %) with vvECLA. Of these, 11 patients (29 %) were on low-flow vvECCO2R and 11 (29 %) on high-flow vvECMO. Median tidal and minute volumes on IMV were significantly reduced within 24 h of commencement of ECLA (337 vs. 276 ml and 9.5 vs. 4.7 L/min, p<0.01). The median times on ECLA and on IMV were 6.5 days (5-11) and 15.5 days (8-27), respectively. Six patients (16 %) were successfully treated with ECLA to avoid intubation and IMV. Overall 28-day

mortality was 33.3 %, and in the subgroups of patients on vvECCO2R, avECCO2R, and vvECMO 28-day mortality rates were 18.1, 31.2, and 63.6 %, respectively. In 15 patients (36 %) on renal replacement therapy (RRT) for acute renal failure 28-day mortality was 60 % vs. 22 % in those patients without RRT ($p<0.05$). Bleeding complications were observed in 20 patients (47.6 %), of which 5 (11.9 %) were cannula related and 9 (21.4 %) episodes were considered major bleedings. In 2 patients (4.8 %) circuit clotting required urgent membrane exchange. In 2 patients (4.8 %) on avECCO2R cannula related limb ischemia occurred, necessitating vascular surgery in one case. No death related directly to complications was observed. CONCLUSIONS. Treatment of COPD patients with ECLA helped to reduce the invasiveness of mechanical ventilation. However, 28-day mortality in this patient group still remained high, especially in sicker patients with more invasive extracorporeal treatment. Moreover, complication rates were clinically relevant. More prospective studies on patients with COPD on ECLA are needed to further evaluate the effectiveness and safety of an extracorporeal treatment strategy in this special patient group with acute on chronic lung injury.
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330.

Systolic and diastolic right ventricular function in patients with ARDS without acute cor pulmonale in ICU.
Tavazzi G., White M., Bergsland N., De Francesco V., Canestrini S., Price S.
Intensive Care Medicine. Conference: 27th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2014. Barcelona Spain. Conference Publication: (var.pagings). 40 (1 SUPPL. 1) (pp S176-S177), 2014. Date of Publication: September 2014.
AN: 71630451
INTRODUCTION. Right ventricular (RV) function has been extensively investigated in the last several years in patients with ARDS and robust correlations between the incidence of acute cor pulmonale (ACP), high pressure, tidal volume ventilation and increased mortality have been found (1). The RV diastolic function has been less studied. OBJECTIVES. We aimed to describe the systolic and diastolic RV function in patients with ARDS without the features of ACP. METHODS. An observational analysis of retrospectively collected data in mechanically ventilated patients who underwent bedside echocardiography. We collected RV function data (bidimensional and Doppler) in addition to clinical and ventilator factors. We assessed relationships using Pearson's correlation coefficients. RESULTS. All the patients (total 98 of whom 58 male and 40 female; mean age 48,6 +/- 17,9) were admitted with diagnosis of ARDS (23 on interventional lung assist (iLA); 37 on veno-venous ECMO and 38 on conventional ventilation management; the admission APACHE II was 14,9 (+/- 6,1). The mean TAPSE was 1.78 cm (+/- 0.61); mean pulmonary valve acceleration time (as sign of increased pulmonary vascular resistance) 88.5 ms +/- 19.6; mean tricuspid regurgitation velocity was 3,16 m/sec +/- 0,68; Pulmonary valve pre-systolic a wave (sign of diastolic restrictive pattern) (2) was present in 58 % of the patients (iLA 78 %, VV-ECMO 62 %; 42 % of conventional ventilated patients). The mean TV/Kg was 5.01 +/- 2. We found a significant correlation between correlations

between the presence of a presystolic a wave on the pulmonary valve (PV a wave) with pulmonary valve acceleration time (PV acc T)(r = -0.572, p<0.0001). Moreover we tested and found correlations between PV a wave and both PEEP (r = 0.593, p<0.0001) and pCO2 (r = 0.338, p<0.0001). A strong correlation was found even between the PV acc T and: PEEP (r = - 0.532, p<0.0001), Peak inspiratory pressure (r = -0.618, p<0.0001) and pCO2 (r 0.229, p<0.0001). We also found correlations between tricuspid regurgitation duration (TR dur) with TAPSE (r 0.344, p 0.017) and TAPSE length (r0,389, p 0.016); systolic pulmonary pressure with TAPSE (r 0.353, p 0.012) and pCO2 (r 0,279, p 0.047); right ventricular filling time and TR dur (r 0,408, p 0.014). No correlations were found between VT/Kg and right ventricular function. CONCLUSIONS. These results highlight the importance of the detection of RV systolic and diastolic impairment by pressure ventilation in patients with ARDS even in the absence of ACP. More studies are needed focusing on the management of ventilation setting in patients with early signs of RV hemodynamic dysfunction.
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Springer Verlag

331.

Extracorporeal carbon dioxide removal in a child.
Pozzato R., Amigoni A., Varotto E., Mozzo E., Ferrarese P., Pettenazzo A.
Pediatric Critical Care Medicine. Conference: 7th World Congress on Pediatric Intensive and Critical Care, PICC 2014. Istanbul Turkey. Conference Publication: (var.pagings). 15 (4 SUPPL. 1) (pp 105), 2014. Date of Publication: May 2014.
AN: 71626278
Background and aims: Mutations of ABCA3 surfactant proteins are associated with abnormalities of lipids transport in type 2 pneumocytes with subsequent interstitial pneumonia evolving to chronic obstructive pulmonary disease and often death.
Aim(s): We describe a case of a 7-year old girl affected by ABACA3 abnormality and a progressively deteriorating chronic respiratory failure, needing up to 10 l/min oxygen and home ventilation through a tracheostomy.
Method(s): The child was admitted at our PICU, for acute respiratory failure (EGV: pH 7.22, pCO2 180 mmHg); she was dyspnoeic and showed severe bronchospasm and air trapping. Salbultamol was started i.v. by continuous infusion and mechanical ventilation was initiated. On admission blood cultures were negative and a bronchial aspirate was positive for Stenotrophomonas maltophilia. Broad spectrum antibiotics were initiated. On the second day, due to intractable hypercapnia associated with bronchospasm, MgSO4 were started i.v. and a trial with Heliox was performed without any benefit. Oxygenation Index was 8, PaO2/FiO2 ratio was 103. Venous-venous femoral Extracorporeal Carbon Dioxide Removal (ECCO2R) was then started with rapid progressive reduction of PaCO2.
Result(s): Lungs progressively improved and ECCO2R was stopped on day 18.The child awoke with no neurological complications. On the following day, the patient underwent bilateral lung transplantation and 3 weeks later discharged home with no oxygen. ECCO2R was initially used in adults as a "rescue"for severe ARDS, then in

severe COPD associated with a protective ventilation.
Conclusion(s): This is the first case of a pediatric patient with chronic lung disease assisted with ECCO2R and successfully weaned to spontaneous assisted ventilation.
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332.

Extra-corporeal membrane oxygenation after living related liver transplantation.
Gedik E., Otan E., Celik R.M., Disli O.M., Aydin C., Erdil N., Kutlu R., Yilmaz S.
Liver Transplantation. Conference: 2014 Joint International Congress of ILTS, ELITA and LICAGE. London United Kingdom. Conference Publication: (var.pagings). 20 (SUPPL. 1) (pp S153), 2014. Date of Publication: June 2014.
AN: 71562320
ECMO is a rescue therapy with indications as acute and cardiorespiratory failure, when conventional treatments fail. ECMO can be performed with either pumpless or pump. There is little literature about ECMO, especially after LT. We presented our experience of two patients. CASE 1:69 y-o woman underwent LT due to autoimmune hepatitis. 4 weeks later, she was admitted to ICU with acute respiratory failure and sepsis. She was intubated and mechanically ventilated. Her respiratory status was compromised gradually. Acinetobacter b. and Aspergillus f. were isolated from her tracheal aspirate culture. Appropriate antibiotics were started. On the 5th day, bilateral tube drainage were inserted due to massive pleural effusion. CVVHF was initiated for AKI. Thorax CT showed that bilateral Aspergillus ball. Her ABG's and clinics were deteriorated on conventional mechanical ventilation. The rescue therapy with pumpless extracorporeal lung assist (pECLA, ILA membrane ventilator, Novalung, Germany) was planned. On the 10th day, 15F right arterial,17F left venous cannula were inserted with fluoroscopy guidance at the femoral vessels. She was anti-coagulated with UF heparin (ACT 180-200s). Her ABG's and lung mechanics were dramatically improved in 2 days. CVVHF was simultaneously continued. Therapy was continued for 7 days with lung improvement. On 27th day she was lost due to refractory septic shock. CASE 2: An 8 m-o male infant underwent LT and hepatico-jejunostomy due to congenital extrahepatic biliary atresia. He had an acute onset on CLF with pneumonia. On the 3rd day, after successful operation, he was admitted to ICU. The ABG's and clinical condition of baby was deteriorated suddenly on 1st day. On 3rd day, the conventional MV and maximum inotropic therapy were failed. Near cardiac arrest, we decided urgent veno-arterial ECMO therapy. Right 8F c. carotis and 16F i. juguler vein cannula were inserted. ECMO pump (Novalung, Germany) was connected to the cannulas. He was heparinized (ACT 180-200 s). With high dose inotropic support and ECMO therapy, his cardiopulmonary status was improved on 1st day. Nevertheless, he was lost on 7th day due to severe collapse. Despite our unsuccessful experience of 2 cases, the ECMO therapy for LT patients will cause well prognosis in selected cases.
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Link to the Ovid Full Text or citation:
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333.

Severe respiratory failure in multiple trauma patients: extracorporeal support as a salvage therapy-a single-center experience.
Biderman P.B.
Critical Care. Conference: 34th International Symposium on Intensive Care and Emergency Medicine. Brussels Belgium. Conference Publication: (var.pagings). 18 (SUPPL. 1) (pp S112), 2014. Date of Publication: 17 Mar 2014.
AN: 71507029
Introduction Use of extracorporeal life support (ECLS) in trauma casualties is limited by concerns regarding hemorrhage, particularly in the presence of traumatic brain injury (TBI). We report usage of ECMO/ interventional lung assist (iLA) as salvage therapy in 13 trauma patients. A high-flow technique without anticoagulation was used in cases with coagulopathy or severe TBI. Methods Data were collected from all adult trauma cases referred to one center for ECMO/iLA treatment due to severe hypoxemic respiratory failure. Thirteen consecutives cases are reported. The type of assistance was chosen based on a flowchart.
Type of Study: therapeutic, level of evidence IV. We analyzed patient data, injury data, blood gases before connection, methods of assistance, coagulation study, complications, survival and neurological outcome. Results Thirteen casualties had an average Injury Severity Score of 50.3 +/- 10.5 (age 27.7 +/- 8.6 years, 69.2% male) and were supported 9.9 +/- 4.8 days on ECMO (n = 7) and 7.16 +/- 5.9 days on iLA (n = 6). All suffered severe chest injuries, including one cardiac perforation. Most were coagulopathic prior to initiation of ECMO/iLA support. Among the seven patients with TBI, four had active intracranial hemorrhage. Only 30% of the patients received continuous anticoagulation during the first 24 hours of support without clotting of the system or diagnosis of a thromboembolic event. Complications directly related to support therapy were not lethal; these included hemorrhage from a cannulation site (n = 1), accidental removal of a cannula (n = 1) and pressure sores (n = 3). Deaths occurred due to septic (n = 3) and cardiogenic shock (n = 1). Survival rates were 57 and 83% on ECMO and iLA, respectively. Follow-up of survivors detected no neurological deterioration. Conclusion ECMO/iLA therapy can be used as rescue therapy in adult trauma cases with severe hypoxemic respiratory failure, even in the presence of coagulopathy, bleeding and/or brain injury. The benefits of oxygenation and circulatory support must be weighed individually against the risk of hemorrhage. Further research should determine whether ECMO therapy also confers survival benefit.
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334.

Extracorporeal carbon dioxide removal as a bridge to lung transplantation in life-threatening hypercapnia.
Riss K., Lang G., Staudinger T., Ullrich R., Krenn C.G., Sitzwohl C., Bojic A., Wohlfarth P., Sperr W.R., Rabitsch W., Aigner C., Taghavi S., Klepetko W.P., Schellongowski P.
Critical Care. Conference: 34th International Symposium on Intensive Care and Emergency Medicine. Brussels Belgium. Conference Publication: (var.pagings). 18 (SUPPL. 1) (pp S110), 2014. Date of Publication: 17 Mar 2014.
AN: 71507023
Introduction The introduction of the lung allocation score has resulted in a growing number of patients who are considered for lung transplantation (LTX) while being acutely decompensated. In the sickest of these patients, mechanical ventilation (MV) alone may not be sufficient to establish adequate gas exchange. Thus, different modes of extracorporeal life support have come to the focus of interest in this setting. Methods A retrospective analysis of 17 patients (male/female ratio: 6/11; median age: 35 (range 16 to 63)) who underwent arteriovenous or venovenous interventional lung assist (iLA; Novalung, Germany) support as bridging to primary LTX (n = 11) or re-LTX (n = 6) between 2005 and 2013. Results The underlying diagnosis was bronchiolitis obliterans syndrome III in re-LTX patients (n = 6), cystic fibrosis (n = 5), idiopathic pulmonary fibrosis (n = 2), emphysema (n = 1), adult respiratory distress syndrome (n = 1), hemosiderosis (n = 1), and chronic obstructive lung disease (n = 1), respectively. The type of iLA was arteriovenous in 10 and venovenous (iLA active) in seven patients. The median bridging time was 14 (1 to 58) days. The type of transplantation was bilateral LTX (n = 6), size-reduced bilateral LTX (n = 5), lobar bilateral LTX (n = 4), and right single LTX with contralateral pneumonectomy (n = 1), respectively. Hypercapnia was effectively corrected in all patients within the first 12 hours of iLA therapy: PaCO2 levels declined from 145 (70 to 198) to 60 (36 to 99) mmHg, P <0.0001. iLA was initiated during non-invasive ventilation in three patients, of whom one was intubated prior to LTX. All other patients (n = 14) were placed on iLA while on invasive MV. Of those, three patients were extubated and remained on iLA until LTX, one patient was weaned from iLA and remained on MV until LTX, and one patient was weaned from iLA and MV prior to LTX. Five patients were switched to extracorporeal membrane oxygenation (venovenous n = 2, venoarterial n = 3) after 5 (1 to 30) days on iLA support. One patient died prior to LTX due to septic multiorgan failure (SMOF). All others (n = 16; 94%) were successfully transplanted. Of these, two patients died in the ICU due to SMOF. The remaining 14 patients (82%) survived to hospital discharge and were alive at a median follow-up of 20 (1 to 63) months. Conclusion In patients with life-threatening hypercapnia, bridging to LTX with iLA is feasible, and results in favorable short-term and longterm outcome.
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Publisher
BioMed Central Ltd.

335.

High-frequency oscillatory ventilation and acute respiratory distress syndrome: At the crossroads?.
Wise M.P., Saayman A.G., Gillies M.A.

Thorax. 68 (5) (pp 406-408), 2013. Date of Publication: May 2013.
AN: 368735677
PMID
23585581 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23585581]
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336.

A novel extracorporeal CO2 removal system: Results of a pilot study of hypercapnic respiratory failure in patients with COPD.
Burki N.K., Mani R.K., Herth F.J.F., Schmidt W., Teschler H., Bonin F., Becker H., Randerath W.J., Stieglitz S., Hagmeyer L., Priegnitz C., Pfeifer M., Blaas S.H., Putensen C., Theuerkauf N., Quintel M., Moerer O.
Chest. 143 (3) (pp 678-686), 2013. Date of Publication: March 2013.
AN: 368520704
Background : Hypercapnic respiratory failure in patients with COPD frequently requires mechanical ventilatory support. Extracorporeal CO 2removal (ECCO2R) techniques have not been systematically evaluated in these patients. Methods : This is a pilot study of a novel ECCO2R device that utilizes a single venous catheter with high CO2removal rates at low blood flows. Twenty hypercapnic patients with COPD received ECCO2R. Group 1 (n = 7) consisted of patients receiving noninvasive ventilation with a high likelihood of requiring invasive ventilation, group 2 (n = 2) consisted of patients who could not be weaned from noninvasive ventilation, and group 3 (n = 11) consisted of patients on invasive ventilation who had failed attempts to wean.
Result(s): The device was well tolerated, with complications and rates similar to those seen with central venous catheterization. Blood flow through the system was 430.5 +/- 73.7 mL/min, and ECCO2R was 82.5 +/- 15.6 mL/min and did not change significantly with time. Invasive ventilation was avoided in all patients in group 1 and both patients in group 2 were weaned; Pa CO2decreased significantly (P < .003) with application of the device from 78.9 +/- 16.8 mm Hg to 65.9 +/- 11.5 mm Hg. In group 3, three patients were weaned, while the level of invasive ventilatory support was reduced in three patients. One patient in group 3 died due to a retroperitoneal bleed following catheterization.
Conclusion(s): This single-catheter, low-flow EC CO2R system provided clinically useful levels of CO2removal in these patients with COPD. The system appears to be a potentially valuable additional modality for the treatment of hypercapnic respiratory failure. © 2013 American College of Chest Physicians.
PMID
23460154 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23460154]
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Publisher
American College of Chest Physicians

337.

Amiodarone-induced pulmonary toxicity-A fatal case report and literature review.
Range F.T., Hilker E., Breithardt G., Buerke B., Lebiedz P.
Cardiovascular Drugs and Therapy. 27 (3) (pp 247-254), 2013. Date of Publication: June 2013.
AN: 52436567
Amiodarone is a widely used and very potent antiarrhythmic substance. Among its adverse effects, pulmonary toxicity is the most dangerous without a causal treatment option. Due to a very long half-life, accumulation can only be prevented by strict adherence to certain dosage patterns. In this review, we outline different safe and proven dosing schemes of amiodarone and compare the incidence and description of pulmonary toxicity. Reason for this is a case of fatal pulmonary toxicity due to a subacute iatrogenic overdosing of amiodarone in a 74-year-old male patient with known severe coronary artery disease, congestive heart failure and ectopic atrial tachycardia with reduced function of kidneys and liver but without preexisting lung disease. Within 30 days, the patient received 32.2 g of amiodarone instead of 15.6 g as planned. Despite early corticosteroid treatment after fast exclusion of all other differential diagnoses, the patient died another month later in our intensive care unit from respiratory failure due to bipulmonal pneumonitis. © Springer Science+Business Media New York 2013.
PMID
23397327 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23397327]
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Publisher
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338.

To ventilate, oscillate, or cannulate?.
Shekar K., Davies A.R., Mullany D.V., Tiruvoipati R., Fraser J.F.
Journal of Critical Care. 28 (5) (pp 655-662), 2013. Date of Publication: October 2013.
AN: 52657579
Ventilatory management of acute respiratory distress syndrome has evolved significantly in the last few decades. The aims have shifted from optimal gas transfer without concern for iatrogenic risks to adequate gas transfer while minimizing lung injury. This change in focus, along with improved ventilator and multiorgan system management, has resulted in a significant improvement in patient outcomes. Despite this, a number of patients develop hypoxemic respiratory failure refractory to lung-protective ventilation (LPV). The intensivist then faces the dilemma of either persisting with LPV using adjuncts (neuromuscular blocking agents, prone positioning, recruitment maneuvers, inhaled nitric oxide, inhaled prostacyclin, steroids, and surfactant) or making a transition to rescue therapies such as high-frequency oscillatory ventilation (HFOV) and/or extracorporeal membrane oxygenation (ECMO) when both these modalities are at their disposal. The lack of quality evidence and potential harm reported in recent studies question the use of HFOV as a routine rescue option. Based on current literature, the role for venovenous (VV) ECMO is probably sequential as a salvage therapy to ensure ultraprotective ventilation in selected young patients with potentially reversible respiratory failure who fail LPV despite neuromuscular paralysis and prone ventilation. Given the risk profile and the economic impact, future research should identify the patients who benefit most from VV ECMO. These choices may be further influenced by the emerging novel extracorporeal carbon dioxide removal devices that can compliment LPV. Given the heterogeneity of acute respiratory distress syndrome, each of these modalities may play a role in an individual patient. Future studies comparing LPV, HFOV, and VV ECMO should not only focus on defining the patients who benefit most from each of these therapies but also consider long-term functional outcomes. © 2013 Elsevier Inc.
PMID
23827735 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23827735]
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Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

339.

The evolution of extracorporeal life support as a bridge to lung transplantation.
Diaz-Guzman E., Hoopes C.W., Zwischenberger J.B.
ASAIO Journal. 59 (1) (pp 3-10), 2013. Date of Publication: January-February 2013.
AN: 368090336

The use of extracorporeal membrane oxygenation (ECMO) as a bridge to lung transplantation was reported for the first time more than three decades ago; nevertheless, its use in lung transplantation was largely abandoned because of poor patient survival and frequent complications. The outcomes of patients bridged to lung transplantation using ECMO have substantially improved in the last 5 years. Recent advances in extracorporeal life support technology now allow patients with end-stage lung disease to be successfully supported for prolonged periods of time, preventing the use of mechanical ventilation and facilitating physical rehabilitation and ambulation while the patients awaits lung transplantation. This review briefly describes the evolution of ECMO use in lung transplantation and summarizes the available technology and current approaches to provide ECMO support. Copyright © 2013 by the American Society for Artificial Internal.
PMID
23271390 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23271390]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

340.

Current opinions on non-invasive ventilation as a treatment for chronic obstructive pulmonary disease.
Ramsay M., Hart N.
Current Opinion in Pulmonary Medicine. 19 (6) (pp 626-630), 2013. Date of Publication: November 2013.
AN: 52789933
PURPOSE OF REVIEW: This review examines the current reports, the evidence and the issues surrounding the use of non-invasive ventilation (NIV) for the treatment of chronic obstructive pulmonary disease (COPD) in both the acute and domiciliary setting. RECENT FINDINGS: With the increasing use of NIV, more recent studies have focused on investigating the outcomes of our current practice. Although overall morbidity and mortality outcomes in the acute setting have improved, patients who initially stabilize but then deteriorate during an acute exacerbation of COPD have a poor prognosis. The focus must be on phenotyping this high-risk group to investigate other potential rescue treatments, including extracorporeal carbon dioxide removal. Indeed, phenotyping appears to favour the obese COPD patient, which may have a protective role in reducing the risk of NIV failure and recurrent hospital admissions. Randomized controlled trial evidence to support the use of NIV in a domiciliary setting as a treatment for COPD is awaited, and until the data from a number of ongoing clinical trials are available, the wide variation in global practice will continue. Increased understanding of patient ventilator asynchrony has improved domiciliary NIV set up, which is expected to enhance the tolerability of NIV, promoting patient adherence. SUMMARY: NIV is the established standard of care to treat acute hypercapnic exacerbations of COPD postoptimal medical management. NIV as a long-term treatment for COPD remains controversial based on the evidence from the

published randomized controlled trials. With increasing experience of NIV therapy, patient outcomes are improving; however, further work is still required to better characterize and target the patients who will most benefit from NIV. © 2013 Wolters Kluwer Health
Lippincott Williams & Wilkins.
PMID
24060980 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24060980]
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341.

Extracorporeal lung support in trauma patients with severe chest injury and acute lung failure: A 10-year institutional experience.
Ried M., Bein T., Philipp A., Muller T., Graf B., Schmid C., Zonies D., Diez C., Hofmann H.-S.
Critical Care. 17 (3) (no pagination), 2013. Article Number: R110. Date of Publication: 20 Jun 2013.
AN: 52647711
Introduction: Severe trauma with concomitant chest injury is frequently associated with acute lung failure (ALF). This report summarizes our experience with extracorporeal lung support (ELS) in thoracic trauma patients treated at the University Medical Center Regensburg.
Method(s): A retrospective, observational analysis of prospectively collected data (Regensburg ECMO Registry database) was performed for all consecutive trauma patients with acute pulmonary failure requiring ELS during a 10-year interval.
Result(s): Between April 2002 and April 2012, 52 patients (49 male, three female) with severe thoracic trauma and ALF refractory to conventional therapy required ELS. The mean age was 32 +/- 14 years (range, 16 to 72 years). Major traffic accident (73%) was the most common trauma, followed by blast injury (17%), deep fall (8%) and blunt trauma (2%). The mean Injury Severity Score was 58.9 +/- 10.5, the mean lung injury score was 3.3 +/- 0.6 and the Sequential Organ Failure Assessment score was 10.5 +/- 3. Twenty-six patients required pumpless extracorporeal lung assist (PECLA) and 26 patients required veno-venous extracorporeal membrane oxygenation (vv-ECMO) for primary post-traumatic respiratory failure. The mean time to ELS support was 5.2 +/- 7.7 days (range, <24 hours to 38 days) and the mean ELS duration was 6.9 +/- 3.6 days (range, <24 hours to 19 days). In 24 cases (48%) ELS implantation was performed in an external facility, and cannulation was done percutaneously by Seldinger's technique in 98% of patients. Cannula-related complications occurred in 15% of patients (PECLA, 19% (n = 5); vv-ECMO, 12% (n = 3)). Surgery was performed in 44 patients, with 16 patients under ELS prevention. Eight patients (15%) died during ELS support and three patients (6%) died after ELS weaning. The overall survival rate was 79% compared

with the proposed Injury Severity Score-related mortality (59%).
Conclusion(s): Pumpless and pump-driven ELS systems are an excellent treatment option in severe thoracic trauma patients with ALF and facilitate survival in an experienced trauma center with an interdisciplinary treatment approach. We encourage the use of vv-ECMO due to reduced complication rates, better oxygenation and best short-term outcome. © 2013 Ried et al.; licensee BioMed Central Ltd.
PMID
23786965 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23786965]
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Publisher
BioMed Central Ltd. (Floor 6, 236 Gray's Inn Road, London WC1X 8HB, United Kingdom)

342.

Extracorporeal lung support in patients with chronic obstructive pulmonary disease.
Braune S.A., Kluge S.
Minerva Anestesiologica. 79 (8) (pp 934-943), 2013. Date of Publication: August 2013.
AN: 370179150
When patients with chronic obstructive lung disease (COPD) and acute on chronic respiratory insufficiency fail non-invasive ventilation (NIV) they are commonly intubated and treated with invasive mechanical ventilation (IMV) to ensure adequate gas exchange. However, IMV itself is associated with considerable complications which can aggravate any pre-existing lung disease and contribute to morbidity and mortality. When lung protective ventilation fails or cannot be maintained, full or partial extracorporeal lung assist (ECLA) is increasingly used to provide oxygenation and/or carbon dioxide removal. This can rescue patients' lives, help resting their lungs until recovery or transplantation or even avoiding intubation and IMV in the first place. Recent technological improvements of extracorporeal devices have made ECLA more efficient and safe. This article discusses different types of ECLA, their potential indications in patients with COPD as well as the preliminary clinical evidence for their effectiveness and safety.
PMID
23698548 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23698548]
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Publisher
Edizioni Minerva Medica (Corso Bramante 83-85, Torino 10126, Italy)

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343.

Catastrophic respiratory failure from tuberculosis pneumonia: Survival after prolonged extracorporeal membrane oxygenation support.
Andresen M., Tapia P., Mercado M., Bugedo G., Bravo S., Regueira T.
Respiratory Medicine Case Reports. 10 (pp 19-22), 2013. Date of Publication: 2013.
AN: 369475644
Tuberculosis (TB) is an uncommon cause of severe respiratory failure, even in highly endemic regions. Mortality in cases requiring mechanical ventilation (MV) varies between 60 and 90%. The use of extracorporeal membrane oxygenation (ECMO) is not frequently needed in TB. We report the case of a 24 year old woman diagnosed with bilateral pneumonia that required MV and intensive care, patient was managed with prone ventilation for 48h, but persisted in refractory hypoxemia. Etiological study was only positive for mycobacterium tuberculosis. As a rescue therapy arterio-venous extracorporeal CO2 removal was started and lased for 4 days, but fails to support the patient due to greater impairment of oxygenation. Veno-venous ECMO was then initiated, thus normalizes gas exchanged and allows lungs to rest. ECMO was maintained for 36 days, with two episodes of serious complication treated successfully. Given the absence of clinical improvement and the lack of nosocomial infection, at 42-day of ICU stay methylprednisolone 250mg daily for 4 days was started, since secondary organizing pneumonia associated with TB was suspected. Thereafter progressive improvement in pulmonary mechanics and reduction of pulmonary opacities was observed, allowing the final withdrawal of ECMO. Percutaneous tracheostomy was performed and the patient remained connected until her transfer to her base hospital at day 59 of admission to our unit. The tracheostomy was removed prior to hospital discharge, and the patient is today at home. Prolonged ECMO support is a useful and potentially successful tool in catastrophic respiratory failure caused by TB. © 2013.
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Publisher
W.B. Saunders Ltd (32 Jamestown Road, London NW1 7BY, United Kingdom)

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344.

Extracorporeal life support for acute respiratory distress syndromes.
Hayes D., Tobias J.D., Kukreja J., Preston T.J., Yates A.R., Kirkby S., Whitson B.A.
Annals of Thoracic Medicine. 8 (3) (pp 133-141), 2013. Date of Publication: July-September 2013.
AN: 369387351
The morbidity and mortality of acute respiratory distress syndrome remain to be high. Over the last 50 years, the clinical management of these patients has undergone

vast changes. Significant improvement in the care of these patients involves the development of mechanical ventilation strategies, but the benefits of these strategies remain controversial. With a growing trend of extracorporeal support for critically ill patients, we provide a historical review of extracorporeal membrane oxygenation (ECMO) including its failures and successes as well as discussing extracorporeal devices now available or nearly accessible while examining current clinical indications and trends of ECMO in respiratory failure.
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345.

High-frequency oscillation for acute respiratory distress syndrome.
Young D., Lamb S.E., Shah S., MacKenzie I., Tunnicliffe W., Lall R., Rowan K., Cuthbertson B.H.
New England Journal of Medicine. 368 (9) (pp 806-813), 2013. Date of Publication: 28 Feb 2013.
AN: 368412047
BACKGROUND: Patients with the acute respiratory distress syndrome (ARDS) require mechanical ventilation to maintain arterial oxygenation, but this treatment may produce secondary lung injury. High-frequency oscillatory ventilation (HFOV) may reduce this secondary damage.
METHOD(S): In a multicenter study, we randomly assigned adults requiring mechanical ventilation for ARDS to undergo either HFOV with a Novalung R100 ventilator (Metran) or usual ventilatory care. All the patients had a ratio of the partial pressure of arterial oxygen (PaO2) to the fraction of inspired oxygen (FIO 2) of 200 mm Hg (26.7 kPa) or less and an expected duration of ventilation of at least 2 days. The primary outcome was all-cause mortality 30 days after randomization.
RESULT(S): There was no significant between-group difference in the primary outcome, which occurred in 166 of 398 patients (41.7%) in the HFOV group and 163 of 397 patients (41.1%) in the conventional- ventilation group (P=0.85 by the chi-square test). After adjustment for study center, sex, score on the Acute Physiology and Chronic Health Evaluation (APACHE) II, and the initial PaO2:FIO2 ratio, the

odds ratio for survival in the conventional-ventilation group was 1.03 (95% confidence interval, 0.75 to 1.40; P=0.87 by logistic regression).
CONCLUSION(S): The use of HFOV had no significant effect on 30-day mortality in patients undergoing mechanical ventilation for ARDS. (Funded by the National Institute for Health Research Health Technology Assessment Programme; OSCAR Current Controlled Trials number, ISRCTN10416500.)
PMID
23339638 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23339638]
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Publisher
Massachussetts Medical Society (860 Winter Street, Waltham MA 02451-1413, United States)

346.

Strategies to reduce ventilator-associated lung injury (VALI).
Salman D., Finney S.J., Griffiths M.J.D.
Burns. 39 (2) (pp 200-211), 2013. Date of Publication: March 2013.
AN: 52316038
Optimal management of the acute respiratory distress syndrome (ARDS) requires prompt recognition, treatment of the underlying cause and the prevention of secondary injury. Ventilator-associated lung injury (VALI) is one of the several iatrogenic factors that can exacerbate lung injury and ARDS. Reduction of VALI by protective low tidal volume ventilation is one of the only interventions with a proven survival benefit in ARDS. There are, however, several factors inhibiting the widespread use of this technique in patients with established lung injury. Prevention of ARDS and VALI by detecting at-risk patients and implementing protective ventilation early is a feasible strategy. Detection of injurious ventilation itself is possible, and potential biological markers of VALI have been investigated. Finally, facilitation of protective ventilation, including techniques such as extracorporeal support, can mitigate VALI. © 2012 Elsevier Ltd and ISBI.
PMID
23183376 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23183376]
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Publisher
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347.

Novel uses of arteriovenous extracorporeal membrane carbon dioxide removal (AV-ECCO2R) - Two case studies.
Hughes T., Slack A., Bernal W., Wendon J., Finney S., Willars C., Auzinger G.
Journal of the Intensive Care Society. 14 (2) (pp 169-173), 2013. Date of Publication: April 2013.
AN: 369031150
Extracorporeal carbon dioxide removal (ECCO2R) device technologies have enhanced the management of acute respiratory distress syndrome (ARDS) and other lung pathologies necessitating low tidal volume protective ventilation. We report the novel use of the interventional Lung Assist Membrane Ventilator (iLA, Novalung GmbH) in a multi-trauma patient with pulmonary contusion and pre-existing cyanotic congenital heart disease and in a patient with raised intracranial pressure in the context of acute liver failure and primary graft non-function. In both cases, heart-lung interactions were complex, but AV-ECCO2R brought about significant improvements in respiratory indices and left/right ventricular function. The device facilitated restoration of homeostasis where other therapeutic options were limited or had failed.

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Publisher
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348.

Emerging indications for extracorporeal membrane oxygenation in adults with respiratory failure.
Abrams D., Brodie D.
Annals of the American Thoracic Society. 10 (4) (pp 371-377), 2013. Date of Publication: August 2013.
AN: 369729080
Recent advances in technology have spurred the increasing use of extracorporeal membrane oxygenation (ECMO) in patients with severe hypoxemic respiratory failure. However, this accounts for only a small percentage of patients with respiratory failure. We envision the application of ECMO in many other forms of respiratory failure in the coming years. Patients with less severe forms of acute respiratory distress syndrome, for instance, may benefit from enhanced lung-protective ventilation with the very low tidal volumesmade possible by direct carbon dioxide removal from the blood. For those in whom hypercapnia predominates,

extracorporeal support will allow for the elimination of invasive mechanical ventilation in some cases. The potential benefits of ECMO may be further enhanced by improved techniques, which facilitate activemobilization. Although ECMO for these and other expanded applications is under active investigation, it has yet to be proven beneficial in these settings in rigorous controlled trials. Ultimately, with upcoming and future technological advances, there is the promise of true destination therapy, which could lead to a major paradigm shift in the management of respiratory failure.
PMID
23952860 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23952860]
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349.

Pilot study of extracorporeal carbon dioxide removal to facilitate extubation and ambulation in exacerbations of chronic obstructive pulmonary disease.
Abrams D.C., Brenner K., Burkart K.M., Agerstrand C.L., Thomashow B.M., Bacchetta M., Brodie D.
Annals of the American Thoracic Society. 10 (4) (pp 307-314), 2013. Date of Publication: August 2013.
AN: 369729068
Rationale: Acute exacerbations of chronic obstructive pulmonary disease (COPD) requiring invasive mechanical ventilation (IMV) are associated with significant morbidity and mortality. Extracorporeal carbon dioxide removal (ECCO2R) may facilitate extubation and ambulation in these patients and potentially improve outcomes.
Objective(s):Weassessed the feasibility of achieving early extubation and ambulation in subjects requiring IMV for exacerbations of COPD using single-site ECCO2R.
Method(s): Five subjects with exacerbations of COPD with uncompensated hypercapnia requiring IMVwere enrolled in this singlecenter, prospective, feasibility trial using a protocol of ECCO2R, extubation, and physical rehabilitation. The primary endpoint was extubation within 72 hours of starting ECCO2R.
Measurements and Main Results: Mean preintubation pH and PaCO2 were 7.23 +/- 0.05 and 81.6 +/-15.9 mm Hg, respectively. All subjects met the primary endpoint (median duration, 4 h; range, 1.5-21.5 h). Mean duration of extracorporeal support was 193. +/-76.5 hours. Mean time to ambulation after extracorporeal initiation was 29.4 +/- 12.6 hours. Mean maximal ambulation on extracorporeal support was 302 feet (range, 70-600). Four subjects were discharged home, and one underwent planned lung transplantation. Two minor bleeding complications occurred. There were no complications from mobilization on extracorporeal support.
Conclusion(s): ECCO2R facilitates early extubation and ambulation in exacerbations of COPD requiring IMV and has the potential to serve as a new paradigm for the management of a select group of patients. Rigorous clinical trials are needed to corroborate these results and to investigate the effect on longterm outcomes and

cost effectiveness over conventional management. © 2013 by the American Thoracic Society.
PMID
23952848 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23952848]
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Publisher
American Thoracic Society (61 Broadway 4th Floor, New York NY 10006 - 2755, United States)

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350.

Extracorporeal life support in patients with multiple injuries and severe respiratory failure: A single-center experience?.
Biderman P., Einav S., Fainblut M., Stein M., Singer P., Medalion B.
Journal of Trauma and Acute Care Surgery. 75 (5) (pp 907-912), 2013. Date of Publication: November 2013.
AN: 370445695
BACKGROUND: The use of extracorporeal life support in trauma casualties is limited by concerns regarding hemorrhage, particularly in the presence of traumatic brain injury (TBI). We report the use of extracorporeal membrane oxygenation (ECMO)/interventional lung assist (iLA) as salvage therapy in trauma patients. High-flow technique without anticoagulation was used in patients with coagulopathy or TBI.

METHOD(S): Data were collected from all adult trauma patients referred to one center for ECMO/iLA treatment owing to severe hypoxemic respiratory failure.
RESULT(S): Ten casualties had a mean (SD) Injury Severity Score (ISS) of 50.3 (10.5) (mean [SD] age, 29.8 [7.7] years; 60% male) and were supported 9.5 (4.5) days on ECMO (n = 5) and 7.6 (6.5) days on iLA (n = 5). All experienced blunt injury with severe chest injuries, including one cardiac perforation. Most were coagulopathic before initiation of ECMO/iLA support. Among the seven patients with TBI, four had active intracranial hemorrhage. Complications directly related to support therapy were not lethal; these included hemorrhage from a cannulation site (n = 1), accidental removal of a cannula (n = 1), and pressure sores (n = 3). Deaths occurred owing to septic (n = 2) and cardiogenic shock (n = 1). Survival rateswere 60% and 80% on ECMOand iLA, respectively. Follow-up of survivors detected no neurologic deterioration.
CONCLUSION(S): ECMO/iLA therapy can be used as a rescue therapy in adult trauma patients with severe hypoxemic respiratory failure, even in the presence of coagulopathy and/or brain injury. The benefits of rewarming, acid-base correction, oxygenation, and circulatory support must beweighed individually against the risk of hemorrhage. Further research should determinewhether ECMO therapy also confers survival benefit. Copyright © 2013 by Lippincott Williams & Wilkins.
PMID
24158215 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24158215]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

351.

Respiratory dialysis for avoidance of intubation in acute exacerbation of COPD.
Mani R.K., Schmidt W., Lund L.W., Herth F.J.F.
ASAIO Journal. 59 (6) (pp 675-678), 2013. Date of Publication: November-December 2013.
AN: 370253865
Noninvasive ventilatory support has become the standard of care for patients with chronic obstructive pulmonary disease (COPD) experiencing exacerbations leading to acute hypercapnic respiratory failure. Despite advances in the use of noninvasive ventilation and the associated improvement in survival, as many as 26% of these patients fail noninvasive support and have a higher subsequent risk of mortality than patients treated initially with invasive mechanical ventilation. We report the use of a novel device to avoid invasive mechanical ventilation in two patients who were experiencing acute hypercapnic respiratory failure because of an exacerbation of COPD and were deteriorating, despite support with noninvasive ventilation. This device provided partial extracorporeal carbon dioxide removal at dialysis-like settings through a single 15.5 Fr venovenous cannula inserted percutaneously through the right femoral vein. The primary results were rapid reduction in arterial carbon dioxide and correction of pH. Neither patient required intubation, despite imminent failure of noninvasive ventilation before initiation of extracorporeal support. Both patients were weaned from noninvasive and extracorporeal support within 3 days. We concluded that low-flow extracorporeal carbon dioxide removal, or respiratory dialysis, is a viable option for avoiding intubation and invasive mechanical ventilation in patients with COPD experiencing an exacerbation who are failing noninvasive ventilatory support. © 2013 by the American Society for Artificial Internal Organs.
PMID
24172275 [http://www.ncbi.nlm.nih.gov/pubmed/?term=24172275]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

352.

Lung transplantation for cystic fibrosis and bronchiectasis.
Corris P.
Seminars in Respiratory and Critical Care Medicine. 34 (3) (pp 297-304), 2013. Date of Publication: 2013.
AN: 369277390
Lung transplantation has become an excellent treatment option for patients with cystic fibrosis (CF) and bronchiectasis with very advanced lung disease. Despite the challenges that the CF patients present, survival is more favorable than that seen in patients with chronic obstructive pulmonary disease and pulmonary fibrosis. Although those CF and bronchiectasis patients with severe respiratory disease are often infected with organisms that display in vitro resistance to the commonly used antibiotics, they usually have successful outcomes with transplantation, which are reported to be the same as in those patients with less resistant bacteria. Preoperative synergy testing has been demonstrated to reduce the presence of postoperative bacteremia and empyema in patients with CF. Newer challenges include the increasing presence of nontuberculous mycobacteria and in particular the rapid grower Mycobacterium abscessus, for which patient-to-patient spread has been recently recognized. The increased recognition of gastroesophageal reflux offers challenges regarding when and to whom one should offer fundoplication. Most potential CF recipients have metabolic bone disease warranting treatment, especially with the significant loss of bone density seen in the first year after transplantation. Diabetes mellitus, renal dysfunction, and hypertension and their consequences remain common and are of increasing importance as median survival increases in excess of 10 years. With increased experience, more programs are now transplanting patients who require membrane oxygenator support in addition to noninvasive ventilation pretransplantation and the use of a membrane device in the awake patient principally to remove excessive CO2 and reduce acidemia is worthy of note (Novalung; Novalung GmbH, Heilbronn, Federal Republic of Germany). Many centers now take the view that an awake and ambulant patient receiving such support represents a more favorable option than an intubated patient. The limiting factor in lung transplantation remains the number of organs available. Efforts to increase the donor pool, such as low tidal volume ventilation, are effective in allowing a greater percentage of offered organs to be accepted. Perhaps the most encouraging development, however, is that of ex vivo lung perfusion. This permits not only the ability to measure the function of the lungs, something of great value for lungs from donors with circulatory death (donation after cardiac death), but also the potential to introduce lung repair and convert a nonusable lung to one that can be safely used for transplantation. © 2013 by Thieme Medical Publishers, Inc.
PMID
23821505 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23821505]
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Publisher
Thieme Medical Publishers, Inc. (333 7th Avenue, New York NY 10001-5004, United States)

353.

Artificial Lung and Novel Devices for Respiratory Support.
Martin J.T., Zwischenberger J.B.
Seminars in Thoracic and Cardiovascular Surgery. 25 (1) (pp 70-75), 2013. Date of Publication: 21 2013.
AN: 369210266
There is a growing demand for new technology that can take over the function of the human lung, whether it is to assist an injured or recently transplanted lung or to completely replace the native lung. The use of extracorporeal membrane oxygenation (ECMO) as a bridge to lung transplantation was reported for the first time more than 3 decades ago; nevertheless, its use in lung transplantation was largely abandoned owing to poor patient survival and frequent complications. ECMO as a bridge to lung transplantation has significantly increased during the past 10 years. This increase in utilization is reflected in the growing success reported with the use of different ECMO modalities in patients awaiting lung transplantation. The use of ECMO is now being considered in awake and nonintubated patients so as to improve oxygenation, facilitate ambulation, and improve physical conditioning before transplant. Several programs have developed ambulatory capability of most forms of ECMO, and ambulatory ECMO is now often referred to as the "artificial lung." We present a brief description of the evolution of the use of ECMO in lung transplantation and summarize the available technology and current approaches to provide ECMO support. © 2013 Elsevier Inc.
PMID
23800531 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23800531]
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354.

Lower tidal volume strategy (=3 ml/kg) combined with extracorporeal CO2 removal versus 'conventional' protective ventilation (6 ml/kg) in severe ARDS: The prospective randomized Xtravent-study.
Bein T., Weber-Carstens S., Goldmann A., Muller T., Staudinger T., Brederlau J., Muellenbach R., Dembinski R., Graf B.M., Wewalka M., Philipp A., Wernecke K.-D., Lubnow M., Slutsky A.S.
Intensive Care Medicine. 39 (5) (pp 847-856), 2013. Date of Publication: May 2013.
AN: 52385838
Background: Acute respiratory distress syndrome is characterized by damage to the lung caused by various insults, including ventilation itself, and tidal hyperinflation can lead to ventilator induced lung injury (VILI). We investigated the effects of a low tidal volume (V T) strategy (V T = 3 ml/kg/predicted body weight [PBW]) using pumpless extracorporeal lung assist in established ARDS.
Method(s): Seventy-nine patients were enrolled after a 'stabilization period' (24 h with optimized therapy and high PEEP). They were randomly assigned to receive a low V T ventilation (=3 ml/kg) combined with extracorporeal CO2 elimination, or to a

ARDSNet strategy (=6 ml/kg) without the extracorporeal device. The primary outcome was the 28-days and 60-days ventilator-free days (VFD). Secondary outcome parameters were respiratory mechanics, gas exchange, analgesic/sedation use, complications and hospital mortality.
Result(s): Ventilation with very low V T's was easy to implement with extracorporeal CO2-removal. VFD's within 60 days were not different between the study group (33.2 +/- 20) and the control group (29.2 +/- 21, p = 0.469), but in more hypoxemic patients (PaO2/FIO2 <=150) a post hoc analysis demonstrated significant improved VFD-60 in study patients (40.9 +/- 12.8) compared to control (28.2 +/- 16.4, p = 0.033). The mortality rate was low (16.5 %) and did not differ between groups.
Conclusion(s): The use of very low V T combined with extracorporeal CO2 removal has the potential to further reduce VILI compared with a 'normal' lung protective management. Whether this strategy will improve survival in ARDS patients remains to be determined (Clinical trials NCT 00538928). © 2013 The Author(s).
PMID
23306584 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23306584]
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Publisher
Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

355.

Use of extracorporeal membrane oxygenation in combination with high-frequency oscillatory ventilation in post-traumatic ARDS.
Gothner M., Buchwald D., Schlebes A., Strauch J.T., Schildhauer T.A., Swol J.
Acta Anaesthesiologica Scandinavica. 57 (3) (pp 391-394), 2013. Date of Publication: March 2013.

AN: 52384765
Acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) are life-threatening complications in trauma patients. Despite the implantation of a veno-venous extracorporeal membrane oxygenation (vv ECMO), sufficient oxygenation (arterial SaO2 > 90%) is not always achieved. The additive use of high-frequency oscillation ventilation (HFOV) and ECMO in the critical phase after trauma could prevent the occurrence of life-threatening hypoxaemia and multi-organ failure. We report on a 26-year-old female (Injury Severity Score 29) who had multiple injuries as follows: an unstable pelvic fracture, a blunt abdominal trauma, a blunt trauma of the left thigh, and a thoracic injury. Three days after admission, the patient developed fulminant ARDS (Murray lung injury score of 11 and Horovitz- Index <80 mmHg), and vv ECMO therapy was initiated. The Horovitz- Index was <80 mm Hg, and the lung compliance was minimal. With HFOV, almost complete recruitment of the lung was achieved, and the fraction of inspired oxygen (FiO2) was significantly reduced. The pelvic fracture was treated non-operatively. The HFOV was terminated after 3 days, and the ECMO was stopped after 19 days. © 2013 The Acta Anaesthesiologica Scandinavica Foundation.
PMID
23298282 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23298282]
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Publisher
Blackwell Munksgaard (1 Rosenorns Alle, P.O. Box 227, Copenhagen V DK-1502, Denmark)

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356.

Discussion: Extracorporeal membrane oxygenation for adult respiratory failure.
Anonymous
Respiratory Care. 58 (6) (pp 1049-1052), 2013. Date of Publication: 01 Jun 2013.
AN: 369024660
Publisher
American Association for Respiratory Care (9425 N. MacArthur Blvd. Suite 100, Irving TX 75063, United States)

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357.

Removing extra CO2 in COPD patients.
Lund L.W., Federspiel W.J.
Current Respiratory Care Reports. 2 (3) (pp 131-138), 2013. Date of Publication:

September 2013.
AN: 369487441
For patients experiencing acute respiratory failure due to a severe exacerbation of chronic obstructive pulmonary disease (COPD), noninvasive positive pressure ventilation has been shown to significantly reduce mortality and hospital length of stay compared to respiratory support with invasive mechanical ventilation. Despite continued improvements in the administration of noninvasive ventilation (NIV), refractory hypercapnia and hypercapnic acidosis continue to prevent its successful use in many patients. Recent advances in extracorporeal gas exchange technology have led to the development of systems designed to be safer and simpler by focusing on the clinical benefits of partial extracorporeal carbon dioxide removal (ECCO2R), as opposed to full cardiopulmonary support. While the use of ECCO2R has been studied in the treatment of acute respiratory distress syndrome (ARDS), its use for acute hypercapnic respiratory during COPD exacerbations has not been evaluated until recently. This review will focus on literature published over the last year on the use of ECCO2R for removing extra CO2 in patients experiencing an acute exacerbation of COPD.
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Publisher
Current Medicine Group LLC (400 Market St, Ste 700 Philadelphia PA 19106, United States)

358.

Outcome and prognosis for patients younger than thirty with primary lung cancer.
Duan L., You Q., Chen X., Wang H., Zhang H., Xie D., Xu X., Jiang G.
Minerva Chirurgica. 68 (2) (pp 175-182), 2013. Date of Publication: April 2013.
AN: 369606844
Aim: Aim of the present study was to investigate the clinical and pathological features of surgical treatment for primary bronchogenic carcinoma in adolescent patients.
Patient(s): We retrospectively reviewed the clinico-pathological records documenting surgical outcomes and prognostic factors in 68 lung cancer patients aged less than 30 years old enrolled in our hospital between March 1980 and December 2009.
Result(s): Sixty-eight patients were identified (38 male, 30 female) with a mean age of 22+/-5 years (range 8 to 29 years). Preoperative clinical manifestations were present in 82.4% (56/68) of the patients and 26.5% (16/68) of patients were initially misdiagnosed. Fiftytwo patients had undergone radical surgery, 4 palliative surgery, 9 had exploratory thoracotomies, and 3 had thoracoscopic lung biopsies. Eight patients were classified (TNM) stage Ia, 7 stage Ib, 9 stage IIa, 13 stage IIb, 17 stage IIIa, 10 stage IIIb, and 4 stage IV. Postoperative atelectasis was observed in 4.41% (3/68) of the patients, and 1.47% (1/68) died of respiratory failure 5 days after exploratory thoracotomy. The overall 5-year survival rate in very young people was 31%, while those who underwent radical surgery was slightly higher at 36.7%. Five-year survival rates were correlated with the surgical procedures and pTNM stage ($P < 0.05$). Multivariate analysis indicated that the TNM stage is the only independent prognostic factor ($P=0.000$).
Conclusion(s): We conclude that radical surgeries, the predominant comprehensive therapies are the best choice for primary lung cancer patients younger than 30 years

of age.
PMID
23612231 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23612231]
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Publisher
Edizioni Minerva Medica (Corso Bramante 83-85, Torino 10126, Italy)

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359.

Extracorporeal carbon dioxide removal trough ventilation of acidified dialysate: An experimental study.
Patroniti N., Zanella A., Redaelli S., Mangili P., Ormas V., Sosio S., Peluso L., Pesenti A.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2013. Philadelphia, PA United States. Conference Publication: (var.pagings). 187 (MeetingAbstracts) (no pagination), 2013. Date of Publication: 2013.
AN: 71983454
RATIONALE: Extracorporeal carbon dioxide removal (ECCO2R) plays a critical role in implementing lung protective strategy in patients with severe respiratory failure. We have previously described, in long-term animal study, the efficacy and safety of an enhanced ECCO2R technique based on continuous infusion of lactic acid in a closed dialysis circuit assembled just before the membrane lung (ML). In the present study we modified the previous extracorporeal circuit moving the ML from the blood stream to the dialysate circuit and we evaluated the efficiency of this ECCO2R technique based on ventilation of acidified dialysate and the effect of different dialysate flows.
METHOD(S): Four pigs were sedated, mechanically-ventilated and connected to a veno-venous dialysis circuit (blood flow 250 ml/min). The dialysate, exiting the hemofilter, flowed through the ML (gas flow 10 l/min) and returned to the hemofilter recirculating in a closed loop circuit in countercurrent with the blood flow. We performed 8 steps repeated 3 times: 4 different dialysis flows (200, 400, 600 and 800 ml/min), each with and without lactic acid infusion at the ML inlet (2.5 mEq/min). At the end of each step we measured the amount of CO2 removed by the ML (VCO2ML) and blood gas parameters.
RESULT(S): VCO2ML was 34+/-6 ml/min and 86+/-7 ml/min, respectively, without and with acidification ($p < 0.001$). The dialysis flows did not affected the VCO2ML, except for 200 ml/min which resulted in a slightly lower VCO2ML (27+/-4 and 84.3+/-4.1, respectively, without and with acidification). The pCO2 of blood entering the dialysis filter was maintained constant at 60.9+/-3.6 mmHg and through the filter decreased to 37.1+/-4.8 and 32.5+/-5.3 mmHg, respectively, without and with acidification, while the pH, respectively, increased of 0.18+/-0.03. and 0.03+/-0.04.
CONCLUSION(S): The tested ECCO2R technique based on ventilation of acidified dialysate proved to be efficient, achieving a conspicuous extracorporeal CO2 removal (40% of the total CO2 production of an adult man) from an extracorporeal blood flow as low as 250 ml/min. Future studies are needed to evaluate possible advantages of this strategy (reduced extracorporeal blood volume, reduced blood

flow resistance, lower clotting problems) during prolonged applications.
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Publisher
American Thoracic Society

360.

Extracorporeal carbon dioxide removal and non-invasive ventilation in chronic obstructive pulmonary disease or asthma patients with severe respiratory failure.
Patroniti N., Mangili P., Redaelli S., Ormas V., Sosio S., Peluso L., Ponzoni F., Pesenti A.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2013. Philadelphia, PA United States. Conference Publication: (var.pagings). 187 (MeetingAbstracts) (no pagination), 2013. Date of Publication: 2013.
AN: 71982569
RATIONALE: Extracorporeal carbon dioxide removal (ECCO2R) allows to implement a protective ventilatory strategy in patients with severe respiratory failure. Partial ECCO2R, with low extracorporeal blood flow (BF, < 1l/min), was recently proposed in the treatment of COPD exacerbation in association with non-invasive ventilation, to decrease work of breathing and prevent endotracheal intubation (1). We report a case series of COPD and asthma patient treated with ECCO2R and non-invasive ventilation.
METHOD(S): From February 2012 we treated five patients (age 54+/-17, SAPSII 30+/-9), admitted to our intensive care unit (ICU) for severe respiratory failure, with extracorporeal CO2 removal and non-invasive ventilation: four with COPD exacerbation (Gold III-IV) and one with severe asthma (Raw 30 cm H2O/L/sec despite full therapy). We collected respiratory parameters (mode of ventilation; PaO2/FiO2 ratio; minute ventilation, MV; positive end-expiratory pressure, PEEP; airways resistance, Raw; pulmonary compliance, Cpl), ECCO2R parameters (BF; gas flow, GF and extracorporeal CO2 removal, VCO2ML) and blood gas analysis over days of treatment. All data are reported as mean +/- standard deviation, otherwise as median (min-max).
RESULT(S): All patients were intubated within the first day in the ICU, ECCO2R started after 1.5+/-1 days from intubation; the four COPD patients were connected to a low flow extracorporeal circuit (two with CardioHelp PALP and two with Maquet pediatric circuit) while the asthma patient, due to severe hypoxia, initially required a full ECMO (BF 4 l/min). During extracorporeal support median BF was 0.6 (0.5-4) L/min and median GF was 6.5 (3-10) L/min, mean VCO2ML was 105+/-10 ml/min; ECCO2R treatment lasted 11+/-7 days. Before ECCO2R institution, minute ventilation, pH and PaCO2 we respectively 5.4+/-1.1 L/min, 7.36+/-0.03 and 66+/-13 mmHg; after ECCO2R were respectively 3.2+/-2.5 L/min, 7.44+/-0.02 and 55+/-17 mmHg. Patients were extubated after 1.4+/-1.1 days from ECCO2R start and managed with non-invasive continuous positive airway pressure and/or oxygen mask. PaO2/FiO2 slightly decreased during ECCO2R from 205+/-59 to 180 +/-96 mmHg, possibly due to the reduction in MV. Two patients were successfully decannulated after 6+/-3 days and discharged from ICU after 10 days (one COPD and one asthmatic). Two patients developed severe hypoxia and required re-intubation, both died due to multi-organ failure. One patient is still on ECCO2R.

CONCLUSION(S): Extracorporeal CO2 removal reduced minute ventilation and expiratory effort and could be used in COPD or asthma patients to allow early extubation. However if patient became severe hypoxic, re-intubation and/or full ECMO support is needed.
Institution
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Publisher
American Thoracic Society

361.

Extracorporeal CO2 removal in patients with severe COPD exacerbation failing non invasive ventilation.
Pisani L., Fasano L., Del Sorbo L., Fanelli V., Ranieri M.V., Nava S.
European Respiratory Journal. Conference: European Respiratory Society Annual Congress 2013. Barcelona Spain. Conference Publication: (var.pagings). 42 (SUPPL. 57) (no pagination), 2013. Date of Publication: 01 Sep 2013.
AN: 71841362
BACKGROUND. Noninvasive ventilation (NIV) has a success rate of about 75% during an episode of severe hypercapnic respiratory failure in COPD patients. Recently, a new minimally invasive CO2 extracorporeal removal device (ECCO2-R, Decap; Hemodec, Salerno, Italy) consisting of a pump-driven veno-venous hemofiltration system has been developed. The main features of this system are a low extracorporeal blood flow (<500 ml/min), using a small (14-French) double-lumen catheter, and a relatively small infusion rate of heparin. METHODS. 15 COPD patients with severe hypercapnic respiratory failure failing NIV after a trial of 2-4 hrs and meeting the criteria for intubation (i.e.pH < 7.30 and hypercapnia (no changes or increased in the PaCO2 baseline values), respiratory rate > 35 b/min, moderate to severe dyspnea) were enrolled. The average duration of treatment with Decap was 18-24 hours. Intubation was required in 2/15 (13%) patients, and other 2 had procedure related complications (i.e bleeding and obstruction of hemofiltration circuit), but did not require intubation. RESULTS. Decap improved gas exchange vs baseline (pH 7.28+/-0.06, PaCO2 81+/-16 mmHg PaO2/FiO2 184+/-79, RR 29+/-8 b/min baseline; pH 7.34+/-0.07,PaCO2 70+/-19, PaO2/FiO2 169+/-60, RR 22+/-6 b/min at 1 hour; pH 7.37+/-0.07, PaCO2 64+/-16, PaO2/FiO2 210+/-85 RR 21+/-6 b/min after 12 hours).
CONCLUSION(S): This study shows that extracorporeal CO2 removal may be applied safely with veno-venous technique needing low blood flow and therefore can be used to avoid intubation in those patients failing a NIV attempt.
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Publisher
European Respiratory Society

362.

Elevation of procalcitonin after implantation of an interventional lung assist device in critically ill patients: Wait and watch or hit 'em hard?.
Kott M., Bewig B., Schaedler D., Becher T., Frerichs I., Weiler N.
Intensive Care Medicine. Conference: 26th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2013. Paris France. Conference Publication: (var.pagings). 39 (SUPPL. 2) (pp S492), 2013. Date of Publication: October 2013.
AN: 71446934
Introduction. In patients with acute respiratory distress syndrome (ARDS), need for mechanical ventilation and refractory hypercapnia, pumpless veno-arterial interventional lung assist (iLA) devices are used as part of a lung-protective ventilation strategy [1]. Delayed antimicrobial therapy increases the mortality in this group of high-risk patients in case of bacterial infection [2]. Besides clinical signs and symptoms, treatment is based on the kinetics of biomarkers, like Procalcitonin (PCT) [3]. We hereby report PCT elevations in patients after iLA implantation in the absence of documented infection. OBJECTIVES. To evaluate peri-interventional kinetics of PCT concentrations before and after iLA implantation. METHODS. Retrospective study in a small series of patients with ARDS of non-infectious cause. RESULTS. An up to ten-fold increase in PCT concentrations was observed in critically ill patients after iLA implantation. In the absence of clinical signs of infection it is likely to relate this phenomenon to the release of pro-inflammatory cytokines following contact of the blood with the artificial surfaces of the iLA membrane, with subsequent PCT release. Hence, the start of administration of antibiotics should be carefully considered in the context of other clinical findings, and repeated PCT measurements in short time intervals should be performed.
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Publisher
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363.

Different behavior between copd and ARDS patients in the respiratory drive response to the extracorporeal CO2 unloading during spontaneous breathing.
Crotti S., Spinelli E., Bottino N., Polli F., Chiurazzi C., L'Acqua C., Protti A., Gattinoni L.
Intensive Care Medicine. Conference: 26th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2013. Paris France. Conference Publication: (var.pagings). 39 (SUPPL. 2) (pp S305), 2013. Date of Publication: October 2013.
AN: 71446271
Introduction. Extracorporeal membrane oxygenation (ECMO) has been proposed as

an alternative to mechanical ventilation in the treatment of acute respiratory failure with the objectives to correct respiratory gas exchanges and reduce respiratory distress. The use of ECMO in patients who are awake and spontaneously breathing has been described in COPD exacerbation1 and as a bridge to lung transplantation, but no data exist about its application in the early phase of ARDS. OBJECTIVES. The aim of this retrospective analysis is to evaluate whether the extracorporeal CO2 removal by reducing the need to clear CO2 by the native lung reduces respiratory distress in spontaneously breathing patients with COPD exacerbation and ARDS. METHODS. Seven patients with COPD exacerbation and five patients with severe ARDS who failed non invasive ventilation, underwent ECMO while maintaining spontaneous breathing in the early phase of respiratory failure. The ECMO parameters were set clinically. In both the COPD and the ARDS patients the ECMO Gas flow (GF) was progressively raised to increase extracorporeal CO2 removal in the attempt to obtain a relief of the dyspnea and reduce the work of breathing. To evaluate respiratory drive responses we retrospectively compared the respiratory rate (RR) and tidal oesophageal pressure swings (DPes, an index of work of breathing) recorded at the lowest and the highest level of ECMO GF clinically set during the first 48 h. RESULTS. COPD and ARDS patients revealed a different respiratory drive response to extracorporeal CO2 removal. In the COPD population both RR and DPes significantly decreased increasing the ECMO GF (*paired Student t-test P\0.05), while in the ARDS patients RR slightly reduced and DPes did not change with the increase of ECMO GF (Table Persented) CONCLUSIONS. In spontaneously breathing patients with acute respiratory failure ECMO allows a control of respiratory drive in COPD exacerbation but not in ARDS. Further studies are needed to investigate whether different pathophysiological mechanisms of the underlying diseases explain this different behavior.
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Publisher
Springer Verlag

364.

A membrane oxygenator phosphorylcholine coated (ABYLCAP) allows protective ventilation in hypercapnic patients with minimal impairment of coagulation and improvement of right ventricular function.
Turani F., Martini S., Candidi F., Belli A., Busatti S., Falco M.
Intensive Care Medicine. Conference: 26th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2013. Paris France. Conference Publication: (var.pagings). 39 (SUPPL. 2) (pp S250), 2013. Date of Publication: October 2013.
AN: 71446091
Introduction. Extracorporeal CO2 removal may be a useful support in hypercapnic patients, in which mechanical ventilation may result in VILI and Barotrauma. Many ECCO2R systems are actually used, but a new ECCO2R device-fosforilcoline coated- may decrease the thrombogenicity during the treatment. OBJECTIVES. The aims of this study to evaluate. 1. The clinical safety of this device 2. The changes of the main cardiorespiratory indices 3. The coagulative response. METHODS. Ten patients with hypercapnic respiratory failure have been enrolled in the study. ECCO2R was initiated by using a modified continuous veno-venous hemofiltration

system with a membrane oxygenator (ABYLCAP Bellco Mirandola IT-membrane surface area: 0.67 m2, priming volume 90 ml, blood flow 280-350 ml/min, phosphorylcholine coated). Femoral vein cannulation with a double lumen catheter (14 F, Arrow International) was used to connect the patients to the extracorporeal system. Heparin was infused to maintain ACT\190-240[s. All patients had ECCO2R for 4 days. Every 12 h the changes of PH, PaCO2, Peak Pressure, PaO2 were evaluated. Platelets count and fibrinogen were evaluated every 24 h. Vigileo system was used to monitor CCO (continuous cardiac output). RVEDA/LVEDA ratio was assessed by echocardiography. All data are expressed as mean +/-: SD. ANOVA TEST one way with Bonferroni correction was used to compare the changes of parameters. P\0.05 was considered statistically significant. RESULTS. At Table 1 are reported the main results of this study. The CO2 removal by membrane oxygenator ranged from 56 to 37 ml/min. Only one oxygenator was used for every patient without clotting of the circuit nor any major bleeding problem. (Table Presented). CONCLUSIONS. ECCO2 removal with a membrane oxygenator phosphorylcholine coated allows protective ventilation without impairment of coagulation (minimal decrease of platelets, no fibrinolysis).Right ventricular function improves during this treatment.
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Springer Verlag

365.

Perioperative lung injuries.
Licker M.
Applied Cardiopulmonary Pathophysiology. Conference: 28th Annual Meeting of the European Association of Cardiothoracic Anaesthesiologists, EACTA 2013. Barcelona Spain. Conference Publication: (var.pagings). 17 (2) (pp 102-104), 2013. Date of Publication: 2013.
AN: 71105039
Currently, the incidence of postoperative pulmonary complications (PPC) far outnumbers cardiovascular complications [1], varying from 10% to 70%, depending on definition, study design, heterogeneity of patient population and type of procedure [2]. In thoracic surgery, the main causes of peri-operative deaths have now shifted from cardiovascular to infections and pulmonary complications [3, 4]. Pulmonary morbidity has also been associated with increasing health care costs and poor outcome as reflected by prolonged hospital stay, (re-)admission in intensive care units and reduced long-term survival [5, 6]. Transient and self-limiting impairments in gas exchange should be considered as part of the anaesthesia emergence period and as the physiological response to surgery. Most of the patients undergoing cardiothoracic or abdominal operations present some degree of hypoxaemia and diffuse micro-atelectasis that will barely impact on the postoperative clinical course. In contrast, pleural effusions, sustained bronchospasm, lobar atelectasis or hypoxaemia unresponsive to supplemental oxygen may forecast serious adverse events such as bronchopleural fistula, pneumonia, acute lung injury (ALI) or respiratory failure [7]. Predictive factors of PPCs entail patientrelated factors (e.g. chronic obstructive pulmonary disease [COPD], advanced age, poor nutritional

status, decreased exercise tolerance, heart failure) and intra-operative related factors (e.g. emergency surgery, upper abdominal and intra-thoracic procedures, duration of anaesthesia, presence of a nasogastric tube, ventilatory settings, fluid balance) [2, 8]. These procedure-related factors are much more amenable to modification than preexisting chronic diseases. Ventilator-induced lung injuries (VILI) During spontaneous ventilation, tidal volume (VT) and transpulmonary pressure (Ptp) in healthy subjects vary within tight limits of 4 to 6 ml per kg of ideal body weight (IBW) and 4 to 8 mmHg, respectively. Surprisingly and for decades, anaesthetists have been taught to apply "unphysiological" large tidal volume (10 to 15 ml/kg) to prevent the development of atelectasis. To date, a growing body of knowledge indicates that mechanical ventilation induces alveolar injuries by repetitive opening and closing of unstable lung units owing to surfactant inactivation, upregulation of pro-inflammatory mediators, generation of reactive oxygen/nitrogen intermediates and excessive mechanical stress between atelelectatic areas and neighbouring ventilated areas [9]. In anaesthetized patients with healthy lungs, besides "high" VT and elevated inspiratory pressure, other risk factors for lung injuries have been identified [10, 11]. Fluid overhydration increases capillary hydrostatic pressure and promotes interstitial/alveolar oedema particularly when lymphatics are disrupted. Additionally, tissue trauma, ischaemia- reperfusion, blood transfusion and exposure to extracorporeal devices may all combine to trigger (or to amplify) a widespread inflammatory response with potential deleterious effects on the lungs [12]. Some individuals are prone to develop ALI, given their deficient lung defence and repair mechanisms (e.g., antioxidant, heat shock protein, p75 receptor for tumour necrosis factor alpha [TNF-alpha]) that fail to counteract the inflammatory and oxidative responses to damaging insults [13]. Genetic disruption of the transcription factor Nrf2 (NF-E2 related factor 2) has been associated with overexpression of proinflammatory cytokines and increased risk of ALI due to hyperoxia and high VT. Relevant gene variants or single nucleotide polymorphisms (SNPs) in ALI candidate genes have been tested for differences in allelic frequency in cohort studies (Nrf2, ACE genotype) [14,15]. Interestingly, a recent survey among members of the UK Association of Cardiothoracic Anaesthetists revealed that only 40% of 132 respondents were using "low" VT (median 6 ml/kg, interquartile range 5-7 ml/kg) during one-lung ventilation [16]. Lung Protective Approaches Based on experimental models of ALI/ ARDS, the "open-lung" approach including the combination of low VT, titrated external PEEP and periodic recruitment manoeuvres, has been shown to minimize the bronchoalveolar strain while preserving the FRC and preventing the development of atelectasis [17,18]. In thoracic and non-thoracic surgery, preliminary data also support this concept, although well designed RCTs are still lacking [19,20]. The fraction of inspired oxygen (FIO2) might be reduced to levels sufficient to keep SaO2 > 96% (FIO2 < 60%). The use of volatile anaesthetic should be considered in patients with bronchospastic disease and may potentially confer additional protection to the lungs and other organs [21, 22]. The use of minimally invasive haemodynamic monitors is advocated to optimize oxygen transport while avoiding fluid overload [23]. In the postoperative period, noninvasive ventilation can be considered in high risk patients [24]. In all patients, voluntary deep breathing and early mobilization should be encouraged and will be facilitated if optimal analgesic techniques are provided without undue sedation and while cardiovascular homeostasis is maintained. Newer technological modalities including extracorporeal membrane oxygenation (ECMO) and pumpless extracorporeal interventional lung assist (ILA) should also be considered, not only as rescue therapies in refractory respiratory failure but also in lesser severe ALI to minimize mechanical stress on the lung [25].

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366.

Usefulness of extracorporeal support systems during thoracic surgery.
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Applied Cardiopulmonary Pathophysiology. Conference: 28th Annual Meeting of the European Association of Cardiothoracic Anaesthesiologists, EACTA 2013. Barcelona Spain. Conference Publication: (var.pagings). 17 (2) (pp 88-89), 2013. Date of Publication: 2013.
AN: 71105033
Improvements in medical technology offer new horizons in the treatment of critical ly ill patients. Extracorporeal lung support systems have existed for a long time. However new developments have been reported, whose efficacy has to be confirmed. Generally, there are two major indications for extracorporeal ventilation. It can be applied to give the injured or diseased lung a chance to heal (bridge to recovery) or in an end-stage lung disease, it might be used as a bridge to lung transplantation. Moreover, it is also indicated in the intra-operative period of complex trachea operations and combined cardiac and pulmonary procedures. It is also considered as a possible approach to hypoxaemia during one-lung ventilation; but very rarely and only as a "final chance". On the other hand, it has been reported that there is an increased use of this technique in the treatment ARDS. Extracorporeal membrane oxygenators (ECMO) and pump-less extracorporeal lung support (interventional lung assist [iLA]) (NovaLung TM) have been increasingly used as bridges to transplantation. ECMO can be applied either in a "VV" (veno-venous) (mainly indicated in respiratory failure not responding to mechanical ventilation) or in "VA" (veno-arterial) (in cases where both respiratory and cardiac support are necessary) configuration. For iLA, an "AV" (arterio-venous) bypass system, into which a gas exchange membrane is integrated, is used. iLA provides effective CO2 elimination but only a moderate improvement in oxygenation. Both methods have advantages and disadvantages regarding their capabilities and technical difficulties. During and after thoracic surgery, both techniques are indicated mainly in patients with bronchopleural fistulas after lung resection, severe lung contusion in trauma patients, life-threatening hypoxaemia caused by pneumonia, lung transplantation as well as primary graft failure in order to prevent ventilator-induced lung injury and to reduce inspiratory peak pressures. During mechanical ventilation in the postoperative period of thoracic surgery, "protecting" the lung against ventilator injury (while still achieving adequate oxygenation and/or gas exchange) can be very challenging. In these cases, there are reports showing the beneficial effects of the extracorporeal techniques. However, more studies showing the effects (but also the unwarranted effects) are necessary. The use of these systems is appropriate only if it is considered that the lung failure is reversible with therapy and there would be gain time for recovery In irreversible cases, these systems can help as a bridge to transplant.
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Publisher
Pabst Science Publishers

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367.

A case of post pneumonectomy acute lung injury coupled with pulmonary embolus.
Egan S., Marsh B., O'Loughlin C.
Irish Journal of Medical Science. Conference: RAMI Section of Interns Study Day 2013. Dublin Ireland. Conference Publication: (var.pagings). 182 (SUPPL. 5) (pp S145), 2013. Date of Publication: June 2013.
AN: 71103392
A 52-year-old lady with a history significant for bronchiectasis presented to the Mater Misericordiae University Hospital (MMUH) with one episode of haemoptysis. Computed tomography, bronchoscopy and histology revealed a bronchial carcinoid tumour. This patient underwent left lower lobe sleeve resection. Following this she had persistent atelectasis, refractory to treatment, and completion pneumonectomy was performed. Five days postoperatively she suffered an acute deterioration. Her ABG revealed a respiratory acidosis (pH 7.2). She was admitted to the Intensive Care Unit for management of respiratory distress and was subsequently intubated. Despite this the patient was persistently acidotic and hypercapnic and a 'novalung' was put in place. Due to ongoing haemodynamic instability and increasing inotrope requirements, trans-oesphageal echo was performed which revealed a thrombus in her right ventricle. This patient subsequently arrested due to a pulmonary embolic event and passed away despite aggressive attempts at resuscitation. The occurrence of two separate clinically significant processes in this patient, along with her severe haemodynamic collapse, must be equally considered in this case. Post pneumonectomy Acute Lung Injury (ALI) is a significant cause of mortality with an approximately 50 % case fatality rate. Its aetiology is multifactorial but includes an endothelial insult which results in a high protein, low pressure pulmonary oedema. Mediastinal lymphatic drainage and serum cytokines have also been implicated. This case demonstrates the high mortality rate associated with post pneumonectomy ALI despite aggressive management. It also highlights the devastating effect a pulmonary embolus can have when a patient has only one pulmonary artery.
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Publisher
Springer London

368.

Right ventricular restriction in interventional lung assist for acute respiratory distress syndrome.
Tavazzi G., Bojan M., Canestrini S., White M., Price S.
Critical Care. Conference: 33rd International Symposium on Intensive Care and Emergency Medicine. Brussels Belgium. Conference Publication: (var.pagings). 17 (SUPPL. 2) (pp S64), 2013. Date of Publication: 19 Mar 2013.
AN: 71030469
Introduction Acute cor pulmonale (ACP) is associated with increased mortality in patients ventilated for acute respiratory distress syndrome (ARDS). Interventional lung assist (iLA) allows a lung-protective ventilatory strategy, whilst allowing CO2

removal, but requires adequate right ventricular (RV) function. RV restriction (including presystolic pulmonary A wave) [1] is not routinely assessed in ARDS. Methods A prospective analysis of retrospectively collected data in patients with echo during iLA was performed. Data included epidemiologic and ventilatory factors, LV/RV function, evidence of RV restriction and pulmonary hemodynamics. Data are shown as mean +/- SD/median (interquartile range). Results Thirty-two patients (45 +/- 17 years), 22 male (68%), SOFA score 11.15 +/- 2.38 were included. Pulmonary hypertension (PHT) was 53%, and hospital mortality 43%. Mortality was not associated with age, days on iLA, length of ICU stay, inotropic support, nitric oxide or level of ventilatory support, but was associated with pressor requirement (P = 0.005), a worse PaO2:FiO2 ratio (9.4 (7.8 to 12.6) vs. 15.2 (10.7 to 23.9), P = 0.009) and higher pulmonary artery pressures (56.5 mmHg (50 to 60) vs. 44.5 (40.5 to 51.2), P = 0.02). No echo features of ACP were (Graph Presented) found, with no significant difference between RV systolic function, pulmonary acceleration time and pulmonary velocity time integral between survivors and nonsurvivors. The incidence of RV restriction was high (43%), and independent of PHT, RV systolic function and level of respiratory support, but correlated with CO2 levels (restrictive 7.1 kPa (7.4 to 8.0) vs. 6.1 (5.8 to 6.8), P = 0.03). See Figure 1. Conclusion Typical echo features of ACP were not seen in this study, possibly because of the protective ventilatory strategies allowed by use of iLA. The incidence of RV restriction may reffect more subtle abnormalities of RV function. Further studies are required to elucidate RV pathophysiology in critically ill adult patients with ARDS.
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Publisher
BioMed Central Ltd.

369.

Combined use of pumpless extracorporeal lung assist system and continuous renal replacement therapy with citrate anticoagulation in polytrauma patients.
Atalan H.K., Dumantepe M., Denizalti T.B., Tarhan I.A., Ozler A.
Critical Care. Conference: 33rd International Symposium on Intensive Care and Emergency Medicine. Brussels Belgium. Conference Publication: (var.pagings). 17 (SUPPL. 2) (pp S23), 2013. Date of Publication: 19 Mar 2013.
AN: 71030363
Introduction The usefulness of a pumpless extracorporeal lung assist system (pECLA) and continuous renal replacement therapy (CRRT) in critically ill patients has been demonstrated in previous studies [1,2]. The aim of this report was to examine combined use of pECLA and CRRT to improve carbon dioxide and inflammatory mediator removal, which allows for lung protective ventilation strategies. Methods In our 10 patients with ARDS due to polytrauma and sepsis, pECLA was established by insertion of cannulae to the femoral artery and vein. CRRT cannulae were introduced by venous line of the same vascular access (Figure 1). We preferred regional anticoagulation with trisodium citrate for both CRRT and ILA. (Image Presented) Results Mean SAPS II and APACHE II scores were 55 and 23 respectively. Mean time on mechanical ventilation was 22 days. Mean ICU stay was 30 days for survivors and 38 days for nonsurvivors. When compared with baseline values most relevant parameters were the improvement in tidal volumes, plateau pressures, PaCO2 levels and pH (Figure 2). Four patients survived while six

patients died from sepsis-MOF. Conclusion We concluded that pECLA can effectively address the impaired gas exchange in ARDS and CRRT is a safe procedure with potential therapeutic value for treating MOF. Citrate anticoagulation was well tolerated and f lter life was appropriate. The use of the same vascular access for ILA and CRRT may minimize invasive procedures and related side effects.
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Publisher
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370.

Lung transplantation for bronchiolitis obliterans after allogeneic hematopoietic stem cell transplantation.
Kim Y.R., Haam S.J., Park Y.G., Lim B.J., Park Y.M., Paik H.C.
Yonsei Medical Journal. 53 (5) (pp 1054-1057), 2012. Date of Publication: July 2012.
AN: 365385001
Bronchiolitis obliterans (BO) is a late onset complication of allogeneic hematopoietic stem cell transplantation (HSCT), and treatment outcome is dismal if it does not respond to immunosuppressive therapy. A 21-year-old male diagnosed with acute myeloid leukemia received an allogeneic HSCT from human leukocyte antigen-identical sibling donor. Twenty one months after transplantation, he developed progressive dyspnea and was diagnosed BO. Despite standard immunosuppressive therapy, the patient rapidly progressed to respiratory failure and Novalung interventional lung-assist membrane ventilator was applied in the intensive care unit. Three months after the diagnosis of BO, the patient underwent bilateral lung transplantation (LT) and was eventually able to wean from the ventilator and the Novalung. Since the LT, the patient has been under a strict rehabilitation program in order to overcome a severe lower extremity weakness and muscle atrophy. Histologic findings of the explanted lungs confirmed the diagnosis of BO. Nine months after the LT, the patient showed no signs of rejection or infectious complications, but still required rehabilitation treatment. This is the first LT performed in a patient with BO after allogeneic HSCT in Korea. LT can be an effective therapy in terms of survival for patients with respiratory failure secondary to development of BO following HSCT. © Yonsei University College of Medicine 2012.
PMID
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Publisher
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371.

Avoiding invasive mechanical ventilation by extracorporeal carbon dioxide removal in patients failing noninvasive ventilation.
Kluge S., Braune S.A., Engel M., Nierhaus A., Frings D., Ebelt H., Uhrig A., Metschke M., Wegscheider K., Suttorp N., Rousseau S.
Intensive Care Medicine. 38 (10) (pp 1632-1639), 2012. Date of Publication: October 2012.
AN: 365710244
Purpose: To evaluate whether extracorporeal carbon dioxide removal by means of a pumpless extracorporeal lung-assist (PECLA) device could be an effective and safe alternative to invasive mechanical ventilation in patients with chronic pulmonary disease and acute hyper-capnic ventilatory failure not responding to noninvasive ventilation (NIV).
Method(s): In this multicen-tre, retrospective study, 21 PECLA patients were compared with respect to survival and procedural outcomes to 21 matched controls with conventional invasive mechanical ventilation. Matching criteria were underlying diagnosis, age, Simplified Acute Physiology Score II and pH at ICU admission.
Result(s): Of the 21 patients treated with PECLA, 19 (90 %) did not require intubation. Median PaCO2 levels and pH in arterial blood prior to PECLA were 84.0 mmHg (54.2-131.0) and 7.28 (7.10-7.41), respectively. Within 24 h, median PaCO2 levels and pH had significantly improved to 52.1 (33.0-70.1; p<0.001) and 7.44 (7.27-7.56; p < 0.001), respectively. Two major and seven minor bleeding complications related to the device occurred. Further complications were one pseudoaneurysm and one hepa-rin-induced thrombocytopenia type 2. Compared to the matched control group, there was a trend toward a shorter hospital length of stay in the PECLA group (adjustedp = 0.056). There was no group difference in the 28-day (24 % vs. 19 %, adjusted p = 0.845) or 6-month mortality (33 % vs. 33 %).
Conclusion(s): In this study the use of extracorporeal carbon dioxide removal allowed avoiding intubation and invasive mechanical ventilation in the majority of patients with acute on chronic respiratory failure not responding to NIV. Compared to conventional invasive ventilation, short- and long-term survivals were similar. © Copyright jointly held by Springer and ESICM 2012.
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372.

Trends in and perspectives on extracorporeal membrane oxygenation for severe adult respiratory failure.
Sadahiro T., Oda S., Nakamura M., Watanabe E., Tateishi Y., Shinozaki K., Hirayama Y.
General Thoracic and Cardiovascular Surgery. 60 (4) (pp 192-201), 2012. Date of Publication: April 2012.
AN: 364768722
Various approaches such as ventilator management involving lung-protective ventilation, corticosteroids, prone positioning, and nitric oxide have failed to maintain suffi cient lung oxygenation or appropriate ventilation competence in very severe acute respiratory distress syndrome (ARDS). Extracorporeal membrane oxygenation (ECMO) has been aggressively introduced for such patients, although in only a few institutions. The clinical usefulness of ECMO in a large-scale multicenter study (CESAR trial, 2009) and continued development/ improvement of ECMO devices have facilitated performance of ECMO, with further increase in the number of institutions adopting ECMO therapy. Clinical usefulness of ECMO was documented in many cases of severe ARDS secondary to infl uenza A (H1N1) 2009 infection. ECMO requires establishment of an appropriate management system to minimize fatal complications (e.g., hemorrhage), which requires a multidisciplinary team. This, in combination with a new technique, interventional lung assist, will further extend the indications for ECMO. ECMO can be expected to gain importance as a respiratory support technique. © The Japanese Association for Thoracic Surgery 2012.
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373.

Transportable extracorporeal lung support for rescue of severe respiratory failure in combat casualties.
Bein T., Zonies D., Philipp A., Zimmermann M., Osborn E.C., Allan P.F., Nerlich M., Graf B.M., Fang R.
Journal of Trauma and Acute Care Surgery. 73 (6) (pp 1450-1456), 2012. Date of Publication: December 2012.
AN: 366278201
BACKGROUND: Advances in oxygenator membrane, vascular cannula, and centrifugal pump technologies led to the miniaturization of extracorporeal lung support (ECLS) and simplified its insertion and use. Support of combat injuries

complicated by severe respiratory failure requires critical care resources not sustainable in the deployed environment. In response to this need, a unique international military-civilian partnership was forged to create a transportable ECLS capability to rescue combat casualties experiencing severe respiratory failure.
METHOD(S): A multidisciplinary training and consultative relationship developed between the US military at Landstuhl Regional Medical Center (LRMC) and the University Hospital Regensburg (UHR), a German regional aoelung failurea center with expertise in ECLS. ECLS circuits used were pumpless arteriovenous extracorporeal lung assist (NovaLung iLA) and pump-driven venovenous extracorporeal membrane oxygenation (PLS Quadrox D Membrane Oxygenator with Rotaflow Centrifugal Pump). US casualties supported by ECLS between June 2005 and August 2011 were identified from the LRMC Trauma Program Registry for review.
RESULT(S): UHR cared for 10 US casualties supported by ECLS. The initial five patients were cannulated with arteriovenous circuits (pumpless arteriovenous extracorporeal lung assist), and the remaining five were cannulated with pump-driven venovenous circuits (extracorporeal membrane oxygenation). Four patients were cannulated in the war zone, and six patients were cannulated at LRMC after evacuation to Germany. All patients were transferred to UHR for continued management (mean, 9.6 ECLS days). In all cases, both hypoxemia and hypercapnia improved, allowing for decreased airway pressures. Nine patients were weaned from ECLS and extubated. One soldier died from progressive multiple-organ failure.
CONCLUSION(S): ECLS should be considered in the management of trauma complicated by severe respiratory failure. Modern ECLS technology allows these therapies to be transported for initiation outside of specialized centers even in austere settings. Close collaboration with established centers potentially allows both military and civilian hospitals with infrequent ECLS requirements to use it for initial patient stabilization before transfer for continued care. LEVEL OF EVIDENCE: Therapeutic/care management study, level V. © 2012 by Lippincott Williams & Wilkins.
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(Fang) US Air Force Center for Sustainment of Trauma and Readiness Skills, R Adams Cowley Shock Trauma Center, Baltimore, MD, United States
Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

374.

Extracorporeal lung support. Extrakorporale Lungenunterstutzungsverfahren <Extrakorporale Lungenunterstutzungsverfahren.>
Hecker M., Bandorski D., Hecker A.
Medizinische Klinik - Intensivmedizin und Notfallmedizin. 107 (6) (pp 491-501), 2012. Date of Publication: 2012.
AN: 369211299
For decades, techniques for extracorporeal lung support, such as extracorporeal membrane oxygenation (ECMO), have offered in specialized centres the possibility to completely or partly substitute lung function, thus, facilitating healing. Initially the application of ECMO was associated with severe complications, but significant technical progress in recent years has led to the development of safer systems and promotes a wider distribution of the technique. Supported by recent, positive study data, ECMO has become a promising option for acute respiratory distress syndrome (ARDS) therapy in specialized centers. Further developments and modifications, such as pumpless devices for extracorporeal lung support have the potential of becoming an interesting option for intensive care medicine - however, data of prospective studies showing efficacy are still not available. © 2012 Springer-Verlag.
PMID
22907520 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22907520]
Institution
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Publisher
Springer-Verlag (Germany)

375.

The treatment of adult respiratory distress syndrome (ARDS) using extracorporeal membrane oxygenation (ECMO).
Kim G.W., Choi E.Y., Hong S.B.
Tuberculosis and Respiratory Diseases. 72 (1) (pp 1-7), 2012. Date of Publication: 30 Jan 2012.
AN: 364299160
Extracorporeal Membrane Oxygenation (ECMO) support to tissue oxygenation has been shown to improve survival in patients with life threatening respiratory distress syndrome or cardiac failure. Extracorporeal life support such as ECMO, including extracorporeal CO2 removal (ECCO2R), is used as temporary support until successful recovery of organs. A recently published multicentre randomized controlled trial, known as the CESAR (conventional ventilation or extracorporeal membrane oxygenation for severe adult respiratory failure) trial, was the first trial to demonstrate the utility of ECMO in acute respiratory distress syndrome (ARDS). During the 2009 influenza A (H1N1) pandemic, there were many reports of patients with severe ARDS related to H1N1 infection treated with ECMO. These reports revealed a high survival rate and effectiveness of ECMO. In this review, we explain the indication of ECMO clinical application, the practical types of ECMO, and

complications associated with ECMO. In addition, we explain recent new ECMO technology and management of patients during ECMO support.
Institution
(Kim, Hong) Department of Pulmonary and Critical Care Medicine, Asan Medical Center, University of Ulsan College of Medicine, 388-1, Pungnap-dong, Songpa-gu, Seoul 138-736, South Korea (Choi) Division of Pulmonary and Critical Care Medicine, Yeungnam University College of Medicine, Daegu, South Korea
Publisher
Korean National Tuberculosis Association (121-150 Dangsandong-6-ga Yeoungdeungpogu, Seoul 150-046, South Korea)

376.

Rescue therapy with a pumpless extracorporeal lung assist device in a patient with acute interstitial lung disease and severe refractory hypercapnia.
Petzoldt M., Braune S., Bittmann I., Kluge S.
Respiratory Care. 57 (2) (pp 293-297), 2012. Date of Publication: February 2012.
AN: 364223256
Idiopathic interstitial pneumonia frequently causes severe pulmonary restriction that in turn makes mechanical ventilation difficult. We report the case of a 44-year-old woman who developed a refractory severe hypercapnic respiratory failure (PaCO2 281 mm Hg, pH 6.77) despite mechanical ventilation with high inspiratory pressure and PEEP. A pumpless extracorporeal lung assist device, Novalung, was used as rescue therapy for carbon dioxide removal, enabling lung-protective ventilation and normalization of life-threatening acidosis. Open lung biopsy revealed an idiopathic interstitial pneumonia with histological features of a nonspecific interstitial pneumonia. Corticosteroid therapy led to progressive improvement of pulmonary function, soon permitting cessation of mechanical ventilation and extracorporeal therapy. The patient was discharged from the intensive care unit after 20 days. This case demonstrates the successful use of pumpless extracorporeal lung assist as an alternative device to pump-driven extracorporeal membrane oxygenation in severe hypercapnic respiratory failure secondary to nonspecific interstitial pneumonia. © 2012 Daedalus Enterprises.
PMID
21762563 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21762563]
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(Bittmann) Department of Pathology, Diakonie-Hospital, Rotenburg (Wuemme), Germany
Publisher
Daedalus Enterprises Inc. (9425 North MacArthur Blvd, Suite 100, Irving TX 75063, United States)

377.

Bridging to lung transplantation by extracorporeal support.
del Sorbo L., Boffini M., Rinaldi M., Ranieri V.M.
Minerva Anestesiologica. 78 (2) (pp 243-250), 2012. Date of Publication: February 2012.
AN: 364191932
Ideally, bridging patients with end stage severe respiratory failure to lung transplantation should significantly extend the pretransplant life expectancy to increase the chances to receive a suitable organ, as well as efficiently preserve the post-transplant long-term life expectancy by maintaining physiological homeostasis and avoiding multi-organ dysfunction. Various advanced strategies of extracorporeal circulation can replace at least in part the respiratory function of the lung and can potentially provide the appropriate mode and level of cardiopulmonary support for each patient's physiologic requirements. Therefore, patients on the lung transplant waiting list developing severe hypoxemic and/ or hypercapnic respiratory failure can be supported for a prolonged period of time before the transplant, preserving a satisfactory post-transplant life expectancy. However, a more systematic clinical study on this issue is warranted in order to define the actual efficacy of these treatments in reducing the mortality rate on the waiting transplant list, and eventually improve the outcome of patients with end stage respiratory failure. Copyright© 2012 Edizioni Minerva Medica.
PMID
22293922 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22293922]
Institution
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Publisher
Edizioni Minerva Medica S.p.A. (Corso Bramante 83-85, Torino 10126, Italy)

378.

Long-Range Critical Care Evacuation and Reoperative Surgery.
Zonies D.
Surgical Clinics of North America. 92 (4) (pp 925-937), 2012. Date of Publication: August 2012.
AN: 365331705
Long-range critical care aeromedical evacuation has significantly contributed to the unprecedented survival during recent military operations. With advances in critical care, patients with increased injury severity and overall complexity are routinely evacuated while resuscitation is ongoing. Additional specialty teams now provide advanced pulmonary rescue therapies for the most critically ill patients. As part of the continuum of trauma care, an overseas fixed facility provides follow-on emergency surgical critical care to optimize patient outcomes before final evacuation to the continental United States. © 2012.
PMID

22850155 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22850155]
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Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

Link to the Ovid Full Text or citation:
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379.

Refractory hypercapnia: A simplified technique for extracorporeal CO 2 removal (ECCO2R) in the presence of therapeutic limitations.
Bonnet M., Wittebole X., Jacquet L.-M., Hantson P.
Acta Anaesthesiologica Belgica. 63 (4) (pp 177-180), 2012. Date of Publication: Fourth Quarter 2012.
AN: 368700387
Refractory hypercapnia with severe acidosis appeared in a 67-year-old man who presented with lung fibrosis and a left pneumothorax as delayed complications of bleomycin chemotherapy for advanced grade lymphoma. Due to failure of noninvasive ventilation using a high-flow nasal cannula oxygen system, the patient was mechanically ventilated with two ventilators at different settings, after intubation with a double-lumen tube. As he had a poor haematological prognosis, extracorporeal membranous oxygenation was not considered. To remove some amount of carbon dioxide, we used a simplified method based on a veno-venous hemofiltration circuit coupled to a paediatric oxygenator and an air/oxygen blender. The efficacy on carbon dioxide removal was modest, with a percentage of CO2 total extraction ranging from 10.5 to 20.4%, but the system was immediately available, well tolerated and not very expensive. © Acta Anaesthesiologica Belgica.
PMID
23610855 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23610855]
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(Hantson) Louvain Centre for Toxicology and Applied Pharmacology, Universite Catholique de Louvain, Brussels, Belgium
Publisher
ARSMB-KVBMG (Avenue W. Churchill-laan 11/30, Brussels B-1180, Belgium)

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380.

Extracorporeal carbon dioxide removal: The future of lung support lies in the history.
Kaushik M., Wojewodzka-Zelezniakowicz M., Cruz D.N., Ferrer-Nadal A., Teixeira C.,

Iglesias E., Kim J.C., Braschi A., Piccinni P., Ronco C.
Blood Purification. 34 (2) (pp 94-106), 2012. Date of Publication: October 2012.
AN: 365930118
Extracorporeal organ support in patients with dysfunction of vital organs like the kidney, heart, and liver has proven helpful in bridging the patients to recovery or more definitive therapy. Mechanical ventilation in patients with respiratory failure, although indispensable, has been associated with worsening injury to the lungs, termed ventilator-induced lung injury. Application of lung-protective ventilation strategies are limited by inevitable hypercapnia and hypercapnic acidosis. Various alternative extracorporeal strategies, proposed more than 30 years ago, to combat hypercapnia are now more readily available. In particular, the venovenous approach to effective carbon dioxide removal, which involves minimal invasiveness comparable to renal replacement therapy, appears to be very promising. The clinical applications of these extracorporeal carbon dioxide removal therapies may extend beyond just lung protection in ventilated patients. This article summarizes the rationale, technology and clinical application of various extracorporeal lung assist techniques available for clinical use, and some of the future perspectives in the field. Copyright © 2012 S. Karger AG, Basel.
PMID
23095408 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23095408]
Institution
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(Wojewodzka-Zelezniakowicz) Emergency Medicine and Disaster Department, Medical University of Bialystok, Bialystok, Poland
Publisher
S. Karger AG (Allschwilerstrasse 10, P.O. Box, Basel CH-4009, Switzerland)

381.

Advances in Therapy for Acute Lung Injury.
von Dossow-Hanfstingl V.
Anesthesiology Clinics. 30 (4) (pp 629-639), 2012. Date of Publication: December 2012.
AN: 365919601
Despite advances in the therapy for acute lung injury and adult respiratory distress syndrome, mortality remains high. The iatrogenic risk of ventilator-induced lung injury might contribute to this high mortality because the lungs are hyperinflated. Low tidal volume and inspiratory pressure are surrogates for the stress and strain concept; but lung compliance, transpulmonary pressure, and chest wall elastance might differ in individual patients. In previous published studies, an increasing number of patients were treated successfully with extracorporeal support. Extracorporeal membrane oxygenation and interventional lung assist allow ultraprotective ventilation strategies. However, these assists have different technical aspects and different indications. © 2012 Elsevier Inc.

PMID
23089499 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23089499]
Institution
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Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

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382.

A new supportive therapy for adult respiratory distress syndrome: Interventional lung assist device. Eriskin solunum sikintisi sendromunda uygulanan yeni bir destekleyici tedavi: Girisimsel akciger destek araci <Eriskin solunum sikintisi sendromunda uygulanan yeni bir destekleyici tedavi: Girisimsel akciger destek araci.>
Cukurova Z., Eren G., Hergunsel O., Altun D., Kusku A., CetIngok H., Polat Y., Zeydan A., Durdu B., Akgul A.
Turkiye Klinikleri Journal of Medical Sciences. 32 (1) (pp 294-300), 2012. Date of Publication: 2012.
AN: 363119889
Adult respiratory distress syndrome (ARDS) remains a great challenge for physicians in intensive care units with high mortality rates. Although protective lung ventilation is the main-stay of ARDS therapy, it may lead to intractable hypercapnia. Pumpless extracorporeal lung-assist was suggested as an invasive alternative to conventional treatment when gas exchange is not optimized with rigorous mechanical ventilation alone. Here, we report the treatment of a patient with extracorporeal lungasist in the course of pneumonia-related ARDS due to intractable hypercapnia as a result of failure of protective ventilation strategy and her outcome after treatment. Interventional Lung Assist device (iLA) contains a specially designed low resistance lung membrane, which uses the pressure difference between the arterial and venous circulation. This system enables the use of high airway pressures for oxygenation in combination with very low tidal volumes to avoid ventilator-induced lung injury and this gives time to patient for lung recovery. © 2012 by Turkiye Klinikleri.
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Publisher
Turkiye Klinikleri

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383.

Bench to bedside review: Extracorporeal carbon dioxide removal, past present and future.
Cove M.E., MacLaren G., Federspiel W.J., Kellum J.A.
Critical Care. 16 (5) (no pagination), 2012. Article Number: 232. Date of Publication: 21 Sep 2012.
AN: 52028647
Acute respiratory distress syndrome (ARDS) has a substantial mortality rate and annually affects more than 140,000 people in the USA alone. Standard management includes lung protective ventilation but this impairs carbon dioxide clearance and may lead to right heart dysfunction or increased intracranial pressure. Extracorporeal carbon dioxide removal has the potential to optimize lung protective ventilation by uncoupling oxygenation and carbon dioxide clearance. The aim of this article is to review the carbon dioxide removal strategies that are likely to be widely available in the near future. Relevant published literature was identified using PubMed and Medline searches. Queries were performed by using the search terms ECCOR, AVCO2R, VVCO2R, respiratory dialysis, and by combining carbon dioxide removal and ARDS. The only search limitation imposed was English language. Additional articles were identified from reference lists in the studies that were reviewed. Several novel strategies to achieve carbon dioxide removal were identified, some of which are already commercially available whereas others are in advanced stages of development. © 2012 BioMed Central Ltd.
PMID
23014710 [http://www.ncbi.nlm.nih.gov/pubmed/?term=23014710]
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Publisher
BioMed Central Ltd. (Floor 6, 236 Gray's Inn Road, London WC1X 8HB, United Kingdom)

384.

Management of the critically ill obstetric patient.
Frise M.C., Frise C.J., Nelson-Piercy C.
Obstetrics, Gynaecology and Reproductive Medicine. 22 (9) (pp 241-247), 2012.

Date of Publication: September 2012.
AN: 52125888
From 2006 to 2008, 261 women in the United Kingdom died either as a direct or indirect result of pregnancy. More than half of these received critical care input. The support required varied from observation and supportive management to multi-organ support. In many women death occurred despite optimal care, but in a number substandard care was identified when the cases were reviewed as part of the Confidential Enquiry into Maternal Deaths. An understanding of the different types of organ support and treatment that are available in a critical care setting and when these are indicated is therefore crucial for medical professionals caring for these unwell obstetric patients.Described here are the technical aspects of organ support that can be utilized in a critical care setting and the alterations in physiology that occur in pregnancy which influence the use of each treatment modality. Also highlighted in more detail are conditions that are common or life threatening in pregnancy and key points about management of these conditions when they mandate critical care support. © 2012 Elsevier Ltd.
Institution
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(Nelson-Piercy) Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom
Publisher
Churchill Livingstone (1-3 Baxter's Place, Leith Walk, Edinburgh EH1 3AF, United Kingdom)

385.

Decubitus prone position in patient with extracorporeal CO2 removal device novalung. Decubito prono en paciente portador de dispositivo de extraccion extracorporea de CO2 Novalung <Decubito prono en paciente portador de dispositivo de extraccion extracorporea de CO2 Novalung.>
Frade Mera M.J., Vergara Diez L., Fernandez Gaute N., Montes Gil D.
Enfermeria Intensiva. 23 (3) (pp 132-141), 2012. Date of Publication: July 2012.
AN: 52071650
Objective: To describe the course of a patient with the extracorporeal CO2 removal device and discover the effect of Novalung on ventilation, considering the patient's prone position and its influence on the device's blood flow. To develop a protocol of managing and specific care of a patient with Novalung.
Material(s) and Method(s): A case report of a patient with Novalung in a tertiary hospital ICU unit is reported. Parameters considered are hemodynamic, respiratory, pharmacological, analytical, neuromonitoring, managing of the Novalung and length of decubitus prone cycles. Anova Test, Student's T test, Wilcoxon-Mann Whitney and Spearman correlation. Significance p <0.05.
Result(s): A 46-year old women with nosocomial pneumonia and acute respiratory failure with indication of Novalung to decrease hypercapnia and optimize ventilatory management of refractory hypoxemia. ICU Stay 26days, MBP 82. +/-. 9. mmHg, HR 110. +/-. 6. lpm during the admission, monitoring PICCO 5 days CI 3.2. +/-. 0.8 l/min/m2, ELWI 33. +/-. 4. ml, continuous hemofiltration 13.2days with a median removal 50. cc/h. Norepinephrine dose 0.68. +/-. 0.79. mu/kg/min for 15days. Respiratory parameters during the admission: PO2 59. +/-. 13. mmHg, PCO2 68. +/-.

35. mmHg, SatO2 85. +/-. 12%, PO2/FIO2 69. +/-. 35, tidal volume 389. +/-. 141. cc. Novalung 13days, heparin dose 181.42. +/-. 145 mIU/Kg/min, Cephalin time 57.56. +/-. 16.41. sec, O2 flow 7. +/-. 3. l/min, median blood flow 1030. cc/h, interquartile range 1447-612. cc/h. Prone cycles 4, duration 53. +/-. 27. hours. With Novalung PCO2 decreased regardless of position 66. +/-. 21:56. +/-. 9, p. =. 0.005. Tidal volume 512. +/-. 67:267. +/-. 72, p. =. 0.0001. Blood flow on supine-prone position 1053. +/-. 82:113. +/-. 112, p. =. 0.001. There was no link between blood flow and PCO2 (p. =. 0.2) and between O2 and PO2 flow (p. =. 0.05). Specific care: pedal and tibial pulse monitoring, keep circuit safe to prevent and detect signs of bleeding, femoral arterial and venous catheter care, coagulation monitoring. Comments: During the use of Novalung protective, ventilation, low tidal volumes, decreased pressure plateau, PEEP and hypercapnia were achieved. Blood flow decreased in prone position, but the PCO2 did not increase. The device did not coagulate.
PMID
22726348 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22726348]
Institution
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Publisher
Ediciones Doyma, S.L. (Travesera de Gracia 17-21, Barcelona 08021, Spain)

386.

Treatment of sepsis and ARDS with extracorporeal membrane oxygenation and interventional lung assist membrane ventilator in a patient with acute lymphoblastic leukemia.
Gorjup V., Fister M., Noc M., Rajic V., Ribaric S.F.
Respiratory Care. 57 (7) (pp 1178-1181), 2012. Date of Publication: July 2012.
AN: 365267166
We report an 18-year-old ice skater with acute lymphoblast leukemia. She developed Staphylococcus epidermidis bacteremia, severe sepsis, septic shock, and ARDS following chemotherapy-induced severe bone marrow failure. She was successfully treated with extraordinary life support measures, which included extracorporeal membrane oxygenation, double lumen lung ventilation for management of hemoptysis, and lung assist membrane ventilation. After 57 days of ICU treatment and a year of rehabilitation, the patient has fully regained her functional status, is now finishing high school, and is ice
PMID
22369998 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22369998]
Institution
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Publisher
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387.

Report of two cases of ARDS patients treated with pumpless extracorporeal interventional lung assist. Relato de dois casos de pacientes com SARA tratados com membrana extracorporea de troca gasosa sem bomba <Relato de dois casos de pacientes com SARA tratados com membrana extracorporea de troca gasosa sem bomba.>
Coscia A.P., Ramos H.F.C., Longo A.G., Martins E.G.S., Saddy F., Japiassu A.M.
Jornal Brasileiro de Pneumologia. 38 (3) (pp 408-411), 2012. Date of Publication: May/June 2012.
AN: 365273568
PMID
22782614 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22782614]
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Publisher
Sociedade Brasileira de Pneumologia e Tisiologia (SEPS 714/914, Bloco E, Sala 116, Brasilia 70390-145, Brazil)

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388.

Subclinical interstitial lung disease: Why you should care.
Doyle T.J., Hunninghake G.M., Rosas I.O.
American Journal of Respiratory and Critical Care Medicine. 185 (11) (pp 1147-1153), 2012. Date of Publication: 01 Jun 2012.
AN: 364934241
The widespread use of high-resolution computed tomography in clinical and research settings has increased the detection of interstitial lung abnormalities (ILA) in asymptomatic and undiagnosed individuals. We reported that in smokers, ILA were present in about 1 of every 12 high-resolution computed tomographic scans; however, the long-term significance of these subclinical changes remains unclear. Studies in families affected with pulmonary fibrosis, smokers with chronic obstructive pulmonary disease, and patients with inflammatory lung disease have shown that asymptomatic and undiagnosed individuals with ILA have reductions in lung volume, functional limitations, increased pulmonary symptoms, histopathologic changes, and molecular profiles similar to those observed in patients with clinically significant interstitial lung disease (ILD). These findings suggest that, in select at-risk populations, ILA may represent early stages of pulmonary fibrosis or subclinical ILD. The growing interest surrounding this topic is motivated by our poor understanding of the inciting events and natural history of ILD, coupled with a lack of effective therapies. In this perspective, we outline past and current research focused on validating radiologic, physiological, and molecular methods to detect subclinical ILD.

We discuss the limitationsof the available cross-sectional studies andthe need for future longitudinal studies to determine the prognostic and therapeutic implications of subclinical ILD in populations at risk of developing clinically significant ILD.
PMID
22366047 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22366047]
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(Rosas) Lovelace Respiratory Research Institute, Albuquerque, NM, United States
Publisher
American Thoracic Society (61 Broadway 4th Floor, New York NY 10006 - 2755, United States)

389.

Arterial chimney graft cannulation for interventional lung assist.
Burkle M.A., Sodian R., Kaczmarek I., Weig T., Frey L., Irlbeck M., Dolch M.E.
Annals of Thoracic Surgery. 94 (4) (pp 1335-1337), 2012. Date of Publication: October 2012.
AN: 365716492
An interventional lung assist membrane ventilator (iLA) for arteriovenous extracorporeal CO2 removal was connected to a small-diameter femoral artery by use of a chimney graft in an underweight patient with acute respiratory failure and a previous history of heart-lung transplantation. This concept offers additional therapeutic options in underweight patients requiring extracorporeal CO2 removal with arterial vessels that are too small for percutaneous arterial cannulation with standard-sized percutaneous insertable iLA cannulae. © 2012 The Society of Thoracic Surgeons.
Institution
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Publisher
Elsevier USA (6277 Sea Harbor Drive, Orlando FL 32862 8239, United States)

390.

Individualized ventilation in influenza A (H1N1) infection: The experience of a single intensive care unit.
Akoumianaki E., Xirouraki N., Prinianakis G., Kondyli E., Apostolaki E.,

Georgopoulos D.
Pneumon. 25 (2) (pp 229-236), 2012. Date of Publication: April-June 2012.
AN: 365250970
Introduction: Severe influenza A infection (H1N1) is associated with acute respiratory failure the management of which challenges intensive care unit (ICU) physicians. The clinical features and outcome of all patients with laboratory-confirmed H1N1 admitted to the Heraklion University Hospital adult ICU during the last two years are reported.
Method(s): A retrospective observational single centre study was conducted at a tertiary ICU. The medical records of all patients admitted to the ICU with H1N1 infection 10th July 2009 - 1st May 2011 were reviewed. The data collected included demographic characteristics of the patients, the clinical manifestations and illness severity assessed by the Acute Physiology and Chronic Health Evaluation (APACHE) II, and interventions and complications during the ICU stay. The duration of mechanical ventilation, the length of ICU stay and the 60 day mortality were used as outcome indices.
Result(s): During the study period 23 patients with H1N1 were admitted to the ICU. They were relatively young (median age 39 yrs) with a median APACHE II on admission of 12 (range 5-22). In 7 patients (30.4%) there were no comorbidities on admission. In all cases the reason for admission was acute respiratory failure, with a median PaO2/FiO2 128 mmHg (range 83-376). Acute lung injury/ acute respiratory distress syndrome (ALI/ARDS) was the cause of respiratory failure in 21 patients (91.3%), while 2 presented with acute exacerbation of chronic obstructive pulmonary disease (COPD). Twenty patients (87%) required mechanical ventilation; 10 invasive, 5 non invasive and 5 both. Non conventional ventilator management, including oesophageal balloon insertion, high frequency oscillatory ventilation (HFOV), extracorporeal CO2 removal (ECCO2-R) and prone positioning were applied in 8 patients (34.8%). The median duration of mechanical ventilation and median length of ICU stay were 11.6 and 18.6 days, respectively. One patient died (4.3 % mortality).

Conclusion(s): The necessity for non conventional ventilator strategies and the prolonged need for life support characterize the severity of ARDS associated with H1N1 infection. An individualized ventilator approach, based on the principles of lung protective ventilation may have a significant influence on the course of the disease.
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Publisher
Technogramma (12 Markou Avgeri Str., Athens 15343, Greece)

391.

Extracorporeal carbon dioxide removal (ECCO2R) in respiratory failure: An overview, and where next?.
Baker A., Richardson D., Craig G.
Journal of the Intensive Care Society. 13 (3) (pp 232-237), 2012. Date of Publication: July 2012.

AN: 365528531
Extracorporeal carbon dioxide removal (ECCO2R) is used to facilitate protective ventilation strategies and to treat severe hypercapnic acidosis that is refractory to mechanical ventilation. There is an increasing amount of interest in the use of ECCO2R but there are no recommendations for its use that take the most recent evidence into account. In 2008, the National Institute of Health and Clinical Excellence (NICE) published guidelines on 'Arteriovenous Extracorporeal Membrane Carbon Dioxide Removal.'1 However, since that time there have been a number of studies in the area and some significant technological advances including the introduction of commercially available VV-ECCO2R systems. The aim of this article is to provide an overview of ECCO2R, review the literature relating to its use and discuss its future role in the intensive care setting.
Institution
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Publisher
Stansted News Ltd (134 South Street, Bishop's Stortford, Hertfordshire, Essex CM23 3BQ, United Kingdom)

392.

Successful bilateral lung transplantation with extracorporeal lung support by Novalung.
Redwan B., Schmidt J., Koesek V., Schmidt C., Van Aken H., Wiebe K.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2012. San Francisco, CA United States. Conference Publication: (var.pagings). 185 (MeetingAbstracts) (no pagination), 2012. Date of Publication: 2012.
AN: 71990492
Introduction Lung transplantation in patients with severe respiratory failure requires extracorporeal support. However, both cardio-pulmonary bypass and ECMO are associated with substantial side effects and risks. The pumpless interventional lung assist (Novalung) may present a safe and effective alternative. Case presentation A 50 year old male with end-stage pulmonary fibrosis underwent high-urgency bilateral sequential lung transplantation. For respiratory failure the patient was intubated for 16 days. Preoperatively, a pumpless interventional lung assist (Novalung) was implanted percutaneously via the femoral vessels (15 /17 Fr) for severe hypercapnia (pCO2 137 mmHg). At the onset of transplantation normal blood gas values were observed at a FiO2 of 0.9 (pO2 104, pCO2 40 mmHg). The surgical procedure was performed via bilateral anterolateral mini-thoracotomies without sternal splitting. Low dose noradrenalin was required during surgery. Low-dose heparin was applied for anticoagulation (PTT 40-50 sec). Nitric oxide and iloprost inhalation were administered. Left single lung ventilation and perfusion during transplantation of the right lung were well tolerated with a pO2 of 50 -70 mmHg and a pCO2 of 30-40 mmHg at FiO2 of 0.9-1.0. Subsequent left lung transplantation was successfully performed on the device. Conclusion Application of a pumpless lung assist resulted in an effective extracorporeal pulmonary support and allowed for safe bilateral lung transplantation in severe lung failure. This novel concept for intraoperative pulmonary support demonstrates that the use of cardio-pulmonary bypass for lung transplantation can be avoided.

Institution
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Publisher
American Thoracic Society

393.

Arteriovenous extracorporeal membrane carbon dioxide removal as a bridge to lung transplantation in cystic fibrosis.
Beaudoin B.G., Poulin Y., Leclair M.-A., Cantin A.M., Sirois M.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2012. San Francisco, CA United States. Conference Publication: (var.pagings). 185 (MeetingAbstracts) (no pagination), 2012. Date of Publication: 2012.
AN: 71988352
Introduction: A case is presented of a cystic fibrosis patient successfully bridged without intubation to lung transplantation using the arteriovenous extracorporeal membrane carbon dioxide removal (ECCO2R) device. Case Description: A 26 year old Caucasian male with cystic fibrosis and severe bronchiectasis presented to the hospital with progressive dyspnea and abundant dark green sputum. Physical exam revealed muscle wasting, clubbing and diffuse crackles in both pulmonary fields. He was tachycardic (150), tachypnic (33) and his oxygen saturation was 85-89% with a fraction of inspired oxygen of 40%. The chest X-ray showed diffuse airspace opacities and the thoracic scan confirmed right lower lobe pneumonia and several mucoid impactions. Labs were remarkable for leucocytosis (27) and respiratory acidosis (7.30) with a partial pressure of carbon dioxide (PCO2) of 94 mmHg. Sputum culture was positive for Pseudomonas aeruginosa resistant to all antibiotics. He was already on the lung transplant waiting list. Despite treatment with non-invasive ventilation and multiple antibiotics, his status deteriorated and the signs of cor pulmonale made the intensive care team reluctant to intubate him. It was decided to proceed to percutaneous installation of the ECCO2R device on the femoral circulation (arterio-venous) between the two legs while the patient was maintained on non-invasive ventilation. Immediately after the procedure, he was weaned from non-invasive ventilation and his PCO2 decreased below 70 mmHg, thus correcting the respiratory acidosis. There were no complications related to the device, and the patient was successfully transplanted on the fourth day post procedure. Discussion(s): This ECCO2R device was used for the first time in an intubated patient waiting for transplantation with ventilation-refractory hypercapnea in 2006. It has been recently used in two self-ventilating patients with bronchiolitis obliterans, and chronic obstructive pulmonary disease. To the best of our knowledge, this is the first case of a non-invasively ventilated patient with infected terminal cystic fibrosis successfully bridged to lung transplantation with the ECCO2R device. In this patient with mild hypoxemia, the decapneization capacity of the device was sufficient to avoid invasive ventilation with potential complications. Unlike traditional extracorporeal membrane oxygenation, the ECCO2R device is pumpless, does not require a perfusionist team, and allows partial patient mobility. The ECCO2R device should be considered in cystic fibrosis patients with hypercapnic respiratory insufficiency as a bridge to lung transplantation. (Figure Presented).
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QC, Canada
Publisher
American Thoracic Society

Link to the Ovid Full Text or citation:
Click here for full text options

394.

Treatment of hypercapnic respiratory failure with a novel extracorporeal CO2 removal system.
Burki N., Mani R., Herth F., Schmidt W., Teschler H., Bonin F., Becker H., Randerath W., Stieglitz S., Hagmeyer L., Priegnitz C., Pfeifer M., Blaas S., Putensen C., Theuerkauf N., Quintel M., Moerer O.
European Respiratory Journal. Conference: European Respiratory Society Annual Congress 2012. Vienna Austria. Conference Publication: (var.pagings). 40 (SUPPL. 56) (no pagination), 2012. Date of Publication: 01 Sep 2012.
AN: 71923867
Background: Extracorporeal CO2 removal (ECCO2R), a potentially valuable technique, has not been systematically evaluated in patients with hypercapnic respiratory failure. We describe the application of a novel single venous catheter, low blood flow, ECCO2R device (Hemolung Respiratory Assist System, ALung Technologies, Inc.).
Method(s): Twenty three hypercapnic patients received ECCO2R. Group 1 (n=7) consisted of patients with chronic obstructive lung disease on noninvasive ventilation with a high likelihood of requiring invasive ventilation, Group 2 (n=2) were patients who could not be weaned from noninvasive ventilation, Group 3 (n=11) were patients who could not be weaned from invasive ventilation, and Group 4 (n=3) were patients on invasive ventilation requiring lung protective ventilation techniques.
Result(s): The device was well tolerated, with complications and rates similar to those seen with central venous catheterization. Blood flow through the system was 430.5+/-73.7 ml/min, and ECCO2R was 82.5+/-15.6 ml/min. Invasive ventilation was avoided in all patients in Group 1 and both patients in Group 2 were weaned; PaCO2 decreased significantly ($p<0.003$) with application of the device. In Group 3, three patients were weaned, in 3 patients ventilatory support was reduced, and one patient died due to a retroperitoneal bleed following catheterization. In Group 4, lung protective ventilation was enhanced by the ECCO2R device.
Conclusion(s): This single catheter, low blood flow ECCO2R system provided clinically useful levels of CO2 removal in these hypercapnic patients. The system appears to be a potentially valuable additional modality for the treatment of hypercapnic respiratory failure.
Publisher
European Respiratory Society

Link to the Ovid Full Text or citation:
Click here for full text options

395.

Trauma patients treated with extracorporeal membrane oxygenation.

Keyser A., Philipp A., Hilker M., Schmid C.
Thoracic and Cardiovascular Surgeon. Conference: 41st Annual Meeting of the German Society for Cardiovascular and Thoracic Surgery: One Heart - One Team. Freiburg Germany. Conference Publication: (var.pagings). 60 (SUPPL. 1) (no pagination), 2012. Date of Publication: February 2012.
AN: 71145641
Aim: Severe trauma with is a cause of death either due to fatal injuries without any treatment option or due to life threatening complications in the early course. Early complications such as bleeding shock and/or severe respiratory failure following chest trauma or massive blood transfusion are a major task in the treatment of these patients. Massive blood transfusions may result in decreased cardiac output and pulmonary gas exchange, and either massive blood transfusion or pulmonary contusion may lead to acute respiratory distress syndrome (ARDS). In these cases extracorporeal membrane oxygenation (ECMO) as a lifesaving treatment may improve or take over the gas exchange function of the lung or provide additional cardio-circulatory support.
Material(s) and Method(s): Since 2000 we treated trauma patients with resistant cardiopulmonary failure due to ARDS and/or bleeding shock with ECMO (n=84, mean age 35+/-17 years, 72 male). 50 patients (mean age 34+/-17 years, 41 male) were treated due to resistant hyperkapnia with pumpless extracorporeal lung assist (PECLA). For pulmonary failure, that is for resistant hyperkapnia and impaired oxygenation, initially heparin-free ECMO was installed percutaneously veno-venous in 21 patients (mean age 35+/-17 years, 18 male). 13 patients (mean age 41+/-17 years, 12 male) were treated with percutaneously installed veno-arterial ECMO for additional cardiocirculatory impairment following severe trauma.
Result(s): Pulmonary or cardiopulmonary failure was treated effectively with ECMO and systemic gas exchange and blood flow improved rapidly within a couple of hours in all patients. Duration of support ranged from a few hours through 26 days. 61% of our patients recovered completely (PECLA 64%, v-v ECMO 80%, v-a ECMO 23%).
Conclusion(s): ECMO may improve therapy and outcome in severe trauma patients. Coexisting bleeding shock must not be a contraindication for ECMO.
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Publisher
Georg Thieme Verlag

396.

Extracorporeal life support in ARDS due to H1N1 virus: Results of an Italian referral ARDS center.
Vargas M., Vivona L., Marra A., Iannuzzi M., Rosalba T., Servillo G.
European Journal of Anaesthesiology. Conference: European Anaesthesiology Congress, EUROANAESTHESIA 2012. Paris France. Conference Publication: (var.pagings). 29 (SUPPL. 50) (pp 86-87), 2012. Date of Publication: June 2012.
AN: 71084271
Introduction: The aim of our study was to assay the efficacy of extracorporeal life supports (ECLS) in patients with ARDS affected by H1N1 virus and conventional therapy refractory hypoxemia.
Material(s) and Method(s): In 2011, we had 9 H1N1 affected patients by our experienced medical center, who were all refractory to conventional therapy, so that

they needed ECLS: 3 of those 9 had severe hypercapnia and a normal heart function, received extracorporeal carbon dioxide removal. Instead the other 6 patients were eligible for extracorporeal membrane oxygenation (ECMO) according to the ELSO guidelines. All the patients were monitored by evaluating 4 parameters: PaO2, PaCO2, pH, lactate. Those were registered from 48 hours prior to 10 days after ECLS.
Result(s): 48 hours prior ECLS the group of patients which received extracorporeal carbon dioxide removal showed PaO2 115+/-14 mmHg, PaCO2 100+/-20, pH 7.2+/-0.2 and lactate concentration 2.6+/-0.8 mMol/L,respiratory rate 22+/-2 bpm. After 10 days of extracorporeal carbon dioxide removal treatment these patients reported PaO2 122+/-9 mmHg, PaCo2 60+/-12 mmHg, pH 7.4+/-0.05, lactate concentration1.6+/-0.2 mMol/L and respiratory rate decreased to14+/-2 bpm. 48 hours prior ECLS the ECMO-group patients showed PaO2 100+/-23 mmHg, PaCO2 90+/-35, pH 7.1+/-0.1 and lactate concentration 4+/-0.2 mMol/L. They showed as well a pulmonary compliance of 22 ml/cmH2O, Vt 5+/-1.2 ml/kg, PEEP 16+/-2 cmH2O and a FiO2 100%. After 10 days of ECMO treatment the patients reported PaO2 of 290+/-45 mmHg, PaCo2 of 38+/-10 mmHg, pH of 7.3+/-0.1 and a lactate concentration of 3.5+/-0.5 mMol/L. Mechanical ventilation was set in order to let Pplat < 30 mmHg, a Vt of 5 ml/kg, a PEEP of 10 cmH2O, so that we obtained a RR of 9+/-1 bpm, and a progressive FiO2 decreasement. Conclusion(s): As clinical experience suggested us, ECLS treatment improves gas exchange and let the operator keep the ventilation on the patient in a safe way, if it was applied early, while trying to recruit pulmonary parenchyma. (Figure Presented).
Institution
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Publisher
Lippincott Williams and Wilkins

397.

Extracorporeal membrane oxygenation-rescue therapy for status asthmaticus.
Alappan N., Eisen L., Jakobleff W., Shiloh A.
Chest. Conference: CHEST 2012. Atlanta, GA United States. Conference Publication: (var.pagings). 142 (4 SUPPL. 1) (no pagination), 2012. Date of Publication: October 2012.
AN: 71072656
INTRODUCTION: Status asthmaticus is a life-threatening condition characterized by progressive respiratory failure due to asthma that may be unresponsive to standard therapeutic measure1. We describe a patient with status asthmaticus refractory to conventional medical therapy and ventilator management, who was rescued with timely use of extracorporeal membrane oxygenation therapy (ECMO). CASE PRESENTATION: A 23 year old male, non -smoker, with the past history of mild intermittent asthma presented to the emergency department for exacerbation of asthma precipitated by an upper respiratory syndrome. His asthma symptoms had been previously controlled by as needed use of MDI albuterol alone. There was no history of hospitalization or intubation for asthma. Despite aggressive therapy with continuous albuterol, terbutaline, subcutaneous epinephrine, and high dose steroids, his symptoms progressed. He was intubated and transferred to the intensive care unit where he was sedated, paralyzed, and continued on mechanical ventilation. Chest radiograph showed severe hyperinflation. With recommended ventilator

settings for status asthmaticus (low respiratory rate, low tidal volume, and prolonged expiratory phase) he remained extremely difficult to ventilate, generating high peak pressure (49cmH2O) and significant intrinsic PEEP (18cmH2O). Serial blood gases revealed worsening respiratory acidosis (pH 6.95: pCo2 112mmHg). Cardiothoracic surgery was consulted to initiate veno-venous ECMO (Avalon, 27 F Bi-Caval Dual lumen cannulated via the internal jugular vein and using a Quadrox D poly-methylpentene oxygenator). With ECMO, the respiratory acidosis gradually improved over the next few hours and mechanical ventilator settings were set at lung rest mode, with low tidal volumes. With continued use of steroids and inhaled bronchodilator therapy, the bronchospasm improved. ECMO was discontinued on hospital day two and patient was extubated on hospital day four. DISCUSSION: Extracorporeal life support has been used as salvage therapy for adults with acute respiratory failure since 1972. Status asthmaticus, a potentially fatal but reversible process represents a disease which could benefit from extracorporeal gas exchange when standard measures have failed. Evidence supporting the use of ECMO in refractory status asthmaticus is lacking, and only a few case reports exist. Novel modalities like pECLA(pumpless extracorporeal lung assist) are being increasingly utilized in similar acute respiratory failures.
CONCLUSION(S): The application of extracorporeal gas exchange can be lifesaving in refractory status asthmaticus.
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Publisher
American College of Chest Physicians

398.

Is tham a useful adjunct to normalize ph during lung protective ventilation with permissive hypercapnia?.
Hostman S., Borges J., Engstrom J., Suarez-Sipmann F., Hedenstierna G., Larsson A.
Critical Care Medicine. Conference: 42nd Critical Care Congress of the Society of Critical Care Medicine, SCCM 2013. San Juan Puerto Rico. Conference Publication: (var.pagings). 40 (12 SUPPL. 1) (pp 46), 2012. Date of Publication: December 2012.
AN: 71065350
Introduction: Low tidal volume (VT),6 ml/kg, has proved to reduce mortality in ALI/ARDS, probably by reducing the extent of ventilation induced lung injury (VILI). A further reduction of VT may be advantageous. Indeed, ventilation with 3 ml/kg VT decreased the inflammatory response in patients with low lung compliance compared with 6 ml/kg. When using very low VTs the use of an extracorporeal CO2 removal to keep PaCO2 and thus a normal pH has been proposed. NaHCO3 has been used to normalize pH is this context, but experimental studies indicate that this could increase VILI. Hypothesis: THAM, a proton acceptor, could be a possible method to maintain an acceptable pH during very low VT ventilation.
Method(s): In 10 lung lavaged, anesthetized, muscle-relaxed pigs, normo-ventilated (pH 7,4+/-0,01, PaCO2 45+/-3 mmHg, Base excess (BE) 2,9+/-1,6 mEq/L, M+/-SD) with a VT of 6 ml/kg,FIO2 1.0 and 10 cmH2O PEEP via a tracheal double lumen tube, VT was abruptly changed to 3 ml/kg, which was maintained for the rest of the 6 hours experiment. In 5 of the animals THAM (3 mmol/kg) was infused iv during the first hour, aiming at increasing BE by 10 mEq/L, while the other 5 animals served as

controls.
Result(s): After 1 hour, pH in the THAM group decreased to 7,33+/-0,06, PaCO2 increased to 77+/-7 mmHg, and BE increased to 13+/-3,6 mEq/L, and in the controls pH decreased to 7,14+/-0,04, PaCO2 increased to 96+/-7 mmHg (p<0.001 and 0.003, between the groups, respectively),whereas no change occurred in BE. After 6 hours, pH and PaCO2 were similar in the THAM and control groups (7,19+/-0,05 vs 7,13+/-0,06 (p=0.056), and 106+/-15 vs 105+/-13 mmHg, resp), while BE was higher in the THAM group (10+/-2,2 vs.4,0+/-3,1 mEq/L in the control group,p=0.008).Hemodynamics was stable, but MPAP at 1 hour was lower in the THAM group (22+/-3 vs. 28+/-4 mmHg, p=0.04). No differences in PaO2, lung mechanics or functional residual capacity were found between the groups indicating that THAM did not increase VILI.
Conclusion(s): In this pilot study, THAM had a short-term effect on pH but a long term effect on BE. This suggests that it may be feasible to use THAM at a somewhat higher dose than in this study when inducing extremely low VT ventilation to keep pH in an acceptable physiological range.
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Publisher
Lippincott Williams and Wilkins

399.

High frequency oscillatory ventilation and minimally invasive extracorporeal cO2 removal in severe ARDS patients.
Fanelli V., Forfori F., Pennisi M., Del Sorbo L., Simonetti U., Urbino R., Mascia L., Giunta F., Antonelli M., Ranieri V.M.
Intensive Care Medicine. Conference: 25th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2012. Lisbon Portugal. Conference Publication: (var.pagings). 38 (SUPPL. 1) (pp S260-S261), 2012. Date of Publication: October 2012.
AN: 71014183
INTRODUCTION. In severe ARDS patients, high frequency oscillatory ventilation (HFOV) is a possible rescue therapy to optimize gas exchange and provide protective mechanical ventilation. Higher frequencies should be achieved to reduce tidal volume and minimize VILI. However, this ventilation setting may be associated with the development of respiratory acidosis. In this case series, we evaluate the feasibility of a combined HFOV and minimally invasive extracorporeal CO2 removal (Decap) ventilation strategy. METHODS. Five patients (3 pneumonia, 2 sepsis) with severe ARDS and life threating hypoxemia, refractory to conventional mechanical ventilation (CMV), underwent to HFOV followed by HFOV plus Decap to correct severe respiratory acidosis. RESULTS. Results are expressed as mean +/- SD. Patients were ventilated with the following ventilator settings during CMV: Tidal volume (ml/kg PBW) was 6.7 +/- 1, RR (breaths/min) was 28 +/- 5, PEEP (cmH2O) 13 +/- 2, Pplat (cmH2O) 28 +/- 1. The resulting gas exchange was: PaO2/FiO2 90 +/- 23, pH 7.26 +/- 0.1, PaCO2 (mmHg) 72 +/- 34, PaO2 (mmHg) 80 +/- 15, HCO3 (mEq/L) 30 +/- 10. Hemodynamic was similar in all conditions. Ventilator settings and gas exchanges during HFOV and Decap are shown in Table 1. * p<0.05 HFOV + Decap 3 h vs. HFOV 3 h. (Table Presented) CONCLUSION. In severe ARDS patients treated with HFOV, minimally invasive extracorporeal CO2 removal

significantly reduced PaCO2 levels, increased pH, and allowed to increase HFOV frequency. HFOV plus Decap combined ventilation strategy may be a valid approach to enhance lung Protection.
Institution
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Publisher
Springer Verlag

400.

Assessment of regional lung mechanics in severe ards using electrical impedance tomography: Implications for the choice of ventilator strategy.
Camporota L., Smith J., Della Torre V., Specchio V., Sgobio A., Reinero S., Chinelli E., Arces D., Barrett N., Beale R.
Intensive Care Medicine. Conference: 25th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2012. Lisbon Portugal. Conference Publication: (var.pagings). 38 (SUPPL. 1) (pp S138-S139), 2012. Date of Publication: October 2012.
AN: 71013712
INTRODUCTION. ARDS affects the lungs heterogeneously, making global indices of lung mechanics potentially inaccurate in guiding ventilator settings. Electrical impedance tomography (EIT) measures regional changes in lung volumes and mechanics, can quantify lung recruitability and may guide the ventilator strategy. OBJECTIVES. To assess whether the estimation of regional lung mechanics by EIT in response to a PEEP trial would lead to a different ventilator strategy. METHODS. Patients with severe ARDS underwent an incremental and decremental PEEP trial. Pressure-volume curves were performed at PEEP 0 and PEEP 15 cmH2O before and after the PEEP trial to assess global and regional recruitability. At each step of the PEEP trial an inspiratory and an expiratory occlusion manoeuvre was performed to obtain static respiratory system compliance (Crs). Global and regional CEIT were calculated as the change in impedance (DELTAZ) between an inspiratory and an expiratory occlusion manoeuvre (DELTAZi - DELTAZe) divided by the static driving airway pressure. Recruitability was assessed by EIT as an increase in CEIT and end-expiratory lung volume after the PEEP trial. RESULTS. We collected 11 measurements on 8 patients aged 43 +/- 13 years (mean +/- SD), with a PaO2/FiO2 of 99 +/- 29 mmHg, Crs of 20 +/- 13 mL/cmH2O and PEEP of 11 +/- 3cmH2O. All patients had>3 quadrant infiltrate on chest X-ray. 5 patients received conventional ventilation (1 with ECCO2R), 1 HFOV and 2 ECMO. Following the PEEP trial, Crs increased to 24 +/- 16 mL/cmH2O (mean +/- SD). 62 % of the patients demonstrated recruitability. There was a large, although not statistically significant, difference in the PEEP associated with the best Crs versus the best global CEIT (optimal PEEP) with 10 cmH2O (3-10) versus 5 cmH2O (1-15), respectively; [median (range), p = 0.34]. Regional analysis of CEIT demonstrated a mean difference in optimal PEEP between dorsal and ventral regions of 8 cmH2O, with a median of 5 cmH2O (range 0-20). This indicates significant inhomogeneity between dorsal and ventral regions. If this regional inhomogeneity is not taken into account and PEEP is set on the best static Crs, that PEEP generated features consistent with overdistention in ventral regions with a reduction in CEIT after the peak CEIT by a median of 30 % (range 3-64 %). Conversely there was evidence of underrecruitment of the dorsal regions

demonstrated by a lower CEIT occurring before the peak in CEIT of a median of 30 % (range 7-68 %), compared to their respective best regional CEIT. CONCLUSIONS. EIT allows the continuous monitoring of regional lung mechanics and response to recruitment. EIT can potentially guide the choice of PEEP and optimise ventilatory support with the aim of minimising regional overdistention and under-recruitment.
Institution
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Publisher
Springer Verlag

401.

Avoiding invasive mechanical ventilation by extracorporeal carbon dioxide removal in patients failing noninvasive ventilation.
Kluge S., Braune S., Engel M., Nierhaus A., Frings D., Ebelt H., Uhrig A., Metschke M., Wegscheider K., Suttorp N., Rousseau S.
Intensive Care Medicine. Conference: 25th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2012. Lisbon Portugal. Conference Publication: (var.pagings). 38 (SUPPL. 1) (pp S75), 2012. Date of Publication: October 2012.
AN: 71013484
INTRODUCTION. In patients with acute hypercapnic respiratory failure, noninvasive ventilation (NIV) is a well-established means to support the failing ventilatory pump and to avoid intubation and invasive mechanical ventilation (MV) 1. However, this approach often fails for a variety of reasons. Intubation is then often followed by prolonged invasive MV and analgosedation, which in turn can further contribute to morbidity and mortality [2-5]. OBJECTIVE. To evaluate whether extracorporeal carbon dioxide removal by means of a pumpless extracorporeal lung assist (PECLA) device may be an effective and safe alternative to invasive MV in patients with chronic pulmonary disease and acute hypercapnic ventilatory failure refractory to NIV. METHODS. Multicenter, retrospective, case matched study. 21 PECLA patients were compared to 21 matched controls with NIV failure and conventional invasive MV regarding survival and procedural outcomes. Matching criteria were underlying main diagnosis, age, Simplified Acute Physiology Score II and pH on ICU admission. RESULTS. Of the 21 patients treated with PECLA, 19 (90 %) did not require intubation. Median PaCO2 levels and pH in arterial blood prior to PECLA were 84.0 mmHg (54-131) and 7.28 (7.10-7.41), respectively. Within 24 h, median PaCO2 levels and pH had significantly improved to 52.1 (33-70; P<0.001) and 7.44 (7.27-7.56; P<0.001), respectively. Two major and seven minor bleeding complications related to the device occurred. Further complications were one pseudoaneurysm and one heparin-induced thrombocytopenia type II. There was a trend to a shorter median hospital length of stay in the PECLA group (23 vs. 42 days, adjusted p = 0.056). No group difference in 28-day (24 vs. 19 %) and 6-month mortality (33 vs. 33 %) were observed. CONCLUSIONS. In patients with chronic pulmonary disease and acute hypercapnic ventilatory failure refractory to NIV the application of extracorporeal carbon dioxide removal obviated intubation and invasive MV in most cases and reduced hospital length of stay. Compared to conventional MV, survival rates were similar.
Institution

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(Ebelt) University of Halle (Saale), Department of Medicine III, Halle, Germany
(Uhrig, Suttorp, Rousseau) Charitee Universitatsmedizin Berlin, Department of Internal Medicine, Infectious Diseases and Respiratory Medicine, Berlin, Germany
(Wegscheider) University Medical Center Hamburg-Eppendorf, Department of Medical Biometry and Epidemiology, Hamburg, Germany
Publisher
Springer Verlag

402.

CO2 dialysis in the treatment of patient with ards and brain trauma: A case report.
Cracchiolo A.N., Palma D.M., Sapuppo M.F., Ardizzone S., Tetamo R.
Intensive Care Medicine. Conference: 25th Annual Congress of the European Society of Intensive Care Medicine, ESICM 2012. Lisbon Portugal. Conference Publication: (var.pagings). 38 (SUPPL. 1) (pp S19), 2012. Date of Publication: October 2012.
AN: 71013268
INTRODUCTION. Protective mechanical ventilation with low tidal volumes (Vt) has been established as a key therapeutic strategy for treating ALI/ARDS. It has contributed in strong improvement in outcome, but despite this, the mortality rate remains high. OBJECTIVES. We report a case of a 40 years old male patient involved in a head on motorcycle with a car METHODS. He was admitted to our Intensive Care Unit (ICU) for Acute Respiratory Distress Syndrome (ARDS) and brain trauma. His chest CTs showed a diffuse opacity involving both lungs and his brain CTs reported a brain swelling without intracranial bleeding. At admission he had been mechanically ventilated with a protective modality (Vt<6 ml/kg and plateau pressure<30 cmH2O). Despite this he had an oxygen saturation of 81.2 % and his blood gas analysis was as follows: pH 7.20 PaO2 54 mmHg, PaCO2 78 mmHg and PaO2/FiO2 ratio 54 mmHg with a fraction of inspired oxygen (FiO2) = 1. Due to his neurological damage we couldn't use recruitment maneuvers and prone position. In the second day the blood gas analysis reported an increasing in PaCO2 that rised up to 112 mmHg. Thus we decided to use a new mini invasive device named Abylcap CO2 removal(Bellco-Mirandola -Modena) used with a Continuous Venous-Venous Haemofiltration pump driven system (Lynda, Bellco;Mirandola; Modena). The extracorporeal carbon dioxide removal (ECCO2R) circuit was connected to the right femoral vein, accessed via a 14 F double lumen catheter. This system is supplied by a membrane exposed to an high oxygen flow, that provide an extracorporeal CO2 removal while gets an improvement in oxygenation referred as 20 %. The blood flow applied through the circuit was 300 ml/min (range from -150 ml/min to +300 ml/min), and anticoagulant therapy based on heparin was used. RESULTS. We observed a progressive improvement in blood gas analysis that, 4 days after the start, became as follow: pH 7.35 PaCO2 41 mmHg, PaO2 130 mmHg, SaO2 98 % and PaO2/FiO2 ratio 260 at FiO2 = 0.5. Despite this in fifth day our patient died as a consequence of malignant cerebral edema. CONCLUSIONS. Hypercapnia is not an easy partner for patients with low compliance, severe hypoxia and brain trauma, and it is closely related to protective ventilation. This device has been demonstrated useful in reducing hypercapnia while allowed to continue protective ventilation. In agree with

other authors [1], we think that this device could play a role in adjusting respiratory acidosis consequent to tidal volume reduction in a protective ventilator setting. Furthermore we think that in patients with some type of head injury this device could be an interesting therapeutic option, but new experiences are needed.
Institution
(Cracchiolo, Palma, Sapuppo, Ardizzone, Tetamo) Azienda Ospedaliera di Rilievo Nazionale ad Alta Specializzazione AORNAS, Terapia Intensiva Polivalente 2 G. Trombino, Palermo, Italy
Publisher
Springer Verlag

403.

28th Annual Autumn Meeting of the Association of Cardiothoracic Anaesthetists, ACTA 2011.
Anonymous
Anaesthesia. Conference: 28th Annual Autumn Meeting of the Association of Cardiothoracic Anaesthetists, ACTA 2011. Loughborough United Kingdom. Conference Publication: (var.pagings). 67 (5) (no pagination), 2012. Date of Publication: May 2012.
AN: 70850876
The proceedings contain 8 papers. The topics discussed include: biomarkers of acute lung injury after lung resection; pre-operative renal failure and high-risk aortic valve surgery: long-term outcomes; the effect of circulating fresh blood through a micro-bypass circuit on platelet microparticles; validity of the CAM-ICU test in a cardiac high dependency unit; audit of compliance with TEG-based transfusion algorithm; investigating high frequency jet ventilation in simulated bronchopleural fistula; minimize the vascular complications of Novalung cannulae; and effective orifice area and transvalvular gradient after aortic valve replacement.
Publisher
Blackwell Publishing Ltd

404.

Minimise the vascular complications of Novalung cannulae.
Park C.L., Finney S.F., Cordingley J.J., Hunter D.N.
Anaesthesia. Conference: 28th Annual Autumn Meeting of the Association of Cardiothoracic Anaesthetists, ACTA 2011. Loughborough United Kingdom. Conference Publication: (var.pagings). 67 (5) (pp 557), 2012. Date of Publication: May 2012.
AN: 70850874
Effective carbon dioxide removal has been demonstrated using the pumpless interventional lung assist (Novalung GMBH, Talheim, Germany) in patients with severe acute lung injury. Novalung may also be used to facilitate lung-protective

ventilation by enabling low tidal volume and reduced inspiratory plateau pressure [1, 2]. However, insertion of the Novalung cannulae is not without risk. Complications are predominantly vascular, and are most frequently at the arterial cannula insertion site. The manufacturers suggest the use of a percutaneous 'one-push' technique, dilating the vessel in one step after guidewire insertion. Methods Following a review of three cases of vascular complications, we changed our insertion technique in 2009. Since then, we have inserted more than 20 arterial cannulae for the Novalung without any complications. We have continued to see complications in patients in whom cannulae have been inserted elsewhere. Results We propose three main changes to the manufacturer-recommended technique: 1. Use of 'real-time' in-plane ultrasound in the long axis, with direct observation of needle insertion into the vessel. This enables a shallower angle of insertion, thereby decreasing the likelihood of perforation of the posterior wall of the vessel during subsequent dilation. 2. Insertion of an 8-French sheath after initial needle and wire placement. This allows confirmation of correct placement in the vessel before dilation to a large-bore cannula. Also, once inserted and flushed, this allows time to organise the remaining equipment. In addition, should placement be incorrect, (for example into a vein rather than an artery or vice versa), it is possible to leave this sheath in situ while further attempts are made. 3. Sequential serial dilation of the vessel, rather than in one single go, from insertion of the guidewire up to the large-bore 13 to 17 French cannula. The use of sequential dilators such as those found in a haemofiltration catheter insertion set allows safe sequential dilation. Conclusion We report a serial dilation technique for percutaneous Novalung cannulae insertion that we believe reduces the incidence of complications. We feel that this technique should be disseminated to centres whose use of the device is infrequent, but likely to increase over the next few months due to the onset of the winter flu season.
Institution
(Park, Finney, Cordingley, Hunter) Royal Brompton Hospital, London, United Kingdom
Publisher
Blackwell Publishing Ltd

405.

Annual Spring Meeting of the Association of Cardiothoracic Anaesthetists, ACTA 2011.
Anonymous
Anaesthesia. Conference: Annual Spring Meeting of the Association of Cardiothoracic Anaesthetists, ACTA 2011. Cambridge United Kingdom. Conference Publication: (var.pagings). 67 (3) (no pagination), 2012. Date of Publication: March 2012.
AN: 70673209
The proceedings contain 15 papers. The topics discussed include: an audit of end-of-life care on the ICU; euroscore plus a novel addition to risk stratification; potential organ donation in a specialized cardiothoracic center; impact, triage and outcomes of the H1N1 virus outbreak in a cardiothoracic intensive care unit; a national survey of training in cardiac intensive care; arteriovenous extracorporeal carbon dioxide removal as a bridge to recovery in patients developing acute hypercapnic respiratory failure following successful weaning from venovenous extracorporeal membrane oxygenation; changing practice: regular monitoring of tracheal tube cuff pressures on cardiac intensive care; outcomes in cardiac surgical patients refusing blood

transfusion; and point of care assessment of hypothermia induced platelet dysfunction during cardiopulmonary bypass with multiple electrode aggregometry (Multiplate).
Publisher
Blackwell Publishing Ltd

Link to the Ovid Full Text or citation:
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406.

Arteriovenous extracorporeal carbon dioxide removal as a bridge to recovery in patients developing acute hypercapnic respiratory failure following successful weaning from venovenous extracorporeal membrane oxygenation.
Featherstone P., Webb S., Vuylsteke A.
Anaesthesia. Conference: Annual Spring Meeting of the Association of Cardiothoracic Anaesthetists, ACTA 2011. Cambridge United Kingdom. Conference Publication: (var.pagings). 67 (3) (pp 311-312), 2012. Date of Publication: March 2012.
AN: 70673199
Arteriovenous extracorporeal carbon dioxide removal devices have been shown to be effective in patients with respiratory failure who develop hypercapnia and severe acidosis [1]. We report the use of such a device in two patients who had benefitted from a period of extracorporeal membrane oxygenation (ECMO) to support the management of acute respiratory distress syndrome (ARDS), but deteriorated subsequently due to secondary infection. Methods A previously fit 37 year-old female and a 17 year-old male with a background of bronchiolitis obliterans were referred for ECMO support during the 2010 / 11 HIN1 influenza A epidemic. Whilst microbiology and virology proved negative in each case, both patients presented with clinical signs and symptoms consistent with Influenza A. Following an uncomplicated period of veno-venous ECMO, the patients were successfully weaned from extracorporeal support. On day-2 and day-7 after finishing ECMO respectively, both patients deteriorated acutely, developing hypercapnia and severe acidosis refractory to established therapeutic interventions, whilst maintaining adequate oxygen exchange. Rather than re-commence ECMO, we elected to use extra-corporeal carbon dioxide removal using the iLA Membrane Ventilator (Novalung, GmbH, Heilbronn, Germany). Results Use of the Novalung reduced arterial carbon dioxide partial pressure and acidosis, and permitted a reduction in the tidal volume and inspiratory plateau pressure delivered by the mechanical ventilator. There were no complications associated with use of the device in either case, and adequate gas exchange was maintained until the underlying condition improved sufficiently for device removal after 9 and 3 days respectively. Both patients underwent percutaneous tracheostomy to facilitate weaning from mechanical ventilation, and have subsequently made a full recovery. Discussion The Novalung offers an effective strategy for managing acute hypercapnic respiratory failure in patients with ARDS who have been weaned from ECMO.
Institution
(Featherstone, Webb, Vuylsteke) Papworth Hospital, Cambridge, United Kingdom
Publisher
Blackwell Publishing Ltd

Link to the Ovid Full Text or citation:
Click here for full text options

407.

Bronchopleural fistulae and pulmonary ossification in posttraumatic acute respiratory distress syndrome: successful treatment with extracorporeal support.
Bombino M., Patroniti N., Foti G., Isgro S., Grasselli G., Pesenti A.
ASAIO journal (American Society for Artificial Internal Organs : 1992). 57 (4) (pp 336-340), 2011. Date of Publication: 2011 Jul-Aug.
AN: 362763036
We report a case of severe posttraumatic acute respiratory distress syndrome (ARDS) complicated by bronchopleural fistulae (BPF). The stiff ARDS lung and huge air leaks from BPF resulted in the failure of different protective mechanical ventilation strategies to provide viable gas exchange. Lung rest, achieved by extracorporeal carbon dioxide removal (ECCOR), allowed weaning from mechanical ventilation, closure of BPF, and resumption of spontaneous breathing.
PMID
21555937 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21555937]
Institution
(Bombino) Department of Intensive Care, Ospedale San Gerardo, Monza, Italy.

408.

Pumpless extracorporeal lung assist for the treatment of severe, refractory status asthmaticus.
Jung C., Lauten A., Pfeifer R., Bahrmann P., Figulla H.R., Ferrari M.
Journal of Asthma. 48 (1) (pp 111-113), 2011. Date of Publication: February 2011.
AN: 361344580
Background. Until recently, the only available lung-protective treatment option for carbon dioxide removal due to severe, refractory status asthmaticus has been extracorporeal pump-driven membrane oxygenation (ECMO). Pumpless extracorporeal lung assist (pECLA) may serve as an alternative therapy for these patients. Case Report. A 42-year-old woman presented with an acute exacerbation of asthma to our Emergency Department. Despite optimal pharmacological therapy, the patient developed respiratory failure requiring mechanical ventilation with elevated airway pressures. For severe ventilation-refractory hypercapnia and respiratory acidosis, ECMO was used initially and was later replaced by a pECLA device. The clinical condition continuously improved with sufficient pulmonary gas exchange. The pECLA was removed after 8 days, and the patient was successfully weaned from mechanical ventilation. Conclusions. This report suggests that pECLA is an alternative extracorporeal lung assist in patients with ventilation-refractory hypercapnia and respiratory acidosis due to severe, refractory status asthmaticus. © 2011 Informa Healthcare USA, Inc.
PMID
21039186 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21039186]
Institution
(Jung, Lauten, Pfeifer, Figulla, Ferrari) Clinic of Internal Medicine I, Friedrich-Schiller-University, Erlanger Allee 101, 07740 Jena, Germany (Bahrmann) University Heart Center, Department of Cardiology, University of Leipzig, Germany

Publisher
Informa Healthcare (69-77 Paul Street, London EC2A 4LQ, United Kingdom)

409.

[Severe acute respiratory distress syndrome complicating type A (H1N1) influenza treated with extracorporeal CO2 removal]. Zespol ostrej niewydolnosci oddechowej w przebiegu grypy AH1N1 leczony skutecznie pozaustrojowa eliminacja CO2 <Zespol ostrej niewydolnosci oddechowej w przebiegu grypy AH1N1 leczony skutecznie pozaustrojowa eliminacja CO2.>
Smiechowicz J., Barteczko B., Grotowska M., Kaiser T., Zielinski S., Kubler A.
Anestezjologia intensywna terapia. 43 (2) (pp 98-103), 2011. Date of Publication: 2011 Apr-Jun.
AN: 362998450
The influenza pandemic of 2009 was reported to be frequently associated with pulmonary complications, including ARDS. We report the case of a morbidly obese, 37-year-old, AH1N1-infected woman, who was admitted to a regional hospital because of rapidly progressing respiratory failure. She was treated successfully with high frequency oscillatory ventilation (HFOV) and low-flow extracorporeal CO2 removal. The patient was admitted to a regional hospital because of severe viral infection, diabetes and hypertension that developed during pregnancy. On admission, she was deeply unconscious (GCS 5), hypotonic and anuric. Conventional ventilation, veno-venous haemofiltration, antibiotics and antiviral therapy (oseltamivir) did not improve the patient's condition, and she was transferred to a tertiary referral centre. Immediately before the transfer, she suffered two cardiac arrest episodes. They were successfully reversed. On admission, the patient was hypercapnic (PaCO2 150 mm Hg/20 kPa), acidotic (pH 6.92) and hyperkinetic (HR 120 min-1, CO 12.7 L min-1). Total lung compliance was 21 mL cm H2O-1, and SAP/DAP was 63/39 mm Hg). The PaO2/FIO2 index was 85. HFOV was instituted for 48 h, resulting in a marked improvement in gas exchange, however any manipulations caused immediate deterioration in the patient's condition. Extracorporeal CO2 removal was commenced and continued for 120 h, resulting in gradual improvement and eventual weaning from artificial ventilation after 17 days. Further treatment was complicated by septic shock due to Pseudomonas aeruginosa infection of the vagina, treated with piperacillin/tazobactam. The patient eventually recovered and returned to her regional hospital after 24 days. During the 2009 pandemic, a high number of pulmonary complications were observed all over the world. Viral infections are especially difficult to treat and the CESAR study indicated that the use of ECMO or extracorporeal CO2 removal devices may result in a lower mortality when compared with standard therapy. We conclude that the use of a simple CO2 removal device can be beneficial in complicated cases of AH1N1 influenza.
PMID
22011871 [http://www.ncbi.nlm.nih.gov/pubmed/?term=22011871]
Institution
(Smiechowicz) Department of Anaesthesiology and Intensive Therapy, Wroclaw Medical University,Wroclaw.

410.

Addition of acetylsalicylic acid to heparin for anticoagulation management during pumpless extracorporeal lung assist.
Bein T., Zimmermann M., Philipp A., Ramming M., Sinner B., Schmid C., Muller T., Graf B., Schlitt H.J., Weber-Carstens S.
ASAIO journal (American Society for Artificial Internal Organs : 1992). 57 (3) (pp 164-168), 2011. Date of Publication: 2011 May-Jun.
AN: 362416652
Pump-driven extracorporeal membrane oxygenation (ECMO) or pumpless arterio-venous interventional lung assist (iLA) is associated with possible complications, mainly consisting of bleeding or thrombosis/clotting by cellular deposits on the membrane or extracorporeal circuit surfaces, which may reduce gas-exchange capacity. In this study, we report our experiences with the addition of low-dose acetylsalicylic acid (ASA 1.5 mg/kg body weight/d) to heparin for anticoagulation of a pumpless low-resistance gas-exchange membrane (Novalung GmbH, Talheim, Germany). We assessed changes in coagulation parameters and the demand for transfusion of blood components. Furthermore, we compared the function of the artificial membranes (oxygen transfer and capacity of CO2 removal) of the ASA group (n = 15) with that of a matched-pair control group treated with heparin alone. The mean duration of iLA treatment was 6.6 +/- 3.7 days. The addition of ASA did not increase bleeding activity or the demand for transfusion. Relative changes of CO2 removal on day 3 expressed as a percentage in the ASA group were (mean value) -11.8% in comparison with control (-3.0%, p = 0.266), but the relative amount of oxygen transfer tended to be increased in the ASA group (+3.9%) and to be decreased in the control group (-14.7%, p = 0.214). PaO2/FiO2 ratio was significantly improved in the ASA group compared with the control group at day 5. The use of membranes per patient (membrane/patient ratio) tended to be decreased in patients treated with ASA (1.12 +/- 0.34) in comparison with control (1.33 +/- 0.62, p = 0.157). In the ASA group, one patient died due to multiple organ failure, whereas in the control group, five patients died. We conclude that supplementation of low-dose ASA during pumpless extracorporeal lung support is safe and might preserve the function of oxygen transfer.
PMID
21427564 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21427564]
Institution
(Bein) Department of Anesthesiology, Regensburg University Hospital, Regensburg, Germany.

Link to the Ovid Full Text or citation:
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411.

Intensive care medicine - update 2010. Intensiv- und notfallmedizin von a bis Z - update 2010 <Intensiv- und notfallmedizin von a bis Z - update 2010.>
Ehnert T., Ebelt H., Muller-Werdan U., Werdan K.
Intensiv- und Notfallbehandlung. 36 (1) (pp 22-45), 2011. Date of Publication: 2011.
AN: 361649405
This article presents informations of practical relevance from the field of intensive

care and emergency medicine which has been published in 2009/2010. © 2011.
Institution
(Ehnert, Ebelt, Muller-Werdan, Werdan) Universitatsklinik und Poliklinik fur, Innere Medizin III, Universitatsklinikum Halle (Saale), Ernst-Grube-Strase 40, D-06097 Halle (Saale), Germany
Publisher
Dustri-Verlag Dr. Karl Feistle (Bajuwarenring 4, Oberhaching 82041, Germany)

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412.

A surge of flu-associated adult respiratory distress syndrome in an Austrian tertiary care hospital during the 2009/2010 Influenza A H1N1v pandemic.
Schellongowski P., Ullrich R., Hieber C., Hetz H., Losert H., Hermann M., Hermann A., Gattringer K.-B., Siersch V., Rabitsch W., Fuhrmann V., Bojic A., Robak O., Sperr W.R., Laczika K., Locker G.J., Staudinger T.
Wiener Klinische Wochenschrift. 123 (7-8) (pp 209-214), 2011. Date of Publication: April 2011.
AN: 51351744
We report on 17 patients with influenza A H1N1v-associated Adult Respiratory Distress Syndrome who were admitted to the intensive care unit (ICU) between June 11th 2009 and August 10th 2010 (f/m: 8/9; age: median 39 (IQR 29-54) years; SAPS II: 35 (29-48)). Body mass index was 26 (24-35), 24% were overweight and 29% obese. The Charlson Comorbidity Index was 1 (0-2) and all but one patient had comorbid conditions. The median time between onset of the first symptom and admission to the ICU was 5 days (range 0-14). None of the patients had received vaccination against H1N1v. Nine patients received oseltamivir, only two of them within 48 hours of symptom onset. All patients developed severe ARDS (PaO2/FiO2-Ratio 60 (55-92); lung injury score 3.8 (3.3-4.0)), were mechanically ventilated and on vasopressor support. Fourteen patients received corticosteroids, 7 patients underwent hemofiltration, and 10 patients needed extracorporeal membrane-oxygenation (ECMO; 8 patients veno-venous, 2 patients veno-arterial), three patients Interventional Lung Assist (ILA) and two patients pump driven extracorporeal low-flow CO 2-elimination (ECCO2-R). Seven of 17 patients (41%) died in the ICU (4 patients due to bleeding, 3 patients due to multi-organ failure), while all other patients survived the hospital (59%). ECMO mortality was 50%. The median ICU length-of-stay was 26 (19-44) vs. 21 (17-25) days (survivors vs. nonsurvivors), days on the ventilator were 18 (14-35) vs. 20 (17-24), and ECMO duration was 10 (8-25) vs. 13 (11-16) days, respectively (all p = n.s.). Compared to a control group of 241 adult intensive care unit patients without H1N1v, length of stay in the ICU, rate of mechanical ventilation, days on the ventilator, and TISS 28 scores were significantly higher in patients with H1N1v. The ICU survival tended to be higher in control patients (79 vs. 59%; p = 0.06). Patients with H1N1v admitted to either of our ICUs were young, overproportionally obese and almost all with existing comorbidities. All patients developed severe ARDS, which could only be treated with extracorporeal gas exchange in an unexpectedly high proportion. Patients with H1N1v had more complicated courses compared to control patients. © 2011 Springer-Verlag.
PMID
21465083 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21465083]
Institution
(Schellongowski, Hermann, Hermann, Gattringer, Siersch, Rabitsch, Bojic, Robak, Sperr, Laczika, Locker, Staudinger) Department of Medicine i, Intensive Care Unit

13i2, Medical University of Vienna, Waehringer Guertel 18-20, 1090 Vienna, Austria
(Ullrich, Hieber, Hetz) Department of Anaesthesia, Intensive Care Unit 13c2, Medical University of Vienna, Austria
(Losert) Department of Emergency Medicine, Medical University of Vienna, Austria
(Fuhrmann) Department of Medicine III, Intensive Care Unit 13h1, Medical University of Vienna, Vienna, Austria
Publisher
Springer Wien (Sachsenplatz 4-6, P.O. Box 89, Vienna A-1201, Austria)

413.

First experiences in the Netherlands with a new single catheter-based veno-venous extracorporeal carbon dioxide removal system.
Knook A., Baak R., Epker J., Bakker J.
Netherlands Journal of Critical Care. 15 (1) (pp 24-26), 2011. Date of Publication: February 2011.
AN: 361405794
A 34-year-old woman suffering from severe systemic lupus erythematodus was admitted to the ICU with respiratory failure due to a pneumocystis jirovecii infection resulting in severe hypercapnia which could not be controlled with conventional strategies. A new single catheter-based CO2 removal system was initiated in order to control severe hypercapnia. The case and relevant literature are discussed.
Institution
(Knook) Department of Intensive Care, De Gelderse Vallei Hospital, Ede, Netherlands (Baak) Department of Intensive Care, HAGA Hospital, Hague, Netherlands
(Epker, Bakker) Department of Intensive Care, Erasmus Medical Center Rotterdam, Rotterdam, Netherlands
Publisher
NVIC - Netherlands Society of Intensive Care (Horapark 9, Ede LZ 6717, Netherlands)

414.

Use of extracorporeal membrane lung assist device (Novalung) in H1N1 patients.
Johnson P., Frohlich S., Westbrook A.
Journal of Cardiac Surgery. 26 (4) (pp 449-452), 2011. Date of Publication: July 2011.
AN: 51418475
We present three patients with severe respiratory failure secondary to H1N1 influenza type A pneumonitis, in whom hypercapnia and respiratory acidosis were not controlled by the conventional mechanical lung ventilation or high-frequency oscillatory ventilation. Use of a pumpless arteriovenous extracorporeal carbon

dioxide removal device (NovalungTM, Inspiration Healthcare Ltd, Leicester, UK) resulted in reduced carbon dioxide levels, improved pH, and a reduction in inspiratory pressures, allowing for a less-harmful ventilator strategy. These cases demonstrate that the Novalung is a safe and effective device to use in patients with H1N1 pneumonitis refractory to the conventional therapy and may be an alternative to extracorporeal membrane oxygenation (ECMO) in selected cases. © 2011 Wiley Periodicals, Inc.
PMID
21554392 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21554392]
Institution
(Johnson) Department of Intensive Care Medicine, St James's Hospital, Dublin, Ireland (Frohlich) Department of Critical Care, Mater Misericordiae University Hospital, Dublin, Ireland
(Westbrook) Department of Anaesthesia and Critical Care, Midlands Regional Hospital, Mullingar, Ireland
Publisher
Blackwell Publishing Inc. (350 Main Street, Malden MA 02148, United States)

Link to the Ovid Full Text or citation:
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415.

The novalung interventional lung assist as bridge to lung transplantation for self-ventilating patients - initial experience.
Bartosik W., Egan J.J., Wood A.E.
Interactive Cardiovascular and Thoracic Surgery. 13 (2) (pp 198-200), 2011. Date of Publication: August 2011.
AN: 362255055
We report the use of the Novalung pumpless device in self-ventilating patients awaiting a lung transplantation. Two patients developed carbon dioxide retention with respiratory acidosis that did not respond to maximum medical therapy. The Novalung interventional lung assist was established as a bridge to lung transplantation. The first patient was successfully transplanted after 140 days, and this is the longest support that has been reported so far. The second patient was weaned off the Novalung after a short period. The Novalung is a valuable device for self-ventilating patients with carbon dioxide retention being bridged to lung transplantation. © 2011 Published by European Association for Cardio-Thoracic Surgery. All rights reserved.
PMID
21543364 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21543364]
Institution
(Bartosik, Egan, Wood) Mater Misericordiae University Hospital, Eccles Street, Dublin, Ireland
Publisher
Oxford University Press (Great Clarendon Street, Oxford OX2 6DP, United Kingdom)

Link to the Ovid Full Text or citation:
Click here for full text options

416.

Interventional lung assist enables lung protective mechanical ventilation in acute respiratory distress syndrome.
Nierhaus A., Frings D.P., Braune S., Baumann H.-J., Schneider C., Wittenburg B., Kluge S.
Minerva Anestesiologica. 77 (8) (pp 797-801), 2011. Date of Publication: 2011 August.
AN: 362247008
Background. The feasibility and safety of a pumpless arteriovenous extracorporeal lung assist system (pECLA) has been demonstrated in previous studies of patients with severe respiratory insufficiency. The aim of this report was to examine whether pECLA is feasible in a center that is new to the technology and to determine the positive and adverse effects associated with its use. Methods. This was a retrospective case series of 13 consecutive patients with established acute respiratory distress syndrome (ICU patients with ARDS or ALI) at a university hospital. Management consisted of transcutaneous placement of a femoral arteriovenous pECLA to allow lung-protective ventilation. Nonparametric statistics were applied; all data are values and standard deviations (SD). Results. Mean simplified acute physiology score (SAPS) II was 49.5 (26); ICU mortality was 54% (7/13). Mean length of ICU stay was 34.5 (65.3) days for survivors (S) and 36 (32.8) days for non-survivors (NS). Total time on arteriovenous pECLA was 12.0 (22.2) days (S) and 7.0(7.8) days (NS), total time on mechanical ventilation was 31.0 (28.2) (S) and 32.0 (15.2) days (NS). Hypercapnia was significantly (P<0.05) reduced from 80.0 (23.0) (pre-pECLA) to 48.0 (13.0) mmHg (day 7), as were minute ventilation and inspiratory pressure. pECLA was accompanied by a significant (P<0.05) increase in the PaO2/fraction of inspired oxygen (P/F) ratio from 100.0 (28.9) (pre-pECLA) to 191.1 (114.3) mmHg after 7 days of treatment. Major complications were two inadvertent decannulations in the first two patients treated; there was one minor bleeding event in a patient seen subsequently. Conclusion. pECLA is an effective and manageable technique to support gas exchange in ARDS patients. This retrospective case series demonstrates the feasibility of pECLA in a center that did not have prior experience with this technique. pECLA may decrease further lung injury by minimizing the amount of time for which the lung is exposed to high stress and/or strain.
PMID
21730927 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21730927]
Institution
(Nierhaus, Frings, Braune, Wittenburg, Kluge) Department of Critical Care, University Medical Center Hamburg-Eppendorf, Martinistr. 52, D-20246 Hamburg, Germany
(Baumann) Department of Pulmonology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany
(Schneider) Department of General Surgery, University Medical Center Hamburg-Eppendorf, Hamburg, Germany
Publisher
Edizioni Minerva Medica S.p.A. (Corso Bramante 83-85, Torino 10126, Italy)

417.

Veno-venous extracorporeal membrane oxygenation as a bridge to lung transplantation: Is it worthwhile?.
Mendogni P., Rosso L., Palleschi A., Nosotti M.

Interactive Cardiovascular and Thoracic Surgery. 13 (2) (pp 200), 2011. Date of Publication: August 2011.
AN: 362255056
PMID
21775493 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21775493]
Institution
(Mendogni, Rosso, Palleschi, Nosotti) Fondazione IRCCS Ospedale Maggiore Policlinico, University of Milan, Milan, Italy
Publisher
Oxford University Press (Great Clarendon Street, Oxford OX2 6DP, United Kingdom)

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418.

Extracorporeal CO2 Removal in ARDS.
Lynch J.E., Hayes D., Zwischenberger J.B.
Critical Care Clinics. 27 (3) (pp 609-625), 2011. Date of Publication: July 2011.
AN: 362111112
Acute respiratory distress syndrome remains one of the most clinically vexing problems in critical care. As technology continues to evolve, it is likely that extracorporeal CO2 removal devices will become smaller, more efficient, and safer. As the risk of extracorporeal support decreases, devices' role in acute respiratory distress syndrome patients remains to be defined. This article discusses the functional properties and management techniques of CO2 removal and intracorporeal membrane oxygenation and provides a glimpse into the future of long-term gas-exchange devices. © 2011.
PMID
21742219 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21742219]
Institution
(Lynch) Division of General Surgery, Department of Surgery, University of Kentucky College of Medicine, University of Kentucky Medical Center, 800 Rose Street, C-226, Lexington, KY 40517, United States (Hayes) Department of Pediatrics, University of Kentucky College of Medicine, University of Kentucky Medical Center, 800 Rose Street, C-424, Lexington, KY 40536, United States
(Zwischenberger) Department of Surgery, University of Kentucky College of Medicine, University of Kentucky Medical Center, 800 Rose Street, MN-264, Lexington, KY 40536-0298, United States
Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

Link to the Ovid Full Text or citation:
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419.

Protective and ultra-protective ventilation: Using pumpless interventional lung assist (iLA).

Moerer O., Quintel M.
Minerva Anestesiologica. 77 (5) (pp 537-544), 2011. Date of Publication: May 2011.
AN: 361841172
Acute lung failure is associated with high mortality and usually requires mechanical ventilation to ensure adequate gas exchange. However, mechanical ventilation itself can be associated with major complications and can aggravate pre-existing lung disease, thus contributing to morbidity and mortality. Extracorporeal gas exchange is increasingly used when conventional mechanical ventilation has failed. In contrast to veno-venous extracorporeal membrane oxygenation (ECMO), pumpless extracorporeal interventional lung assist (iLA) is applied via an arterio-venous bypass into which a gas exchange membrane is integrated. iLA allows for efficient carbon dioxide removal, which allows for a significant reduction in ventilator settings. iLA may be a useful tool in protective or even 'ultraprotective' ventilation, enabling the application of very low tidal volumes in patients with acute respiratory failure of different etiologies. This article reviews the current status and the potential role of interventional (pumpless) lung-assist iLA within the context of lung-protective ventilation strategies.
PMID
21540810 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21540810]
Institution
(Moerer, Quintel) Department Anaesthesiology, Emergency and Critical Care Medicine, Georg-August-University of Gottingen, Gottingen, Germany
Publisher
Edizioni Minerva Medica S.p.A. (Corso Bramante 83-85, Torino 10126, Italy)

420.

The authors reply:.
Batchinsky A.I., Chung K.K., Cannon J.W., Cancio L.C.
Critical Care Medicine. 39 (12) (pp 2788-2789), 2011. Date of Publication: December 2011.
AN: 362974826
Institution
(Batchinsky, Chung, Cancio) U.S. Army Institute of Surgical Research, Fort Sam Houston, TX, United States (Cannon) Division of Trauma and Acute Care Surgery, Brooke Army Medical Center, Fort Sam Houston, TX, United States
Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

421.

The authors reply:.
Das S.K.

Critical Care Medicine. 39 (12) (pp 2788), 2011. Date of Publication: December 2011.

AN: 362974825
Institution
(Das) University of Medicine and Dentistry of New Jersey, Robert Wood Johnson Medical School, New Brunswick, NJ, United States
Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

422.

Interview with the expert: George B. Mallory, Jr., M.D.
Mallory G.B.
Pediatric, Allergy, Immunology, and Pulmonology. 24 (3) (pp 129-132), 2011. Date of Publication: 01 Sep 2011.
AN: 362664238
Publisher
Mary Ann Liebert Inc. (140 Huguenot Street, New Rochelle NY 10801-5215, United States)

423.

Extracorporeal CO2 removal and O2 transfer: A review of the concept, improvements and future development.
Terragni P.P., Maiolo G., Tenaglia T., Pernechele J., Ranieri V.M.
Trends in Anaesthesia and Critical Care. 1 (3) (pp 123-127), 2011. Date of Publication: June 2011.
AN: 362505375
Since the 70s, the extracorporeal carbon dioxide removal concept played a role in adjusting respiratory acidosis associated with Tidal Volume reduction in protective ventilation settings.Kolobow and Gattinoni in 1977 were the first in introducing extracorporeal support, with the intent to separate carbon dioxide removal from oxygen uptake: carbon dioxide was removed by a pump-driven modified ECMO with veno-venous bypass, while oxygenation was accomplished by high levels of PEEP, applying only a few ventilator breaths at low volumes and low peak inspiratory pressures (" lung rest") to prevent damage of the compromised lungs.Nevertheless extracorporeal support was restricted to controlled clinical trials because of the high incidence of serious complications like hemorrhage, hemolysis and neurological impairments.Technological improvement led to the implementation of different devices less invasive for the patient and less complex for clinician (however unable to transfer oxygen): the interventional Lung Assist (iLA) and the Veno-venous ECCO2R, which brought back attention to the CO2 removal concept.Is foreseeable the future development of more efficient devices capable of removing a substantial

amount of carbon dioxide allowing a more protective ventilation. This would embody the modern mechanical ventilation philosophy: avoid tracheal tubes, minimize sedation, prevent VILI and hospital acquired infections. © 2011 Elsevier Ltd.
Institution
(Terragni, Maiolo, Tenaglia, Pernechele, Ranieri) Universita di Torino, Dipartimento di Anestesia e di Medicina degli Stati Critici, Azienda Ospedaliera S. Giovanni Battista-Molinette, Corso Dogliotti 14, 10126 Torino, Italy
Publisher
Churchill Livingstone (1-3 Baxter's Place, Leith Walk, Edinburgh EH1 3AF, United Kingdom)

424.

Interventional lung assist membrane ventilator : Successful use despite heparin-induced thromocytopenia type II. "interventional-lung-assist"-Membranventilator : Erfolgreiche Anwendung trotz heparininduzierter Thrombozytopenie II <"interventional-lung-assist"-Membranventilator : Erfolgreiche Anwendung trotz heparininduzierter Thrombozytopenie II.>
Lange J., Knuttgen D., Stoelben E., Bauerfeind U., Wappler F., Sakka S.G.
Anaesthesist. 60 (3) (pp 230-235), 2011. Date of Publication: March 2011.
AN: 51205233
Pumpless extracorporeal carbon dioxide elimination using the interventional lung assist (iLA) membrane ventilator is a modern concept for the treatment of hypercapnia due to respiratory failure which cannot be sufficiently treated by conventional strategies. Heparin-induced thrombocytopenia type II (HIT II) is considered to be an absolute contraindication for placement of an iLA because of the system's heparin-coated diffusion membrane. The example demonstrates that iLA therapy can be continued despite occurrence of a HIT II in terms of an "off label use". In the case described, postoperative therapy using the iLA membrane ventilator was installed in a 69-year-old patient with severe ARDS after elective lung resection. Despite a confirmed HIT II detected in the course of iLA, this therapy was continued after changing systemic anticoagulation to argatroban. The platelet count increased again and the patient could be successfully weaned from the iLA membrane and finally transferred to a rehabilitation centre. © 2010 Springer-Verlag.
PMID
21184044 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21184044]
Institution
(Lange) Klinik fur Viszeral-, Gefas- und Transplantationschirurgie, Klinikum der Universitat Witten/Herdecke Mit Sitz in Koln, Kliniken der Stadt Koln GGmbH, Krankenhaus Merheim, Koln, Germany (Knuttgen, Wappler, Sakka) Klinik fur Anasthesiologie und Operative Intensivmedizin, Klinikum der Universitat Witten/Herdecke Mit Sitz in Koln, Kliniken der Stadt Koln GGmbH, Krankenhaus Merheim, Ostmerheimerstr. 200, Koln 51109, Germany
(Stoelben) Lungenklinik, Kliniken der Stadt Koln GGmbH, Krankenhaus Merheim, Koln, Germany
(Bauerfeind) Institut fur Transfusionsmedizin, Kliniken der Stadt Koln GGmbH, Krankenhaus Merheim, Koln, Germany
Publisher
Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

Link to the Ovid Full Text or citation:
Click here for full text options

425.

Use of extracorporeal life support to support patients with acute respiratory distress syndrome due to H1N1/2009 influenza and other respiratory infections.
Wong I., Vuylsteke A.
Perfusion. 26 (1) (pp 7-20), 2011. Date of Publication: January 2011.
AN: 361004763
A large proportion of critically ill H1N1/2009 patients with respiratory failure subsequently developed ARDS and, to date, about 400 patients receiving extracorporeal life support (ECLS) have been accounted for globally, with a reported survival rate from 63% to 79%. The survival rates of patients with ARDS due to non-H1N1/2009 infections are similar. There is no definite evidence to suggest that patient outcomes are changed by ECLS, but its use is associated with serious short-term complications. ECLS relies on an extracorporeal circuit, with extracorporeal membrane oxygenation (ECMO) and pumpless interventional lung assist (ILA) being the two major types employed in ARDS. Both have the potential to correct respiratory failure and related haemodynamic instability. There are only a very limited number of clinical trials to test either and, although ECLS has been used in treating H1N1/2009 patients with ARDS with some success, it should only be offered in the context of clinical trials and in experienced centres. © The Author(s) 2011.
PMID
20826508 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20826508]
Institution
(Wong) School of Clinical Medicine, University of Cambridge, United Kingdom
(Vuylsteke) Anaesthesia and Intensive Care, Papworth Hospital, Cambridge, United Kingdom
Publisher
SAGE Publications Ltd (55 City Road, London EC1Y 1SP, United Kingdom)

Link to the Ovid Full Text or citation:
Click here for full text options

426.

Successful use of interventional lung assist device in a patient with near fatal asthma.

Laura T., Stephen M.
European Respiratory Journal. Conference: European Respiratory Society Annual Congress 2011. Amsterdam Netherlands. Conference Publication: (var.pagings). 38 (SUPPL. 55) (no pagination), 2011. Date of Publication: 01 Sep 2011.
AN: 72117249
Interventional lung assist devices (iLA) are pumpless, arterio-venous, extra-corporeal lung support devices with a low resistance gas exchange membrane that allows rapid removal of carbon dioxide (CO2) and moderate oxygenation. Currently they are mainly used in acute respiratory distress syndrome and as a bridge to lung transplantation. We successfully used iLA in an near fatal asthmatic patient with hypercapnic respiratory failure refractory to conventional ventilation. A male patient aged 55 years presented with a near fatal exacerbation of asthma. He was a current

smoker with co-morbidities including obesity, previous poliomyelitis affecting right leg, stroke and ischaemic heart disease. Despite full medical treatment, endobronchial intubation and invasive mechanical ventilation (IMV) plus a range of intravenous and inhaled medications including intravenous terbutaline, ketamine, adrenaline and inhaled adrenaline and isofluorane he developed persistent hypercapnic respiratory failure with PaCO2 > 20. Conventional ventilation strategies were ineffective with poor compliance, high peak airway pressures and prolonged inspiratory times resulting in air trapping and hyperinflation. Therefore an iLA was inserted on day 2. This resulted in enhanced CO2 removal (Pa CO2 21 down to PaCO2 7.6) and allowed protective lung ventilation at lower pressures with less gas trapping and hyperinflation. The iLA was removed on day 12 with spontaneous breathing on day 19. This could represent a useful future strategy for persistent hypercapnic respiratory failure unresponsive to conventional measures in obstructive diseases such as asthma and COPD.
Publisher
European Respiratory Society

427.

A novel extracorporeal Co2 removal system: Application of the hemolung in patients with hypercapnic respiratory failure.
Burki N., Mani R., Herth F., Schmidt W., Teschler H., Bonin F.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2011. Denver, CO United States. Conference Publication: (var.pagings). 183 (1 MeetingAbstracts) (no pagination), 2011. Date of Publication: 01 May 2011.
AN: 70846082
The treatment of hypercapnic respiratory failure usually requires mechanical ventilatory assistance to remove CO2. Extracorporeal CO2 removal techniques have been applied previously with variable success (JAMA 1986;15;256:881-6; Am J Respir Crit Care Med 1994; 149: 295-305); however, these require the placement of two intravenous catheters, and are associated with a significant extracorporeal blood flow amounting to 25% or more of the cardiac output (Thorax 2009;64:726-727). Hattler (J Thorac Cardiovasc Surg. 2002;124:520-30) described an intravenous catheter which increases CO2 removal, and this has been developed into a system - the Hemolung (ALung Technologies, Inc) - which provides significant CO2 removal (up to 100ml/min) through a single intravenous catheter system, with a relatively low blood flow rate (~ 400ml/min) of about 10% of the cardiac output. The system has been validated in animal studies. We have to date applied the hemolung in 5 patients (4 females, 2 males, age 67.6+/-10.2 yrs) with acute on chronic hypercapnic respiratory failure in an ongoing study of the safety and efficacy of the Hemolung. In all subjects, the hemolung was applied to avoid intubation after failure of noninvasive ventilation. The catheter was placed percutaneously in the femoral vein in 4 patients and in the right jugular vein in one patient. Mean Blood flow through the system was 467+/-58.4 ml/min, and ranged from 300 ml/min to 588 ml/min, and mean CO2 removal was 90.5+/-8.5 ml/min, ranging from 75 to 103 ml/min. The average decrease in arterial PCO2 after application of the hemolung is shown in the figure: (Figure presented) Changes in arterial PCO2 following placement of Hemolung catheter. Mean+/-SEM, n=5 All subjects indicated a significant decrease in dyspnea, measured on a modified Borg scale, following placement of the Hemolung catheter. Initial review indicates that there were no serious adverse events attributable to the

Hemolung. Adverse events included transient bleeding and thrombocytopenia associated with heparin use in one patient, and transient hypotension in one patient. These preliminary results suggest that the Hemolung may be a safe and effective extracorporeal CO2 removal technique for treatment of hypercapnic respiratory failure in human subjects.
Institution
(Burki) University of Connecticut Health Center, Farmington, CT, United States
(Mani) Artemis Health Institute, Gurgaon, India
(Herth, Schmidt) Thoraxklinik and University Hospital, Heidelberg, Germany
(Teschler, Bonin) Ruhrlandklinik, Essen, Germany
Publisher
American Thoracic Society

428.

Extracorporeal CO2 removeal in CU.
Mattei N., Mocavero P., Corcione A.
European Journal of Anaesthesiology. Conference: European Anaesthesiology Congress, EUROANAESTHESIA 2011. Amsterdam Netherlands. Conference Publication: (var.pagings). 28 (SUPPL. 48) (pp 170), 2011. Date of Publication: June 2011.
AN: 70681516
Background and Goal of Study: Hypoxemia and hypercapnia both result in a decrease of glomerular filtration rate but acting the first on the increase in renal vascular resistance leading to renal hypoperfusion and the second on systemic vasodilation, stimulation of the renin-angiotensin system, sympathetic activation and renal vasoconstriction.The veno-venous extracorporeal CO2 removal (DECAP) is a minimally invasive technique requiring low blood flows (300-400 ml/min). The advantages its clinical use could be resumed in: the ability to facilitate a "protective" ventilation setting with Pplateau< 25cmH2O [1,2], the reduction of pulmonary and systemic inflammatory response and the reduction of the incidence of acute renal failure (ARF). Possible clinical indications for the CO2 extracorporeal removal are: ARDS of different etiologies; COPD exacerbation, "bridge" lung transplantation
Material(s) and Method(s): In an 8-bed ICU, we conducted a retrospective study analysing two comparable groups of patients diagnosed of ARDS-induced ARF. Group1 included 165 patients treated with protective ventilation and early renal replacement therapy (CRRT) [3,4]. Group2 included 160 patients treated with protective ventilation, CRRT and DECAP. The baseline characteristics of the two groups (Group1 vs Group2) were compared on the basis of SOFA score (14.5+/-3.7 vs 12+/-2.2, NS), APACHE2 score (26.4+/-7.3 vs 24+/-5.6, NS) and mean age (59.7+/-3.15 vs 60+/-12, NS). Results and Discussion: The duration of CRRT treatment in Group1 and Group2 respectively was 28+/-10 days and 12+/-7 (p< 0.05). The significant difference between groups implied lower costs of hospitalization and also reflected in a significant difference (p< 0.05) in hospital mortality at 60 days varing from 59% (Group1) to 43 % (Goup2).
Conclusion(s): Acute kidney injury is a common complication of acute illness, affecting more than 35% of ICU patients. CRRT is the mainstay of supportive treatment of patients with severe ARF; its use is required in 5 to 6% of critical patients but is associated with mortality rates as high as 50-80%. In critically ill patients with ARF supported by hypoxia and/or hypercapnia with different etiology, contemporary and early treatment with extracorporeal CO2 removal reduces

mortality and costs in ICU.
Institution
(Mattei, Mocavero, Corcione) A.O.R.N., Department of Anaesthesiology and Intensive Care, Napoli, Italy
Publisher
Lippincott Williams and Wilkins

429.

Pumpless extracorporeal lung assist in a pregnant woman with severe ARDS.
Cunha H.F.R.D., Coscia A.P., Longo A., Campioni L., Martins E.G., Meis E.D., Saddy F., Costa R.
Critical Care. Conference: 6th International Symposium on Intensive Care and Emergency Medicine for Latin America. Sao Paulo Brazil. Conference Publication: (var.pagings). 15 (SUPPL. 2) (pp 21-22), 2011. Date of Publication: 22 Jun 2011.
AN: 70601655
Introduction Acute respiratory distress syndrome is characterized by acute-onset, refractory hypoxemia, bilateral infiltrates on chest radiographs and PAOP <18 mmHg or absence of clinical signs of left atrial hypertension. The protective ventilatory strategy limiting plateau pressure to lower than 28 cmH2O, driving pressure below 15 cmH2O and tidal volume between 4 and 6 ml/kg using a PEEP level to sustain the open lung approach usually results in hypercapnia. However, it is the mainstream supportive therapy that can modulate survival in this syndrome. Methods We describe a case report where a 31-year-old woman who was admitted to the intensive care unit with fatigue, shortness of breath and hypoxemia. She was 24 weeks pregnant and acute myeloid leukemia, subtype M3 was diagnosed 5 days before admission. Noninvasive ventilatory support, chemotherapy (doxirubicin and all-trans retinoic acid) and blood components (red blood cells, fresh frozen plasma, cryoprecipitate and platelets) were implemented. After 4 days the clinical scenario was out of control and she was intubated. Renal function deteriorated and hemodialysis was required. Results Controlled mechanical ventilation using neuromuscular blocking (NMB) agents was set to limit plateau pressure, driving pressure, tidal volume and high level of PEEP (15 cmH2O). However, oxygenation progressively deteriorated despite the instituted therapy and on the eighth day on mechanical ventilation the intraabdominal pressure (IAP) was 20 mmHg, the driving pressure was 20 cmH2O and Vt was 5 ml/kg, which resulted in PaO2/FiO2 of 90, pH 7.15, PaCO2 of 115 mmHg. Interventional lung assist (iLA; Novalung, GmbH, Talheim, Germany), a pumpless arterio-venous extracorporeal membrane for CO2 removal, was connected without systemic anticoagulation. After 20 minutes using iLA with 9 l/minute O2, a PEEP level of 20 cmH2O, Vt of 4 ml/kg, driving pressure of 20 cmH2O, I:E of 1:1 resulted in a PaO2/ FiO2 of 175, PaCO2 of 57 mmHg and pH 7.35. Hemodynamics were stable and vasopressor agents were not needed. The blood flow in the circuit was 1.4 l/minute. After 14 hours on iLA the NMB agent was interrupted and assisted ventilatory support with Bivent + PSV (Servo i Maquet, Solna, Sweden) was started, sustaining a driving pressure of 15 cmH2O. After 48 hours on iLA the baby was born naturally and the IAP decreased to 7 mmHg. Respiratory system mechanics and the PaO2/FiO2 ratio improved: 56% and 64%, respectively. CPAP + PSV was started on day 8 after iLA implementation and it was surgically removed on the day after when the PaCO2 was sustained below 40 mmHg. Conclusion We present the first case so far where iLA was safely used during 9 days in a pregnant woman with severe ARDS and multiple organ dysfunction

syndrome under continuous hemodialytic support that allowed us to set a protective ventilatory strategy using an assisted ventilation mode.
Institution
(Cunha, Coscia, Longo, Campioni, Martins, Costa) Hospital Quinta D'Or, Rio de Janeiro - RJ, Brazil (Meis) Instituto Nacional Do Cancer, INCA, Rio de Janeiro - RJ, Brazil
(Saddy) Hospital Copa D'Or, Rio de Janeiro - RJ, Brazil
Publisher
BioMed Central Ltd.

430.

Trauma patients treated with extracorporeal membrane oxygenation.
Keyser A., Philipp A., Hilker M.K., Schmid C.
Injury. Conference: Osteosynthese International 2011 Annual Meeting. Thessaloniki Greece. Conference Publication: (var.pagings). 42 (SUPPL. 3) (pp S17-S18), 2011. Date of Publication: September 2011.
AN: 70552709
Aim: Severe trauma with is a cause of death either due to fatal injuries without any treatment option or due to life threatening complications in the early course. Early complications such as bleeding shock and/or severe respiratory failure following chest trauma or massive blood transfusion are a major task in the treatment of these patients. Massive blood transfusions may result in decreased cardiac output and pulmonary gas exchange, and either massive blood transfusion or pulmonary contusion may lead to acute respiratory distress syndrome (ARDS). In these cases extracorporeal membrane oxygenation (ECMO) as a lifesaving treatment may improve or take over the gas exchange function of the lung or provide additional cardio-circulatory support.
Material(s) and Method(s): Since 2000 we treated trauma patients with resistant cardiopulmonary failure due to ARDS and/or bleeding shock with ECMO (n = 84, mean age 35+/-17 years, 72 male). 50 patients (mean age = 34+/-17 years, 41 male) were treated due to resistant hyperkapnia with pumpless extracorporeal lung assist (PECLA). For pulmonary failure, that is for resistant hyperkapnia and impaired oxygenation, initially heparin-free ECMO was installed percutaneously veno-venous in 21 patients (mean age 35+/-17 years, 18 male). 13 patients (mean age 41+/-17 years, 12 male) were treated with percutaneously installed veno-arterial ECMO for additional cardiocirculatory impairment following severe trauma.
Result(s): Pulmonary or cardiopulmonary failure was treated effectively with ECMO and systemic gas exchange and blood flow improved rapidly within a couple of hours in all patients. Duration of support ranged from a few hours through 26 days. 61% of our patients recovered completely (PECLA 64%, v-v ECMO 80%, v-a ECMO 23%).
Conclusion(s): ECMO may improve therapy and outcome in severe trauma patients. Coexisting bleeding shock must not be a contraindication for ECMO.
Institution
(Keyser, Philipp, Hilker, Schmid) Department of Cardiothoracic Surgery, University Hospital, Regensburg, Germany
Publisher
Elsevier Ltd

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431.

The Use of CO2 Removal Devices in Patients Awaiting Lung Transplantation: An Initial Experience.
Ricci D., Boffini M., Del Sorbo L., El Qarra S., Comoglio C., Ribezzo M., Bonato R., Ranieri V.M., Rinaldi M.
Transplantation Proceedings. 42 (4) (pp 1255-1258), 2010. Date of Publication: May 2010.
AN: 358858137
Background: Lung transplantation is the treatment of choice for patients with end-stage lung failure. Limitations are presented by the shortage of donors and the long waiting list periods. New techniques, such as extracorporeal membrane ventilator devices with or without pump support, have been developed as bridges to transplantation for patients with severe, unresponsive respiratory insufficiency.
Method(s): Between November 2005 and September 2009, 12 patients (7 males and 5 females), of overall mean age of 43.3 +/- 15.5 years underwent decapneization with extracorporeal devices. In 6 cases, a NovaLung system was used; in the remaining 6 patients, it was a Decap device. Causes of respiratory failure that led to implantation of such devices were cystic fibrosis (n = 6), pulmonary emphysema (n = 5), and chronic rejection of a previous double lung transplant (n = 1).
Result(s): Mean time on extracorporeal decapneization was 13.5 +/- 14.2 days. Eight patients died on the device. Three patients were bridged to lung transplantation; 1 recovered and was weaned from the device after 11 days. Mean PaCO2 on the extracorporeal gas exchanger was significantly lower for both the devices at 24, 48, and 72 hours after implantation (P < .05). No significant difference was observed for the 2 systems.
Conclusion(s): In our initial experience, decapneization devices have been simple, efficient methods to support patients with mild hypoxia and severe hypercapnia that is refractory to mechanical ventilation. This could represent a valid bridge to lung transplantation in these patients.
PMID
20534274 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20534274]
Institution
(Ricci, Boffini, El Qarra, Comoglio, Ribezzo, Bonato, Rinaldi) Division of Cardiac Surgery, San Giovanni Battista Hospital Molinette, University of Torino, Torino, Italy
(Del Sorbo, Ranieri) Department of Anestesia, San Giovanni Battista Hospital Molinette, University of Torino, Torino, Italy
Publisher
Elsevier USA (6277 Sea Harbor Drive, Orlando FL 32862 8239, United States)

Link to the Ovid Full Text or citation:
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432.

High frequency oscillation, extracorporeal membrane oxygenation and pumpless arteriovenous lung assist in the management of severe ARDS.
Banach M., Soukup J., Bucher M., Andres J.
Anestezjologia intensywna terapia. 42 (4) (pp 201-205), 2010. Date of Publication:

2010 Oct-Dec.
AN: 361598248
The protective lung strategy for severe ARDS, has markedly decreased the associated morbidity and mortality. Sometimes, even the best instrumentation and therapeutic strategy may be insufficient, and extracorporeal gas exchange support is necessary. We describe a desperate case of ARDS, in which various modes of ventilation, combined with vigorous extracorporeal support, resulted in a successful outcome. A 35-year-old man, a heavy smoker, was admitted to the hospital because of lobar pneumonia. Despite wide spectrum antimicrobial therapy, he developed ARDS and was placed on a ventilator. Standard ventilation was ineffective and veno-venous ECMO was instituted. The extravascular lung water index (EVLWI) was extremely high (over 30 mL kg-1) and signs of a hyperdynamic circulation (CI 6.1 L m-2 min-1) were observed. Modification of the inotropic support and continuous infusion of furosemide resulted in normalisation of the hydration status, and over a week of ECMO therapy, the patient's general condition improved to the stage that he was scheduled to be weaned from extracorporeal treatment. On the 7th day however, he suddenly deteriorated. A lung CT-scan revealed bilateral pneumothoraces and diffuse pulmonary embolism. Three thoracic drains were inserted, but unfortunately, the drainage was complicated by massive bleeding and a subsequent thoracotomy. Two days later, a gastrointestinal haemorrhage occurred. Heparin dosage was reduced, and ECMO was discontinued and replaced with HFOV. This resulted in adequate oxygenation, however because of ineffective CO2 elimination, pumpless arteriovenous extracorporeal lung assist (PECLA) was instituted, allowing conventional ventilation to be resumed after 8 days. The further clinical course was complicated by persistent bilateral pneumothoraces, pleural effusion and Pseudomonas nosocomial infection. The man eventually recovered after 54 days in the ICU, and was transferred to a rehabilitation department. ECMO has been recommended for severe ARDS since it avoids overdistension of the lungs and the use of high oxygen concentrations. Early institution of ECMO decreases mortality and morbidity in rapidly progressing ARDS. In the described case, ECMO was probably started too late, after volutrauma has already occurred. A combination of HFOV and PECLA may be recommended in selected cases, in which CO2 retention poses a serious problem.
PMID
21252837 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21252837]
Institution
(Banach) Klinik fur Anasthesiologie und Operative Intensivmedizin der Martin-Luther-Universitat, Halle, Ernst-Grube Str. 40, 06120 Halle.

Link to the Ovid Full Text or citation:
Click here for full text options

433.

Noninvasive ventilation and low-flow veno-venous extracorporeal carbon dioxide removal as a bridge to lung transplantation in a child with refractory hypercapnic respiratory failure due to bronchiolitis obliterans.
Moscatelli A., Ottonello G., Nahum L., Lampugnani E., Puncuh F., Simonini A., Tumolo M., Tuo P.
Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies. 11 (1) (pp e8-12), 2010. Date of Publication: Jan 2010.
AN: 358556804
OBJECTIVE: To report the successful management of end-stage hypercapnic

respiratory failure through the association of noninvasive mechanical ventilation and a novel automated device (Decapsmart) of low-flow veno-venous extracorporeal CO2 removal. DESIGN: Case report. SETTINGS: Pediatric intensive care unit at a tertiary care children's hospital. PATIENT: A pediatric patient affected by bronchiolitis obliterans with refractory hypercapnic respiratory failure. The patient received successful lung transplantation after respiratory support with noninvasive mechanical ventilation and a novel automated device of low-flow veno-venous extracorporeal CO2 removal. INTERVENTIONS: Treatment of end-stage hypercapnic respiratory failure with the association of noninvasive ventilation and low-flow veno-venous extracorporeal CO2 removal as a bridge to lung transplantation. MEASUREMENTS AND MAIN RESULTS: Respiratory support controlling hypercapnia, limiting volutrauma, barotraumas, and preventing the incidence of ventilator-associated pneumonia/lung colonization.
CONCLUSION(S): Noninvasive mechanical ventilation and Decapsmart have proven efficacious in managing refractory hypercapnic respiratory failure in a pediatric patient awaiting lung transplantation.
PMID
20051789 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20051789]
Institution
(Moscatelli, Ottonello, Nahum, Lampugnani, Puncuh, Simonini, Tumolo, Tuo) Istituto Giannina Gaslini, Department of Anesthesia and Intensive Care, Neonatal and Pediatric Intensive Care Unit, Genoa, Italy.

Link to the Ovid Full Text or citation:
Click here for full text options

434.

Serial use of an interventional lung assist device and a ventricular assist device.
Camboni D., Philipp A., Haneya A., Puehler T., Arlt M., Hilker M., Schmid F.X., Schmid C.
ASAIO journal (American Society for Artificial Internal Organs : 1992). 56 (3) (pp 270-272), 2010. Date of Publication: 2010 May-Jun.
AN: 359330392
A low-resistance membrane oxygenator [interventional lung assist (iLA), Novalung, Hirrlingen, Germany] has been placed in series with a pulsatile extracorporeal left ventricular assist device (LVAD, Berlin Heart EXCOR, Berlin, Germany) in 1 circuit in a patient with postcardiotomy cardiopulmonary failure subsequent to 5 days of extracorporeal life support (ECLS or ECMO). This concept offers an intermediate step between ECLS and mechanical ventilation in this particular patient population. Pulmonary function stabilized under the combined lung and ventricular support. As a result, mechanical ventilation became sufficient after 48 hours, and the iLA was then removed easily out of the circuit. In conclusion, this case demonstrates the feasibility of integrating a low-resistance membrane oxygenator for additional lung support in extracorporeal LVAD patients.
PMID
20335803 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20335803]
Institution
(Camboni) Department of Cardiothoracic Surgery, University Medical Center Regensburg, Regensburg, Germany.

Link to the Ovid Full Text or citation:
Click here for full text options

435.

Influence of different blood flows through a pumpless lung assist system on transpulmonary thermodilution-derived variables.
Mross M., Sakka S.G.
Intensive Care Medicine. 36 (2) (pp 369-370), 2010. Date of Publication: February 2010.
AN: 50653938
PMID
19779695 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19779695]
Institution
(Mros, Sakka) Department of Anesthesiology and Operative Intensive Care Medicine, University of Witten/Herdecke, Medical Center Cologne-Merheim, Ostmerheimerstr 200, 51109 Cologne, Germany
Publisher
Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

Link to the Ovid Full Text or citation:
Click here for full text options

436.

Extracorporeal CO2 removal.
Terragni P.P., Birocco A., Faggiano C., Ranieri V.M.
Contributions to nephrology. 165 (pp 185-196), 2010. Date of Publication: 2010.
AN: 359166709
The extracorporeal carbon dioxide removal (ECCO(2)R) concept, used as an integrated tool with conventional ventilation, plays a role in adjusting respiratory acidosis consequent to tidal volume (Vt) reduction in a protective ventilation setting. This concept arises from the extracorporeal membrane oxygenation (ECMO) experience. Kolobow and Gattinoni were the first to introduce extracorporeal support, with the intent to separate carbon dioxide removal from oxygen uptake; they hypothesized that to allow the lung to 'rest' oxygenation via mechanical ventilation could be dissociated from decarboxylation via extracorporeal carbon dioxide removal. Carbon dioxide is removed by a pump-driven modified ECMO machine with veno-venous bypass, while oxygenation is accomplished by high levels of positive end-expiratory pressure, with a respiratory rate of 3-5 breaths/min. The focus was that, in case of acute respiratory failure, CO(2) extraction facilitates a reduction in ventilatory support and oxygenation is maintained by simple diffusion across the patient's alveoli, called 'apneic oxygenation'. Concerns have been raised regarding the standard use of extracorporeal support because of the high incidence of serious complications: hemorrhage; hemolysis, and neurological impairments. Due to the negative results of a clinical trial, the extensive resources required and the high incidence of side effects, low frequency positive pressure ventilation ECCO(2)R was restricted to a 'rescue' therapy for the most severe case of acute respiratory distress syndrome (ARDS). Technological improvement led to the implementation of two different CO(2) removal approaches: the iLA called 'pumpless arteriovenous ECMO' and the veno-venous ECCO(2)R. They enable consideration of extracorporeal support as something more than mere rescue therapy; both of them are indicated in more protective ventilation settings in case of severe ARDS, and as a support to the

spontaneous breathing/lung function in bridge to lung transplant. The future development of more and more efficient devices capable of removing a substantial amount of carbon dioxide production (30-100%) with blood flows of 250-500 ml/min is foreseeable. Moreover, in the future ARDS management should include a minimally invasive ECCO(2)R circuit associated with noninvasive ventilation. This would embody the modern mechanical ventilation philosophy: avoid tracheal tubes; minimize sedation, and prevent ventilator-induced acute lung injury and nosocomial infections. 2010 S. Karger AG, Basel.
PMID
20427969 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20427969]
Institution
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Link to the Ovid Full Text or citation:
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437.

Extracorporeal CO2 removal--a way to achieve ultraprotective mechanical ventilation and lung support: the missing piece of multiple organ support therapy.
Gramaticopolo S., Chronopoulos A., Piccinni P., Nalesso F., Brendolan A., Zanella M., Cruz D.N., Ronco C.
Contributions to nephrology. 165 (pp 174-184), 2010. Date of Publication: 2010.
AN: 359166708
Extracorporeal therapies are able to sustain life through different mechanisms. This approach, called multiple organ support therapy, can in fact obtain blood purification by hemodialysis/hemofiltration to replace kidney function, temperature control, electrolyte and acid-base control to mimic homeostatic regulation of the kidney and circulation, fluid balance control to support the right hydration and cardiac performance, cardiac support removing cardiodepressant substances and equilibrating potassium levels, blood detoxification and liver support by coupled plasma filtration and adsorption or direct adsorption on blood (hemoperfusion), immunomodulation and endothelial support in the presence of sepsis by cutting the peaks of pro- and anti-inflammatory mediators, and immunoadsorption or adsorption of specific substances such as endotoxin. A missing piece of this group of therapies was the protective lung support. Today this is made possible by removal of CO(2) either by complete extracorporeal membrane oxygenation or by using decapneization in conjunction with hemofiltration in a system called DECAP/DECAPSMART. In conclusion, circulating blood outside the body and treating it with different filters or cartridges in a multiple organ support therapy may represent an important support for multiple organ dysfunction conditions induced by sepsis, acute respiratory distress syndrome and in recent times by complicated H1N1-related infections. 2010 S. Karger AG, Basel.
PMID
20427968 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20427968]
Institution
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Link to the Ovid Full Text or citation:
Click here for full text options

438.

Extracorporeal circulatory systems in the interhospital transfer of critically ill patients: Experience of a single instruction.
Haneya A., Philipp A., Foltan M., Mueller T., Camboni D., Rupprecht L., Puehler T., Hirt S., Hilker M., Kobuch R., Schmid C., Arlt M.
Annals of Saudi Medicine. 29 (2) (pp 110-114), 2009. Date of Publication: 2009.
AN: 355218760
Background and Objectives: Critically ill patients with acute circulatory failure cannot be moved to other institutions unless stabilized by mechanical support systems. Extracorporeal heart and lung assist systems are increasingly used as a bridge to end-organ recovery or transplantation, and as an ultimate rescue tool in cardiopulmonary resuscitation.
Patients and Methods: From July 2001 to April 2008, we had 38 requests for extracorporeal support for interhospital transfer carried out by the air medical service. Respiratory failure was present in 29 patients, who were provided with pumpless extracorporeal lung assist (PECLA) or veno-venous extracorporeal membrane oxygenation (ECMO). Cardiac failure dominated in 9 patients, who underwent implantation of extracorporeal life support (ECLS). Underlying diseases were acute respiratory distress syndrome in 15 patients, pneumonia in 7, prior lung transplant status in 4, cardiogenic shock in 7, and septic shock in 4.
Result(s): All assist systems were connected via peripheral vessels by the Seldinger technique. Transport was uneventful in all cases with no technical failures. On arrival at the specialized care hospital, two patients had leg ischemia and underwent relocation of the arterial cannula. After a mean (SD) support of 5.1 (3.0) days for PECLA, 3.5 (2.9) days for ECLS, and 7.3 (5.8) days for ECMO, 60%, 66%, and 66% of patients, respectively, could be successfully weaned from the systems. Discharge rates were 45% for PECLA, 44% for ECLS, and 56% for ECMO.
Conclusion(s): Our experience proves that minimized extracorporeal assist devices allow safe assistance of patients with isolated or combined heart and lung failure in need of interhospital transfer. Critically ill patients get a chance to reach a center of maximum medical care.
PMID
19318758 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19318758]
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Publisher
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439.

Air transport of patients with severe lung injury: Development and utilization of the acute lung rescue team.

Dorlac G.R., Fang R., Pruitt V.M., Marco P.A., Stewart H.M., Barnes S.L., Dorlac W.C.

Journal of Trauma - Injury, Infection and Critical Care. 66 (SUPPL. 4) (pp S164-S170), 2009. Date of Publication: April 2009.
AN: 355025209

BACKGROUND: Critical Care Air Transport Teams (CCATTs) are an integral component of modern casualty care, allowing early transport of critically ill and injured patients. Aeromedical evacuation of patients with significant pulmonary impairment is sometimes beyond the scope of CCATT because of limitations of the transport ventilator and potential for further respiratory deterioration in flight. The Acute Lung Rescue Team (ALRT) was developed to facilitate transport of these patients out of the combat theater.
METHOD(S): The United States TRANSCOM Regulation and Command/Control Evacuation System and the United States Army Institute of Surgical Research Joint Theater Trauma Registry databases were reviewed for all critical patients transported out of theater between November 2005 and March 2007. Patient demographics, diagnosis, and clinical history were abstracted and ALRT patients were compared with CCATT patients.
RESULT(S): The ALRT was activated for 11 patients during the study period. Five patients were transported as a result of these activations. Trauma-related diagnoses were responsible for 82% of these requests. ALRT missions comprised 0.6% of all critical patient movements out of the combat theater and 1% of ventilator transports. Average FIO2 was 0.92 +/- 0.11 for ALRT patients and 0.53 +/- 0.14 for CCATT patients (p = 0.005). ALRT patients required a mean positive end expiratory pressure of 19.0 cm H2O +/- 2.2 cm H2O compared with 6.5 cm H2O +/- 2.4 cm H2O in the CCATT group (p = 0.002).
CONCLUSION(S): Lung injury in the combat theater severe enough to exceed the capability of CCATT transport is uncommon. Patients for whom ALRT was activated had significantly higher positive end expiratory pressure and FIO2 than those transported by CCATT. One-fourth of patients for whom ALRT was considered died before the team could be launched; transport may have been a futile consideration in these patients. Patients with even severe acute respiratory distress syndrome can be successfully transported by experienced, equipped specialty teams.

PMID
19359961 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19359961]

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440.

Pumpless extracorporeal interventional lung assist in patients with acute respiratory distress syndrome: A prospective pilot study.
Zimmermann M., Bein T., Arlt M., Philipp A., Rupprecht L., Mueller T., Lubnow M., Graf B.M., Schlitt H.J.
Critical Care. 13 (1) (no pagination), 2009. Article Number: R10. Date of Publication: 30 Jan 2009.
AN: 354222849
Introduction: Pumpless interventional lung assist (iLA) is used in patients with acute respiratory distress syndrome (ARDS) aimed at improving extracorporeal gas exchange with a membrane integrated in a passive arteriovenous shunt. In previous studies, feasibility and safety of the iLA system was demonstrated, but no survival benefit was observed. In the present pilot study we tested the hypothesis that timely initiation of iLA using clear algorithms and an improved cannulation technique will positively influence complication rates and management of lung protective ventilation.

Method(s): iLA was implemented in 51 patients from multiple aetiologies meeting ARDS-criteria (American-European Consensus) for more than 12 hours. Initiation of iLA followed an algorithm for screening, careful evaluation and insertion technique. Patients with cardiac insufficiency or severe peripheral vascular disease were not considered suitable for iLA. Arterial and venous cannulae were inserted using a new strategy (ultrasound evaluation of vessels by an experienced team, using cannulae of reduced diameter). The incidence of complications and the effects on tidal volumes and inspiratory plateau pressures were primary outcome parameters, while oxygenation improvement and carbon dioxide removal capabilities were secondary study parameters.
Result(s): Initiation of iLA resulted in a marked removal in arterial carbon dioxide allowing a rapid reduction in tidal volume (<= 6 ml/kg) and inspiratory plateau pressure. Adverse events occurred in 6 patients (11.9%). The hospital mortality rate was 49%.
Conclusion(s): The use of an indication algorithm for iLA in early ARDS, combined with a refined application technique was associated with efficient carbon dioxide removal and a reduced incidence of adverse events. iLA could serve as an extracorporeal assist to support mechanical ventilation by enabling low tidal volume and a reduced inspiratory plateau pressure.
PMID
19183475 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19183475]
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441.

First experience with a paracorporeal artificial lung in humans.
Camboni D., Philipp A., Arlt M., Pfeiffer M., Hilker M., Schmid C.
ASAIO Journal. 55 (3) (pp 304-306), 2009. Date of Publication: May-June 2009.
AN: 355024700
Lung transplantation is the only treatment option for patients suffering form end-stage respiratory failure. To date, no mechanical device is available to support patients on the waiting list up to months. Here, we summarize our experience with our first two patients, who were supported with a paracorporeal artificial lung (PAL) placed in parallel to the pulmonary circulation with connection to the pulmonary artery and to the left atrium. A low resistance membrane oxygenator (iLA, Novalung, Hirrlingen, Germany) was attached in both patients. Our first patient suffering from a pulmonary veno-occlusive disease was supported for 18 days until he died due to severe sepsis. Our second patient with a primary pulmonary hypertension of unknown origin was supported 62 days followed by successful lung transplantation. In conclusion, the experience obtained with these first two patients under PAL encourages further studies and introduction of this promising concept into clinical practice.

PMID
19282751 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19282751]
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Publisher
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442.

Extracorporeal lung support technologies - Bridge to recovery and bridge to lung transplantation in adult patients.
Anonymous
Ontario Health Technology Assessment Series. 10 (5) (pp 1-47), 2010. Date of Publication: April 2010.
AN: 358921252
For cases of acute respiratory distress syndrome (ARDS) and progressive chronic respiratory failure, the first choice or treatment is mechanical ventilation. For decades, this method has been used to support critically ill patients in respiratory failure. Despite its life-saving potential, however, several experimental and clinical studies have suggested that ventilator-induced lung injury can adversely affect the lungs and patient outcomes. Current opinion is that by reducing the pressure and volume of gas delivered to the lungs during mechanical ventilation, the stress applied to the lungs is eased, enabling them to rest and recover. In addition, mechanical ventilation may fail to provide adequate gas exchange, thus patients may suffer from

severe hypoxia and hypercapnea. For these reasons, extracorporeal lung support technologies may play an important role in the clinical management of patients with lung failure, allowing not only the transfer of oxygen and carbon dioxide (CO 2) but also buying the lungs the time needed to rest and heal.
Objective(s): The objective of this analysis was to assess the effectiveness, safety, and cost-effectiveness of extracorporeal lung support technologies in the improvement of pulmonary gas exchange and the survival of adult patients with acute pulmonary failure and those with end-stage chronic progressive lung disease as a bridge to lung transplantation (LTx).The application of these technologies in primary graft dysfunction (PGD) after LTx is beyond the scope of this review and is not discussed. Clinical Applications of Extracorporeal Lung Support: Extracorporeal lung support technologies [i.e., Interventional Lung Assist (ILA) and extracorporeal membrane oxygenation (ECMO)] have been advocated for use in the treatment of patients with respiratory failure. These techniques do not treat the underlying lung condition; rather, they improve gas exchange while enabling the implantation of a protective ventilation strategy to prevent further damage to the lung tissues imposed by the ventilator. As such, extracorporeal lung support technologies have been used in three major lung failure case types: 1) As a bridge to recovery in acute lung failure - for patients with injured or diseased lungs to give their lungs time to heal and regain normal physiologic function. 2) As a bridge to LTx - for patients with irreversible end stage lung disease requiring LTx. 3) As a bridge to recovery after LTx - used as lung support for patients with PGD or severe hypoxemia. Ex-Vivo Lung Perfusion and Assessment Recently, the evaluation and reconditioning of donor lungs ex-vivo has been introduced into clinical practice as a method of improving the rate of donor lung utilization. Generally, about 15% to 20% of donor lungs are suitable for LTx, but these figures may increase with the use of ex-vivo lung perfusion. The ex-vivo evaluation and reconditioning of donor lungs is currently performed at the Toronto General Hospital (TGH) and preliminary results have been encouraging (Personal communication, clinical expert, December 17, 2009). If its effectiveness is confirmed, the use of the technique could lead to further expansion of donor organ pools and improvements in post-LTx outcomes. Extracorporeal Lung support Technologies: ECMO The ECMO system consists of a centrifugal pump, a membrane oxygenator, inlet and outlet cannulas, and tubing. The exchange of oxygen and CO2 then takes place in the oxygenator, which delivers the reoxygenated blood back into one of the patient's veins or arteries. Additional ports may be added for haemodialysis or ultrafiltration. Two different techniques may be used to introduce ECMO: venoarterial and venovenous. In the venoarterial technique, cannulation is through either the femoral artery and the femoral vein, or through the carotid artery and the internal jugular vein. In the venovenous technique cannulation is through both femoral veins or a femoral vein and internal jugular vein; one cannula acts as inflow or arterial line, and the other as an outflow or venous line. Venovenous ECMO will not provide adequate support if a patient has pulmonary hypertension or right heart failure. Problems associated with cannulation during the procedure include bleeding around the cannulation site and limb ischemia distal to the cannulation site. ILA Interventional Lung Assist (ILA) is used to remove excess CO2 from the blood of patients in respiratory failure. The system is characterized by a novel, low-resistance gas exchange device with a diffusion membrane composed of polymethylpentene (PMP) fibres. These fibres are woven into a complex configuration that maximizes the exchange of oxygen and CO2 by simple diffusion. The system is also designed to operate without the help of an external pump, though one can be added if higher blood flow is required. The device is then applied across an arteriovenous shunt between the femoral artery and femoral vein. Depending on the size of the arterial cannula used and the mean systemic arterial pressure, a blood flow of up to 2.5 L/min can be achieved (up to 5.5 L/min with an external pump). The cannulation is performed after intravenous administration of heparin. Recently, the first commercially available extracorporeal membrane ventilator (NovaLung GmbH, Hechingen, Germany) was approved for clinical use by Health Canada for patients in respiratory failure. The system has been used in more than 2,000 patients with

various indications in Europe, and was used for the first time in North America at the Toronto General Hospital in 2006. Evidence-Based Analysis The research questions addressed in this report are: 1. Does ILA/ECMO facilitate gas exchange in the lungs of patients with severe respiratory failure? 2. Does ILA/ECMO improve the survival rate of patients with respiratory failure caused by a range of underlying conditions including patients awaiting LTx? 3. What are the possible serious adverse events associated with ILA/ECMO therapy? To address these questions, a systematic literature search was performed on September 28, 2009 using OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, the Cumulative Index to Nursing & Allied Health Literature (CINAHL), the Cochrane Library, and the International Agency for Health Technology Assessment (INAHTA) for studies published from January 1, 2005 to September 28, 2008. Abstracts were reviewed by a single reviewer and, for those studies meeting the eligibility criteria, full-text articles were obtained. Reference lists were also examined for any additional relevant studies not identified through the search. Articles with an unknown eligibility were reviewed with a second clinical epidemiologist and then a group of epidemiologists until consensus was established. Inclusion Criteria Studies in which ILA/ECMO was used as a bridge to recovery or bridge to LTx Studies containing information relevant to the effectiveness and safety of the procedure Studies including at least five patients Exclusion Criteria Studies reporting the use of ILA/ECMO for interhospital transfers of critically ill patients Studies reporting the use of ILA/ECMO in patients during or after LTx Animal or laboratory studies Case reports Outcomes of Interest Reduction in partial pressure of CO2 Correction of respiratory acidosis Improvement in partial pressure of oxygen Improvement in patient survival Frequency and severity of adverse events The search yielded 107 citations in Medline and 107 citations in EMBASE. After reviewing the information provided in the titles and abstracts, eight citations were found to meet the study inclusion criteria. One study was then excluded because of an overlap in the study population with a previous study. Reference checking did not produce any additional studies for inclusion. Seven case series studies, all conducted in Germany, were thus included in this review (see Table 1). Also included is the recently published CESAR trial, a multicentre RCT in the UK in which ECMO was compared with conventional intensive care management. The results of the CESAR trial were published when this review was initiated. In the absence of any other recent RCT on ECMO, the results of this trial were considered for this assessment and no further searches were conducted. A literature search was then conducted for application of ECMO as bridge to LTx patients (January, 1, 2005 to current). A total of 127 citations on this topic were identified and reviewed but none were found to have examined the use of ECMO as bridge to LTx. Quality of Evidence To grade the quality of evidence, the grading system formulated by the GRADE working group and adopted by MAS was applied. The GRADE system classifies the quality of a body of evidence as high, moderate, low, or very low according to four key elements: study design, study quality, consistency across studies, and directness.
Result(s): Trials on ILA Of the seven studies identified, six involved patients with ARDS caused by a range of underlying conditions; the seventh included only patients awaiting LTx. All studies reported the rate of gas exchange and respiratory mechanics before ILA and for up to 7 days of ILA therapy. Four studies reported the means and standard deviations of blood gas transfer and arterial blood pH, which were used for meta-analysis. Fischer et al. reported their first experience on the use of ILA as a bridge to LTx. In their study, 12 patients at high urgency status for LTx, who also had severe ventilation refractory hypercapnea and respiratory acidosis, were connected to ILA prior to LTx. Seven patients had a systemic infection or sepsis prior to ILA insertion.
Publisher
Medical Advisory Secretariat

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443.

Double ECMO in severe ARDS: Report of an outstanding case and literature review.
Litmathe J., Dapunt O.
Perfusion. 25 (6) (pp 363-367), 2010. Date of Publication: November 2010.
AN: 360073582
We report on a 49-year-old male patient who suffered from severe herpes simplex (HSV) pneumonia after a fall-from-height injury, causing a circumscript type B aortic dissection.The subsequent occurrence of ARDS required a veno-venous ECMO circuit that was upgraded to a veno-arterial system due to further oxygenation deficits. Following continued respiratory deterioration, the ECMO system already in place had to be complemented by a second veno-arterial line. After the onset of recovery and because of a developing of a disseminated intravasal coagulation, the double ECMO circuit was replaced by a pumpless extracorporeal lung assist system (PECLA). The patient recovered completely under systemic virostatic therapy. © The Author(s) 2010.
PMID
20696738 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20696738]
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Publisher
SAGE Publications Ltd (55 City Road, London EC1Y 1SP, United Kingdom)

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444.

ECMO and ARDS-therapy an update. Die ECMO in der ARDS-Therapie Ein Update <Die ECMO in der ARDS-Therapie Ein Update.>
Moller T., Vassiliou T., Rolfes C., Wulf H.
Anasthesiologie Intensivmedizin Notfallmedizin Schmerztherapie. 45 (9) (pp 544-550), 2010. Date of Publication: 2010.
AN: 359608761
The Acute Respiratory Distress Syndrome (ARDS) is a life threatening disease and is associated with a high mortality, mainly due to multi-organ failure. Invasive mechanical ventilation can worsen multi-organ failure which must be avoided. A tidal volume of 6 ml/kg bodyweight should be the aim. Extracorporeal lung assist devices like ECMO or iLA can contribute to lung-protective mechanical ventilation. © Georg Thieme Verlag KG Stuttgart.
PMID
20839142 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20839142]
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Publisher
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445.

Ventilatory support for acute respiratory failure: New and ongoing pathophysiological, diagnostic and therapeutic developments.
Del Sorbo L., Slutsky A.S.
Current Opinion in Critical Care. 16 (1) (pp 1-7), 2010. Date of Publication: February 2010.
AN: 358176563
Purpose of review: Acute respiratory failure and its most severe form, the acute respiratory distress syndrome, are relatively common in the ICU setting and have a high morbidity and mortality. This article will discuss ongoing research in this area, with a focus on relatively novel approaches in terms of pathophysiology, diagnosis and therapeutic advancements. Recent findings: Several novel diagnostic and therapeutic tools, such as electrical impedance tomography, high frequency oscillatory ventilation, minimally invasive extracorporeal CO2 removal devices and neurally adjusted ventilatory assist, have recently been studied to minimize ventilator-induced lung injury. A brief review of these studies is presented in this article. Summary: It is increasingly evident that only integration of physiological, clinical and technological approaches will lead to improvement in the outcome of patients with acute respiratory failure. © 2010 Wolters Kluwer Health
Lippincott Williams & Wilkins.
PMID
19952735 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19952735]
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446.

Extracorporeal support as a bridge to lung transplantation.
Strueber M.
Current Opinion in Critical Care. 16 (1) (pp 69-73), 2010. Date of Publication: February 2010.
AN: 358176573
Purpose of review: Allocation of grafts for lung transplantation has been directed in many countries to patients in life-threatening conditions. Advances in technology for extracorporeal devices led to new concepts and increased use for bridging to lung transplantation. Taking these two developments into account, it seems that bridging technologies are used more frequently around the world. Recent findings: The

durability of extracorporeal devices for some weeks was described in many institutional and case reports. The change in technology seems to open a new era of possibilities. Use of this new technology not only in bridge to transplant but also as a bridge to recovery in acute respiratory distress syndrome patients was published most recently. Current and future use of extracorporeal gas exchange as an alternative to mechanical ventilation appears in the literature. Use of low resistance membranes in patients with pulmonary hypertension was described as a new therapeutical option.
Summary: Bridge to lung transplantation is of increasing importance with new allocation systems and the increasing demand. New extracorporeal technologies address this demand with reliable function for some weeks. But these developments also raise ethical questions of how to use these new tools wisely individually and also collectively for the field of lung transplantation. © 2010 Wolters Kluwer Health Lippincott Williams & Wilkins.
PMID
19952734 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19952734]
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Publisher
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447.

Pulmonary/renal interaction.
Ricci Z., Ronco C.
Current Opinion in Critical Care. 16 (1) (pp 13-18), 2010. Date of Publication: February 2010.
AN: 358176565
Purpose of review: Acute kidney injury contributes to the development of acute lung injury and vice-versa. Volume overload that may occur during renal impairment increases pulmonary capillary hydrostatic pressure. However, experimental evidence clearly shows that lung damage occurs even in the absence of positive fluid balance. However, acute lung injury with its attendant hypoxemia, hypercapnia and mechanical ventilation worsens renal hemodynamics and function. Recent findings: An increasing body of evidence suggests that kidney and lung interact (crosstalk) during severe insults, such as shock, trauma, and sepsis, due to a loss of the normal balance of immune, inflammatory and soluble mediators. Kidney-lung crosstalk in the critically ill constitutes a possibility to analyze mechanisms of multiple organ failure in which the kidney and the lung can play an important role. Consequently, on the clinical side, specific therapeutic options can be hypothesized for kidney/lung dysfunction.
Summary: Fluid management optimization and prevention of inflammation and lung stretching are currently recommended for the treatment of acute lung and renal injury. Extracorporeal CO2 removal and renal replacement associated with extracorporeal membrane oxygenation might be interesting options for a future approach to pulmonary/renal syndrome. © 2010 Wolters Kluwer Health Lippincott Williams & Wilkins.
PMID
19935063 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19935063]

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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

448.

Carbon dioxide dialysis will save the lung.
Pesenti A., Patroniti N., Fumagalli R.
Critical Care Medicine. 38 (10 SUPPL.) (pp S549-S554), 2010. Date of Publication: October 2010.
AN: 360195160
Mechanical ventilation and ventilator-associated lung injury could be avoided by decreasing the ventilatory needs of the patient by extracorporeal carbon dioxide removal. The reasons for the increased ventilatory needs of the patients with acute respiratory distress syndrome are outlined, as well as some of the mechanisms of continuing damage. Extracorporeal gas exchange has been used mainly as a rescue procedure for severely hypoxic patients. Although this indication remains valid, we propose that extracorporeal carbon dioxide removal could control the ventila-tory needs of the patient and allow the maintenance of spontaneous breathing while avoiding intubation and decreasing the concurrent sedation needs. A scenario is depicted whereby an efficient carbon dioxide removal device can maintain blood gas homeostasis of the patient with invasiveness comparable to he-modialysis. High carbon dioxide removal efficiency may be achieved by combinations of hemofiltration and metabolizable acid loads. Copyright © 2010 by the Society of Critical Care Medicine and Lippincott Williams & Wilkins.
PMID
21164396 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21164396]
Institution
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

449.

We do not need mechanical ventilation any more.
Del Sorbo L., Ranieri V.M.
Critical Care Medicine. 38 (10 SUPPL.) (pp S555-S558), 2010. Date of Publication:

October 2010.
AN: 360195161
Mechanical ventilation is a lifesaving treatment delivered to patients with a wide spectrum of medical and surgical diseases. However, significant limitations of the clinical application of mechanical ventilation in current practice have emerged, prompting the definition of novel therapeutic perspectives, especially concerning the prevention and treatment of acute respiratory failure. In the past few decades, there has been a consistent scientific and technologic effort to develop alternative strategies to avoid the need for mechanical ventilation. In particular, several studies have explored the feasibility and efficacy of extracorporeal oxy-genation and carbon dioxide removal. Furthermore, promising results on the prevention of the occurrence of severe acute respiratory failure have been provided by clinical studies on the noninvasive application of continuous positive airway pressure as well as by experimental investigations in basic science. Therefore, further development in this direction will occur only with a permanent integration and exchange of knowledge among industry, clinicians, and scientific investigators. (Crit Care Med 2010;

PMID
21164397 [http://www.ncbi.nlm.nih.gov/pubmed/?term=21164397]
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Publisher
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450.

Successful treatment of a severely injured soldier from Afghanistan with pumpless extracorporeal lung assist and neurally adjusted ventilatory support.
Bein T., Osborn E., Hofmann H.S., Zimmermann M., Philipp A., Schlitt H.J., Graf B.M.
International Journal of Emergency Medicine. 3 (3) (pp 177-179), 2010. Date of Publication: September 2010.
AN: 50990021
Background Life-threatening acute lung injury due to combat and/or terror attacks is associated with high mortality. The successful management includes the use of "rescue" extracorporeal lung assist and early transport by aeromedical evacuation teams. Aims Description of the pre-hospital support of a severely injured soldier with a pumpless extracorporeal arteriovenous lung assist in critical hypercapnia/hypoxemia. Method A British soldier suffered fromsevere gunshot injuries to the chest and abdomen in Afghanistan. After traumatic pneumonectomy, he developed critical hypercapnia/hypoxemia. He was mechanically ventilated and supported with a pumpless interventional extracorporeal lung assist (iLA, Novalung, Talheim, Germany) and transferred to Germany. Results A sufficient CO2 extraction and improvement in oxygenation enabled the safe transportation and lung protective ventilation. Weaning from mechanical ventilation was promoted by the application of a new neurally adjusted ventilatory assist (NAVA). The patient recovered, and he left Germany in stable condition. Conclusion Novel techniques in extracorporeal lung assist and in ventilatory support may help save lives even in disaster medicine. ©

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Publisher
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451.

Thoracic Surgical Procedures Supported by a Pumpless Interventional Lung Assist.
Wiebe K., Poeling J., Arlt M., Philipp A., Camboni D., Hofmann S., Schmid C.
Annals of Thoracic Surgery. 89 (6) (pp 1782-1788), 2010. Date of Publication: June 2010.
AN: 358819820
Background: For support of pulmonary function during complex thoracic surgical procedures, especially in respiratory compromised patients, a pumpless interventional lung assist (iLA) was applied. Feasibility and effectiveness for this novel indication were evaluated.
Method(s): Ten patients underwent thoracic surgery with respiratory support by iLA. Indication for iLA application was the need for intraoperative prolonged discontinuation of ventilation (tracheal surgery and lung resections after pneumonectomy [n = 6], and emergency procedures in patients with acute respiratory failure [n = 4]. The pumpless extracorporeal system was inserted percutaneously into the femoral blood vessels before surgery. Blood flow through the iLA, cardiac output, and gas exchange were monitored.
Result(s): In all patients, the surgical procedure was successfully performed because of the support by the pumpless iLA. Mean blood flow across the iLA was 1.58 +/- 0.3 L/min (1.2 L/min to 2.2 L/min). Low-dose norepinephrine was required to maintain sufficient systemic blood pressure. There was a moderate improvement in oxygenation (49 mL/min transfer of O2) and a very efficient elimination of carbon dioxide (121 mL/min transfer of CO2). Thus, extended periods of apneic oxygenation were possible during surgery. The device was removed immediately after surgery in 6 patients. In 4 patients with severe respiratory insufficiency, the iLA was continued for a mean of 6.8 days to allow for protective postoperative ventilation.
Conclusion(s): The application of pumpless iLA was hemodynamically well tolerated, and allowed for safe procedures in respiratory compromised patients, avoiding the application and consequences of cardiopulmonary bypass or pump-driven extracorporeal membrane oxygenation. © 2010 The Society of Thoracic Surgeons.
PMID
20494028 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20494028]
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Publisher
Elsevier USA (6277 Sea Harbor Drive, Orlando FL 32862 8239, United States)

452.

Combination of high frequency oscillatory ventilation and interventional lung assist in severe acute respiratory distress syndrome.
Lubnow M., Luchner A., Philipp A., Buchner S., Jeron A., Karagiannidis C., Bein T., Pawlik M., Jungbauer C., Schmid C., Riegger G.A.J., Pfeifer M., Muller T.
Journal of Critical Care. 25 (3) (pp 436-444), 2010. Date of Publication: September 2010.
AN: 50763820
Background: The combination of high-frequency oscillatory ventilation (HFOV) and extracorporeal carbon dioxide removal with the interventional lung assist (iLA) in severe acute respiratory distress syndrome (ARDS) represents a novel treatment option.
Method(s): The study used a retrospective single-center analysis of 21 consecutive adult patients with severe ARDS, ventilated with HFOV/iLA. Efficiency, side effects, and outcome of combined treatment are presented as median (interquartile range).
Measurements and Main Results: The following were used to determine patient characteristics: sequential organ failure assessment score, 14; simplified acute physiology score II, 41; and Murray score, 4. The duration of combined treatment was 6 days. The blood flow through the iLA was 1.9 L/min. The Pao2/inspired fraction of oxygen ratio increased from 61 (47-86) to 98 (67-116) within 2 hours and to 106 (70-135) mm Hg at 24 hours. Paco2 decreased from 58 (50-76) to 37 (29-47) mm Hg at 2 hours with normalization of pH 7.28 (7.16-7.36) to 7.43 (7.33-7.49) after 2 hours associated with hemodynamic stabilization. In 6 patients, complications due to iLA treatment were observed, and in 3 patients, complications associated with HFOV were seen. Weaning from HFOV/iLA was successful in 10 patients. The 30-day mortality rate was 43%, and hospital mortality rate was 57%.
Conclusion(s): The combination of HFOV/iLA is an option in severe pulmonary failure if conventional ventilation fails and pumpdriven extracorporeal membrane oxygenation therapy is not available. © 2010 Elsevier Inc.
PMID
20074908 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20074908]
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Publisher
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453.

Extracorporeal lung support for patients who had severe respiratory failure secondary to influenza A (H1N1) 2009 infection in Canada.
Freed D.H., Henzler D., White C.W., Fowler R., Zarychanski R., Hutchison J., Arora R.C., Manji R.A., Legare J.-F., Drews T., Veroukis S., Kesselman M., Guerguerian A.-M., Kumar A.
Canadian Journal of Anesthesia. 57 (3) (pp 240-247), 2010. Date of Publication: March 2010.
AN: 50767106
Background: From March to July 2009, influenza A (H1N1) 2009 (H1N1-2009) virus emerged as a major cause of respiratory failure that required mechanical ventilation. A small proportion of patients who had this condition developed severe respiratory failure that was unresponsive to conventional therapeutic interventions. In this report, we describe characteristics, treatment, and outcomes of critically ill patients in Canada who had H1N1-2009 infection and were treated with extracorporeal lung support (ECLS).
Method(s): We report the findings of a case series of six patients supported with ECLS who were included in a cohort study of critically ill patients with confirmed H1N1-2009 infection. The patients were treated in Canadian adult and pediatric intensive care units (ICUs) from April 16, 2009 to August 12, 2009. We describe the nested sample treated with ECLS and compare it with the larger sample.
Result(s): During the study period, 168 patients in Canada were admitted to ICUs for severe respiratory failure due to confirmed H1N1-2009 infection. Due to profound hypoxemia unresponsive to conventional therapeutic interventions, six (3.6%) of these patients were treated with ECLS in four ICUs. Four patients were treated with veno-venous pump-driven extracorporeal membrane oxygenation (vv-ECMO), and two patients were treated with pumpless lung assist (NovaLung iLA). The mean duration of support was 15 days. Four of the six patients survived (66.6%), one of the surviving patients was supported with iLA and the other three surviving patients were supported with ECMO. The two deaths were due to multiorgan failure, which occurred while the patients were on ECLS.
Interpretation(s): Extracorporeal lung support may be an effective treatment for patients who have H1N1-2009 infection and refractory hypoxemia. Survival of these patients treated with ECLS is similar to that reported for patients who have acute respiratory distress syndrome of other etiologies and are treated with ECMO. © Canadian Anesthesiologists' Society 2010.
PMID
20082167 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20082167]
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454.

Extracorporeal lung assist in severe respiratory failure and ARDS. Current situation and clinical applications. Asistencia respiratoria extracorporea en la insuficiencia respiratoria grave y el SDRA. Situacion actual y aplicaciones clinicas <Asistencia respiratoria extracorporea en la insuficiencia respiratoria grave y el SDRA. Situacion actual y aplicaciones clinicas.>
Gomez-Caro A., Badia J.R., Ausin P.
Archivos de Bronconeumologia. 46 (10) (pp 531-537), 2010. Date of Publication: October 2010.
AN: 50956903
Despite improvements in ventilation support techniques, lung protection strategies, and the application of new support treatment, acute respiratory distress syndrome continues to have a high mortality rate. Many strategies and treatments for this syndrome have been investigated over the last few year. However, the only therapeutic measure that has systematically shown to be able to improve survival is that of low volume lung protective ventilation. Thus, using a low tidal volume prevents added lung damage by the same mechanical ventilation that is essential for life support. In this context, the use of extracorporeal lung assist systems is considered an exceptional use rescue treatment in extreme cases. On the other hand, it could be a potentially useful complementary method for an ultra-protective ventilation strategy, that is, by using even lower tidal volumes. The currently available extracorporeal lung assist systems are described in this article, including high flow systems such as traditional extracorporeal membrane oxygenation, CO2 removal systems (interventional lung assist or iLA, with or without associated centrifugal pumps), and the new low flow and less invasive systems under development. The aim of this review is to update the latest available clinical and experimental data, the indications for these devices in adult respiratory distress syndrome (ARDS), and their potential indications in other clinical situations, such as the bridge to lung transplantation, multiple organ dysfunction syndrome, or COPD. © 2010 SEPAR.
PMID
20937437 [http://www.ncbi.nlm.nih.gov/pubmed/?term=20937437]
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(Ausin) Servicio de Neumologia, Hospital del Mar-IMIM. CIBERES, ISC III Barcelona, Universidad de Barcelona, CIBER de enfermedades respiratorias CIBERES, Spain
Publisher
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455.

Successful bilateral lung transplantation after previously performed right-sided pneumonectomy.

Ris H., Krueger T., Gonzalez M., Ferrari E., Chollet M., Mazza Stalder J., Aubert J.
Interactive Cardiovascular and Thoracic Surgery. Conference: 24th Annual Meeting of the European Association for Cardio-Thoracic Surgery, EACTS 2010. Geneva Switzerland. Conference Publication: (var.pagings). 11 (SUPPL. 2) (pp S124), 2010. Date of Publication: September 2010.
AN: 71685367
Objectives: To present the feasibility of a bilateral lung transplantation after previously performed pneumonectomy.
Method(s): A 35-year-old female patient underwent right-sided pneumonectomy for post-tuberculosis-related destroyed lung. She then developed a vascular post-pneumonectomy syndrome and underwent realigning of the mediastinum by a mammary prosthesis but developed chronic adult respiratory distress syndrome (ARDS) of the remaining left lung requiring tracheostomy, long-term ventilation and finally the implantation of a Novalung device. She was listed as super-emergency for lung transplantation. The patient underwent bilateral lung transplantation. Via clamshell incision, the post-pneumonectomy cavity was dissected and the superior vena cava (SVC) and carina were exposed. A longitudinal median pericardiotomy was performed followed by right-sided pericardectomy. The pulmonary vessel stumps were dissected intrapericardially. The right pulmonary artery (PA) was clamped between the SVC and the ascending aorta. Extracorporeal circulation (ECC) was installed after cannulation of the aorta and the inferior vena cava. An upper lobe sleeve resection of the donor lung was performed. The intermediate bronchus was sutured end-to-side to the dissected recipient carina. Tension-free end-to-end anastomosis of the PA and the atrial cuffs was performed by retraction of the SVC and by realising an extended hilar release manoeuvre, respectively. Satisfactory right graft function allowed the removal of ECC, decannulation and standard transplantation of the left lung.
Result(s): Bronchoscopy and transoesophageal echocardiography demonstrated a patent airway and vascular anastomosis, respectively. Follow-up was satisfactory with excellent gas exchange, progressive weaning, and satisfactory anastomotic airway healing.
Conclusion(s): This is to our knowledge the first report of a successful bilateral lung transplantation after pneumonectomy.
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Publisher
Oxford University Press

456.

Extracorporeal lung assist for respiratory failure in patients with pandemic h1n1 influenza virus.
Wagner S., Iber T., Bingold T., Moritz A., Zacharowski K., Papadopoulos N.
Interactive Cardiovascular and Thoracic Surgery. Conference: 24th Annual Meeting of the European Association for Cardio-Thoracic Surgery, EACTS 2010. Geneva

Switzerland. Conference Publication: (var.pagings). 11 (SUPPL. 2) (pp S98-S99), 2010. Date of Publication: September 2010.
AN: 71685270
Objectives: To describe treatment options and outcome of adult patients hospitalised with pandemic H1N1 influenza.
Method(s): We report case series findings of seven H1N1 infected patients, admitted to our intensive care unit (ICU).
Result(s): Seven patients with severe respiratory failure associated with pandemic H1N1 influenza virus (and secondary superinfection) were admitted to our ICU and referred for extracorporeal lung assist (ECLA). Five patients could be treated with special mechanical ventilation [superimposed high frequency jet ventilation (SHFJV)]. During the SHFJV treatment, three of these patients needed an ECLA [two interventional lung assist (ILA), one venovenous extracorporeal membrane oxygenation (vv-ECMO)]; two of these patients died (cause of death of vv-ECMO patient, cerebral haemorrhage). One other patient only treated with SHFJV died. Two of the seven patients received exclusive ILA or ECMO (one ILA, one vv-ECMO). Both patients survived. Overall, four of seven H1N1 infected patients survived (57%) and 50% of patients treated with ECLA survived.
Conclusion(s): ECLA is an established therapeutic option for patients with severe respiratory failure. Therefore, ECLA may be an effective treatment for patients who have H1N1 infection-induced acute respiratory distress syndrome and may successfully rescue these severely ill patients. The treatment with SHFJV and ILA in combination seems to be an alternative to ECMO and is less invasive in treatment of severe respiratory failure.
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Publisher
Oxford University Press

457.

Use of pumpless extracorporeal interventional lung assist devices (PEILADs) in patients with H1N1 type a influenza.
Johnson P., Westbrook A.
Irish Journal of Medical Science. Conference: Sylvester O'Halloran Meeting 2010. Limerick Ireland. Conference Publication: (var.pagings). 179 (SUPPL. 1) (pp S42), 2010. Date of Publication: February 2010.
AN: 71326454
The recent H1N1 pandemic is causing severe ARDS in some patients. PEILADs have been used in two of our patients with improvements in hypercapnia and acidosis. Mr V, a morbidly obese 30-year-old gentleman developed severe H1N1 ARDS. He was started on high frequency oscillatory ventilation (HFOV) but rapid development of pneumothoraces, pneumomediastinum, and worsening haemodynamic instability ensued. Extracorporeal Membrane Oxygenation (ECMO) was not available. The right femoral artery and vein were cannulated percutaneously, but poor flow necessitated transfer to theatre for line manipulation by vascular surgeons under fluoroscopy. PEILAD then provided improved pH and pCO2. After 2 weeks the arterial line became dislodged. There was significant blood loss, a

pseudo-aneurysm occurred at the site and a haematoma developed. Mr O'R, a 57-year-old gentleman with multiple myeloma developed ARDS from H1N1 flu and became progressively difficult to ventilate. PEILAD was instituted instead of progression to HFOV. This was successful in improving his pH and PCO2 and the femoral lines remained in situ until they became uneventfully dislodged. PEILADs appear to offer improved carbon dioxide removal and enable utilisation of less aggressive ventilation strategies. They have been used as salvage therapy, but may be of benefit in preventing ventilator-induced lung injury when introduced earlier. This may be of benefit to patients with viral pneumonitis, especially during pandemics when alternative ECMO resources are overwhelmed. These devices have been used successfully but our experience has demonstrated the importance of: * staff education * vigilance for potential complications * support from vascular surgeons.
Institution
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Publisher
Springer London

458.

Outcomes among pandemic 2009 novel H1N1 influenza patients fulfilling historical criteria for extracorporeal membrane oxygenation (ECMO): Salt lake county experience.
Crossno P.F., Miller III R.R., Dean N.C., Morris A.H., Markewitz B.A.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2010. New Orleans, LA United States. Conference Publication: (var.pagings). 181 (1 MeetingAbstracts) (no pagination), 2010. Date of Publication: 01 May 2010.
AN: 70844359
Rationale: Severe hypoxemia among critically ill patients with 2009 novel H1N1 infection has renewed interest in extracorporeal membrane oxygenation (ECMO) as a rescue therapy. As prior randomized controlled studies have not shown a significant effect on mortality in a traditional lung injury population, the relevance of ECMO to current H1N1 influenza pneumonia patients is unknown. It is unclear how many patients with H1N1 influenza pneumonia would qualify for ECMO using historical entry criteria outlined in the ECMO trial by Zapol et al. in 1979 and later in the ECCO2R trial by Morris et al. Data from patients with acute lung injury from H1N1 influenza admitted to 4 intensive care units (ICU) at 3 hospitals in Salt Lake County between May and June 2009 were reviewed to evaluate outcomes among those meeting ECMO entry criteria.
Method(s): Clinical data from 37 critically ill H1N1 influenza patients from Salt Lake County were compared to historic ECMO entry criteria from Zapol et al. The "slow-entry" inclusion criterion from that publication was defined as PaO2 <50 mmHg for more than 12 hours when measured at FiO2 of 0.6 and PEEP >=5 cm H20. In this retrospective analysis, patients were not actively being qualified by the original ECMO criteria. Therefore, we used a comparable surrogate, the PaO2/FiO2 ratio of 83 (i.e., PaO2 50 mmHg/FiO2 0.6) for our analysis. Historical study exclusion criteria were then applied. Clinical outcomes, including survival, length of stay, and duration of ventilation were noted.
Result(s): of 37 patients, 19 (51%) qualified for ECMO by surrogate entry criteria (PaO2/FiO2 <83) and received low tidal volume ventilation (usual care). of this group, 5 patients were excluded (3 for severe neurological injury, 1 for death within 8 hours,

and 1 for severe cardiomyopathy). In the remaining 14 patients, mean PaO2/FiO2 ratio within the first 48h was 56 (standard deviation +/-9), 9 (64%) were female, and the mean age was 28 years (+/-10). Mean duration of ventilation was 16.2 days (+/-10.7). Mean ICU and hospital lengths of stay (LOS) were 22.2 days (+/-16.6) and 27.3 days (+/-20.7). Mortality was 21%.
Conclusion(s): Fourteen patients with acute lung injury due to H1N1 influenza infection met historical ECMO entry criteria with an overall mortality of 21%. These data from a small, Salt Lake County case series demonstrate comparable mortality, ICU LOS, and hospital LOS to recently published data from ANZ ECMO investigators despite not using ECMO.
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(Markewitz) University of Utah, Salt Lake City, UT, United States
Publisher
American Thoracic Society

459.

Efficacy of extracorporeal CO2 removal with the hemolung: Results in animals.
Burki N., Bieniek P., Federspiel W., Morley S., Ochs B., Wearden P.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2010. New Orleans, LA United States. Conference Publication: (var.pagings). 181 (1 MeetingAbstracts) (no pagination), 2010. Date of Publication: 01 May 2010.
AN: 70842870
Rationale Hypercapnic respiratory failure commonly occurs in moderate to severe Chronic Obstructive Pulmonary Disease (COPD) and is frequently treated with intubation and mechanical ventilation. This treatment carries a significant morbidity of its own, including laryngeal trauma, pneumonia, and lung injury. In order to avoid this, an alternative technique has been developed to assist with CO2 removal: the Hemolung is an integrated pump/oxygenator that functions at low blood flow rates (350-500 mL/min) equivalent to those used in renal dialysis. It achieves gas exchange with a reduced membrane surface area (0.59 m2), requires only a small priming volume (280 ml), and utilizes a single, percutaneously inserted dual lumen venous catheter (15 Fr) to provide blood inflow and outflow. We report here studies of the hemocompatibility and gas exchange capabilities of the device in sheep over an 8 day period. Methods In 8 healthy adult sheep, the venous catheter was inserted into the right external jugular vein, and connected to the saline-primed Hemolung circuit. The animals were free to sit or stand throughout the the study. Minimal anticoagulation was maintained with intravenous heparin (aPTT 46 - 70 seconds). Blood flow through the circuit, CO2 removal, blood gases and key hematological parameters were measured over 8 days. Necropsy was performed on termination. Organ samples were taken for histopathology. Results All sheep remained normocapnic (venous PCO2 35-45 mmHg) throughout the study. Six of the eight sheep remained on the device for the full 8 days. In two sheep the Hemolung catheter was accidently dislodged causing a premature cessation of treatment. No animals died unexpectedly during the study, and the Hemolung treatment was generally well tolerated. CO2 removal through the Hemolung remained steady over 8 days averaging 42 to 73 mL/min at blood flows of 350 to 450 mL/min. No devices

failed or required replacement. No significant changes from baseline were noted in body temperature, plasma free hemoglobin, hematocrit, peripheral WBC or platelet count; liver enzymes at the end of the 8 days were not significantly different from baseline. Necropsy showed no signs of thromboembolism or organ damage, and histopathology was unremarkable. (Figure presented) Conclusion The Hemolung appears to be a safe and effective CO2 removal device in animals and has the potential to provide a simple alternative to mechanical ventilation for patients with COPD and hypercapnic respiratory failure. Human trials are currently underway to determine what role extracorporeal CO2 removal will have in this patient population.
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Publisher
American Thoracic Society

460.

Limited veno-venous extracorporeal carbon dioxide removal for severe primary graft dysfunction after lung transplantation.
Lynch J.E., Valentine V.G., Lick S.D., Ates R., Cardenas V.J.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2010. New Orleans, LA United States. Conference Publication: (var.pagings). 181 (1 MeetingAbstracts) (no pagination), 2010. Date of Publication: 01 May 2010.
AN: 70840529
Severe primary graft dysfunction (PGD) following lung transplantation (LT) correlates with poor outcomes at one year. The use of extracorporeal membrane oxygenation (ECMO) is increasingly being used before and after LT. This report describes the successful intervention of limited veno-venous extracorporeal carbon dioxide removal (VVCO2R) for severe PGD after bilateral-sequential LT. A 35-year-old Hispanic female underwent bilateral LT for idiopathic pulmonary fibrosis. Her intraoperative course was complicated by prolonged cardiopulmonary bypass and resection of both lungs with left upper lobectomy for size discrepancy. Increasing oxygen requirements, marked reduction in lung compliance and tamponade-like circulatory physiology were noted towards the end of the intraoperative course. As a result, the mediastinum remained unclosed with just skin approximation with sutures. She was transferred to the ICU requiring 100% fractional inspired oxygen and 20 cm H2O of PEEP with an arterial oxygen tension no > 37 mm Hg over four hours. Norepinephrine and vasopressin were given to maintain a mean arterial blood pressure above 55 mm Hg. To reduce the mean airway pressures, improve bronchial blood flow around the anastomoses, and minimize ventilator-induced lung injury; A 19 F double-lumen vascular cannula (AVALON Elite) was inserted percutaneously through the right internal jugular vein. The circuit comprises a small centrifugal pump (Rotaflo Jostra), a compact gas exchanger (Quadrox D , Jostra), and heparin bonded tubing connected to the cannula and primed with normal saline (prime volume <300 cc's) with blood flow initiated slowly up to a maximum, 1.8 L/min. Management included limited anticoagulation (aPTT 60-100) and limited blood flow with a primary goal to reduce mean airway pressures while maintaining acceptable oxygenation and acid-base homeostasis. Within 24 hours, ventilatory and

vasopressor needs were reduced. Despite profound thrombocytopenia (< 10,000 mm3), no bleeding complications were seen. After 88 hours of support, she was transitioned from VVCO2R to conventional mechanical ventilation (Table 1). (Table Presented) This is the first report using VVCO2R in the immediate postoperative period for severe PGD. This circuit is simple, requires no blood priming and can be instituted in minutes. New cannula technology permits less recirculation allowing for lower blood flow to achieve carbon dioxide removal. This system provides a bridge to recovery for patients with catastrophic acute respiratory failure by reducing lung injury and improving gas exchange.
Institution
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Publisher
American Thoracic Society

461.

Use of the novalung interventional lung assist (iLA) in a patient with ARDS and traumatic brain injury due to polytrauma.
Segaren N., Downey K., Creagh-Brown B.C., Cordingley J.
American Journal of Respiratory and Critical Care Medicine. Conference: American Thoracic Society International Conference, ATS 2010. New Orleans, LA United States. Conference Publication: (var.pagings). 181 (1 MeetingAbstracts) (no pagination), 2010. Date of Publication: 01 May 2010.
AN: 70840525
Introduction ARDS is a serious complication following polytrauma and is associated with substantial risk of death. ARDS is partially an iatrogenic disease caused by ventilator associated lung injury (VALI). In an effort to reduce VALI, lung protective ventilation (LPV) is advocated for all patients at risk of ARDS, as well as those with established ARDS. The Novalung interventional lung assist (iLA) provides extracorporeal CO2 removal and facilitates LPV. Case An 18 year old man sustained multiple injuries having fallen from the 7th floor of his apartment block. Initial management included tracheal intubation, mechanical ventilation, spinal immobilization, fluid resuscitation (41 units RBC in the first 24h), clotting factors, and placement of a left-sided pleural drain. Thoraco-abdominal injuries included a left sided haemo-pneumothorax with associated pulmonary laceration, ruptured hemidiaphragm, ruptured spleen and stomach. Imaging of the head revealed changes compatible with diffuse axonal injury (insert Figure 1) Immediately after damage control surgery and massive transfusion he had ARDS which improved over the following days until he developed septic shock complicated by recurrence of ARDS (Figure 1) due to infected haematoma in his pleural and pericardial spaces. Despite source control, optimal ventilation and inhaled nitric oxide therapy he had refractory hypercapnia (CO2 of 16.3kPa) and moderate hypoxaemia. A Novalung 'iLA membrane ventilator (interventional lung assist)' was sited (Figure 2) and CO2 clearance improved allowing lung protective ventilation. The iLA remained in place for 15 days. The patient made a complete recovery. Discussion LPV generally decreases minute volume causing a degree of hypercapnia that generally should be tolerated (permissive hypercapnia). However, excessive hypercapnia and respiratory acidosis have potentially harmful neurological and cardiovascular sequelae,

particularly in the context of traumatic brain injury. The iLA is a device that provides extracorporeal CO2 removal and facilitates LPV. Use of the iLA in trauma patients with ARDS allows LPV, which may improve pulmonary recovery and decrease duration of mechanical ventilation. (Figure Presented) .
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Publisher
American Thoracic Society

462.

Emergency use of extracorporeal membrane oxygenation in cardiopulmonary failure.
Arlt M., Philipp A., Zimmermann M., Voelkel S., Amann M., Bein T., Muller T., Foltan M., Schmid C., Graf B., Hilker M.
Artificial Organs. 33 (9) (pp 696-703), 2009. Date of Publication: September 2009.
AN: 355313733
Severe pulmonary and cardiopulmonary failure resistant to critical care treatment leads to hypoxemia and hypoxia-dependent organ failure. New treatment options for cardiopulmonary failure are necessary even for patients in outlying medical facilities. If these patients are in need of specialized center treatment, additional emergency medical service has to be carried out quick and safely. We describe our experiences with a pumpless extracorporeal lung assist (PECLA/iLA) for out-of-center emergency treatment of hypercapnic respiratory failure and the use of a newly developed hand-held extracorporeal membrane oxygenation (ECMO) system in cardiac, pulmonary, and cardiopulmonary failure (EMERGENCY-LIFE Support System, ELS System, MAQUET Cardiopulmonary AG, Hechingen, Germany). Between March 2000 and April 2009, we used the PECLA System (n = 20) and the ELS System (n = 33) in adult patients. Cannulation was employed using percutaneous vessel access. The new hand-held ELS System consists of a centrifugal pump and a membrane oxygenator, both mounted on a special holder system for storing on a standard patient gurney for air or ground ambulance transfer. Bedside cannulation processes were uneventful. The PECLA System resulted in sufficient CO2 removal. In all ECMO patients, oxygen delivery and systemic blood flow could be restored and vasopressor support was markedly down. Hospital survival rate in the PECLA group was 50%, and 61% in the ECMO group. Out-of-center emergency treatment of hypercapnic pulmonary failure with pumpless extracorporeal gas exchange and treatment of cardiac, pulmonary, and cardiopulmonary failure with this new hand-held ECMO device is safe and highlyeffective. Patient outcome in cardiopulmonary organ failure could be improved. © 2009, International Center for Artificial Organs and Transplantation andWiley Periodicals, Inc.
PMID
19775261 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19775261]
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(Muller) Department of Internal Medicine, University Hospital Regensburg, Regensburg, Germany
Publisher

463.

Extracorporeal gas exchange.
Pesenti A., Zanella A., Patroniti N.
Current Opinion in Critical Care. 15 (1) (pp 52-58), 2009. Date of Publication: February 2009.
AN: 354254516
Purpose of review We report on recent advances and achievements on the use of extracorporeal gas exchange for long-term application in the therapy of critically ill patients with various forms of respiratory failure. Recent findings The most important results regarding the use of extracorporeal gas exchange are expected from the Conventional Ventilatory Support vs. Extracorporeal Membrane Oxygenation for Severe Adult Respiratory Failure (CESAR) study, a randomized clinical trial assessing the effectiveness of extracorporeal lung assist in acute respiratory distress syndrome patients. Although not yet formally published, the results of this study, if confirmed, represent the first positive randomized clinical trial on adult extracorporeal membrane oxygenation application in acute respiratory distress syndrome patients. Other important results come from the clinical application of interventional lung assist, a pumpless arteriovenous extracorporeal technique, in different clinical conditions (acute respiratory distress syndrome, bridge to transplantation, asthma, and trauma). Among technical progress, of particular interest is the development of microfiber, microporous polymethylpentene membrane lungs, which offer low resistance to blood flow, high gas transfer capability, and high leak-proof performance. Summary Results of recent clinical trials, widespread use of clinical applications, and technical progress are leading to reevaluation and extension of extracorporeal gas exchange in critically ill patients with respiratory failure of various forms. Further developments may come from low invasive techniques with high efficiency of CO2 removal from low blood flow. © 2009 Wolters Kluwer Health Lippincott Williams & Wilkins.
PMID
19179870 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19179870]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

464.

Extracorporeal carbon dioxide removal to "protect" the lung.
Stirling S.L., Cordingley J.J., Hunter D.N., Griffiths M.J., Wort S.J., Evans T.W., Finney S.J.
Thorax. 64 (8) (pp 726-727), 2009. Date of Publication: August 2009.
AN: 355026975
The case histories are presented of three adults who had severe hypercapnic acidosis despite mechanical ventilation with what were considered to be injurious tidal volumes and airway pressures. The use of a percutaneously inserted arteriovenous extracorporeal carbon dioxide removal (AV-ECCO 2R) device facilitated a dramatic reduction in the amount of ventilatory support required, achieving a "lung-protective" level. Two patients survived to hospital discharge. One patient died after it became apparent that her late-stage interstitial lung disease was unresponsive to immunosuppression. AV-ECCO2R may be a useful strategy in facilitating lung-protective ventilation.
PMID
19638565 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19638565]
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Publisher
BMJ Publishing Group (Tavistock Square, London WC1H 9JR, United Kingdom)

465.

Hypercapnia in late-phase ALI/ARDS: Providing spontaneous breathing using pumpless extracorporeal lung assist.
Weber-Carstens S., Bercker S., Hommel M., Deja M., MacGuill M., Dreykluft C., Kaisers U.
Intensive Care Medicine. 35 (6) (pp 1100-1105), 2009. Date of Publication: June 2009.
AN: 50419913
Objective: The fibroproliferative phase of late ALI/ARDS as described by Hudson and Hough (Clin Chest Med 27:671-677, 2006) is associated with pronounced reductions in pulmonary compliance and an accompanying hypercapnia complicating low tidal volume mechanical ventilation. We report the effects of extracorporeal CO2 removal by means of a novel pumpless extracorporeal lung assist (p-ECLA) on tidal volumes, airway pressures, breathing patterns and sedation management in pneumonia patients during late-phase ARDS.
Design(s): Retrospective analysis.
Setting(s): Fourteen-bed university hospital ICU.
Patient(s): Ten consecutive late-phase ALI/ARDS patients with low pulmonary compliance, and severe hypercapnia.
Intervention(s): Gas exchange, tidal volumes, airway pressures, breathing patterns and sedation requirements before (baseline) and after (2-4 days) initiation of treatment with p-ECLA were analysed. Patients were ventilated in a pressure-controlled mode with PEEP adjusted to pre-defined oxygenation goals.
Measurements and Main Results: Median reduction in pCO2 was 50% following institution of p-ECLA. Extracorporeal CO2 removal enabled significant reduction in tidal volumes (to below 4 ml/kg predicted body weight) and inspiratory plateau pressures [30 (28.5/32.3) cmH2O, median 25, 75% percentiles]. Normalization of pCO2 levels permitted significant reduction in the dosages of analgesics and

sedatives. The proportion of assisted spontaneous breathing increased within 24 h of instituting p-ECLA.
Conclusion(s): Elimination of CO2 by p-ECLA therapy allowed reduction of ventilator-induced shear stress through ventilation with tidal volumes below 4 ml/kg predicted body weight in pneumonia patients with severely impaired pulmonary compliance during late-phase ARDS. p-ECLA treatment supported control of breathing pattern while sedation requirements were reduced and facilitated the implementation of assisted spontaneous breathing. © 2009 Springer-Verlag.
PMID
19183941 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19183941]
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466.

Tidal volume lower than 6 ml/kg enhances lung protection: Role of extracorporeal carbon dioxide removal.
Ranieri V.M., Terragni P.P., Del Sorbo L., Mascia L., Urbino R., Martin E.L., Birocco A., Faggiano C., Quintel M., Gattinoni L.
Anesthesiology. 111 (4) (pp 826-835), 2009. Date of Publication: October 2009.
AN: 355402193
BACKGROUND: Tidal hyperinflation may occur in patients with acute respiratory distress syndrome who are ventilated with a tidal volume (VT) of 6 ml/kg of predicted body weight develop a plateau pressure (PPLAT) of 28 <= PPLAT <= 30 cm H2O. The authors verified whether VT lower than 6 ml/kg may enhance lung protection and that consequent respiratory acidosis may be managed by extracorporeal carbon dioxide removal.
METHOD(S): PPLAT, lung morphology computed tomography, and pulmonary inflammatory cytokines (bronchoalveolar lavage) were assessed in 32 patients ventilated with a VT of 6 ml/kg. Data are provided as mean +/- SD or median and interquartile (25th and 75th percentile) range. In patients with 28 <= PPLAT <= 30 cm H2O (n = 10), VT was reduced from 6.3 +/- 0.2 to 4.2 +/- 0.3 ml/kg, and PPLAT decreased from 29.1 +/- 1.2 to 25.0 +/- 1.2 cm H2O (P < 0.001); consequent respiratory acidosis (Paco2 from 48.4 +/- 8.7 to 73.6 +/- 11.1 mmHg and pH from 7.36 +/- 0.03 to 7.20 +/- 0.02; P < 0.001) was managed by extracorporeal carbon dioxide removal. Lung function, morphology, and pulmonary inflammatory cytokines were also assessed after 72 h.
RESULT(S): Extracorporeal assist normalized Paco2 (50.4 +/- 8.2 mmHg) and pH (7.32 +/- 0.03) and allowed use of VT lower than 6 ml/kg for 144 (84-168) h. The improvement of morphological markers of lung protection and the reduction of pulmonary cytokines concentration (P < 0.01) were observed after 72 h of ventilation with VT lower than 6 ml/kg. No patient-related complications were observed.
CONCLUSION(S): VT lower than 6 ml/Kg enhanced lung protection. Respiratory

acidosis consequent to low VT ventilation was safely and efficiently managed by extracorporeal carbon dioxide removal. © 2009, the American Society of nesthesiologists, Inc.
PMID
19741487 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19741487]
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Publisher
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467.

Extracorporeal pumpless interventional lung assist in clinical practice: Determinants of efficacy.
Muller T., Lubnow M., Philipp A., Bein T., Jeron A., Luchner A., Rupprecht L., Reng M., Langgartner J., Wrede C.E., Zimmermann M., Birnbaum D., Schmid C., Riegger G.A.J., Pfeifer M.
European Respiratory Journal. 33 (3) (pp 551-558), 2009. Date of Publication: March 2009.
AN: 354266570
Respiratory acidosis can become a serious problem during protective ventilation of severe lung failure. A pumpless arteriovenous interventional lung assist (iLA) for extracorporeal carbon dioxide removal has been used increasingly to control critical respiratory situations. The present study sought to evaluate the factors determining the efficacy of iLA and calculate its contribution to gas exchange. In a cohort of 96 patients with severe acute respiratory distress syndrome, haemodynamic parameters, oxygen consumption and carbon dioxide production as well as gas transfer through the iLA were analysed. The measurements demonstrated a significant dependency of blood flow via the iLA device on cannula size (mean+/-SD 1.59+/-0.52 L.min -1 for 15 French (Fr), 1.94+/-0.35 L.min-1 for 17 Fr, and 2.22 +/-0.45 L.min-1 for 19 Fr) and on mean arterial pressure. Oxygen transfer capacity averaged 41.7+/-20.8 mL.min-1, carbon dioxide removal was 148.0+/-63.4 mL.min-1. Within two hours of iLA treatment, arterial oxygen partial pressure/inspired oxygen fraction ratio increased significantly and a fast improvement in arterial carbon dioxide partial pressure and pH was observed. Interventional lung assist eliminates ~50% of calculated total carbon dioxide production with rapid normalisation of respiratory acidosis. Despite limited contribution to oxygen transfer it may allow a more protective ventilation in severe respiratory failure. Copyright©ERS Journals Ltd 2009.
PMID
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468.

Automatic control and safety concepts for extracorporeal lung support. Regelungs- und Sicherheitskonzepte fur extrakorporale Systeme zur Lungenunterstutzung <Regelungs- und Sicherheitskonzepte fur extrakorporale Systeme zur Lungenunterstutzung.>
Kopp R., Walter M., Arens J., Stollenwerk A., Leonhardt S., Schmitz-Rode T., Kowalewski S., Rossaint R.
Biomedizinische Technik. 54 (5) (pp 289-297), 2009. Date of Publication: 2009.
AN: 355551210
In some cases of severe acute respiratory distress syndrome, hypoxemia occurs despite optimized conservative therapy; however, extracorporeal membrane oxygenation (ECMO) can assure sufficient gas exchange. To increase safety and reliability of devices, the oxygenator design was optimized integrating new plasma-resistant composite membranes and new blood pumps are used with longer durability and reduced blood cell damage. Another approach is the use of an arterio-venous pumpless extracorporeal lung assist (pECLA) using an oxygenator with reduced pressure drop to simplify management and to avoid pump-related complications. First attempts were made to integrate basic control and safety concepts in ECMO circuits, but this does not seem to be sufficient to overcome the specific problems of ECMO (long-term use and limited supervision of the intensive care unit). The integration of sophisticated automated control and safety concepts in combination with revised ECMO circuits could allow a more reliable application of ECMO of the intensive care unit without continuous observation by a perfusionist. Easier intra- and interhospital transfer of patients with running ECMO would be another advantage. © 2009 by Walter de Gruyter Berlin New York.
PMID
19807292 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19807292]
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Publisher
Walter de Gruyter GmbH and Co. KG (Genthiner Strasse 13, Berlin D-10785, Germany)

469.

Perioperative lung injuries.
Licker M.
Applied Cardiopulmonary Pathophysiology. Conference: 28th Annual Meeting of the European Association of Cardiothoracic Anaesthesiologists, EACTA 2013. (28). Spain. Conference Publication: (234 pages). 17 (2) (pp 102-104) Date of Publication: 2013.
AN: 75005110
Currently, the incidence of postoperative pulmonary complications (PPC) far outnumbers cardiovascular complications [1], varying from 10% to 70%, depending on definition, study design, heterogeneity of patient population and type of procedure [2]. In thoracic surgery, the main causes of peri-operative deaths have now shifted from cardiovascular to infections and pulmonary complications [3, 4]. Pulmonary morbidity has also been associated with increasing health care costs and poor outcome as reflected by prolonged hospital stay, (re-)admission in intensive care units and reduced long-term survival [5, 6]. Transient and self-limiting impairments in gas exchange should be considered as part of the anaesthesia emergence period and as the physiological response to surgery. Most of the patients undergoing cardiothoracic or abdominal operations present some degree of hypoxaemia and diffuse micro-atelectasis that will barely impact on the postoperative clinical course. In contrast, pleural effusions, sustained bronchospasm, lobar atelectasis or hypoxaemia unresponsive to supplemental oxygen may forecast serious adverse events such as bronchopleural fistula, pneumonia, acute lung injury (ALI) or respiratory failure [7]. Predictive factors of PPCs entail patientrelated factors (e.g. chronic obstructive pulmonary disease [COPD], advanced age, poor nutritional status, decreased exercise tolerance, heart failure) and intra-operative related factors (e.g. emergency surgery, upper abdominal and intra-thoracic procedures, duration of anaesthesia, presence of a nasogastric tube, ventilatory settings, fluid balance) [2, 8]. These procedure-related fac tors are much more amenable to modification than preexisting chronic diseases. Ventilator-induced lung injuries (VILI) During spontaneous ventilation, tidal volume (VT) and transpulmonary pressure (Ptp) in healthy subjects vary within tight limits of 4 to 6 ml per kg of ideal body weight (IBW) and 4 to 8 mmHg, respectively. Surprisingly and for decades, anaesthetists have been taught to apply "unphysiological" large tidal volume (10 to 15 ml/kg) to prevent the development of atelectasis. To date, a growing body of knowledge indicates that mechanical ventilation induces alveolar injuries by repetitive opening and closing of unstable lung units owing to surfactant inactivation, upregulation of pro-inflammatory mediators, generation of reactive oxygen/nitrogen intermediates and excessive mechanical stress between atelelectatic areas and neighbouring ventilated areas [9]. In anaesthetized patients with healthy lungs, besides "high" VT and elevated inspiratory pressure, other risk factors for lung injuries have been identified [10, 11]. Fluid overhydration increases capillary hydrostatic pressure and promotes interstitial/alveolar oedema particularly when lymphatics are disrupted. Additionally, tissue trauma, isch-aemia-reperfusion, blood transfusion and exposure to extracorporeal devices may all combine to trigger (or to amplify) a widespread inflammatory response with potential deleterious effects on the lungs [12]. Some individuals are prone to develop ALI, given their deficient lung defence and repair mechanisms (e.g., antioxidant, heat shock protein, p75 receptor for tumour necrosis factor alpha [TNF-alpha]) that fail to counteract the inflammatory and oxidative

responses to damaging insults [13]. Genetic disruption of the transcription factor Nrf2 (NF-E2 related factor 2) has been associated with overexpression of proinflammatory cytokines and increased risk of ALI due to hyperoxia and high VT. Relevant gene variants or single nucleotide polymorphisms (SNPs) in ALI candidate genes have been tested for differences in allelic frequency in cohort studies (Nrf2, ACE genotype) [14,15]. Interestingly, a recent survey among members of the UK Association of Cardiothoracic Anaesthetists revealed that only 40% of 132 respondents were using "low" VT (median 6 ml/kg, interquartile range 5-7 ml/kg) during one-lung ventilation [16]. Lung Protective Approaches Based on experimental models of ALI/ ARDS, the "open-lung" approach including the combination of low VT, titrated external PEEP and periodic recruitment manoeuvres, has been shown to minimize the bronchoalveolar strain while preserving the FRC and preventing the development of atelectasis [17,18]. In thoracic and non-thoracic surgery, preliminary data also support this concept, although well designed RCTs are still lacking [19,20]. The fraction of inspired oxygen (FIO2) might be reduced to levels sufficient to keep SaO2 > 96% (FIO2 < 60%). The use of volatile anaesthetic should be considered in patients with bronchospastic disease and may potentially confer additional protection to the lungs and other organs [21, 22]. The use of minimally invasive haemodynamic monitors is advocated to optimize oxygen transport while avoiding fluid overload [23]. In the postoperative period, noninvasive ventilation can be considered in high risk patients [24]. In all patients, voluntary deep breathing and early mobilization should be encouraged and will be facilitated if optimal analgesic techniques are provided without undue sedation and while cardiovascular homeostasis is maintained. Newer technological modalities including extracorporeal membrane oxygenation (ECMO) and pumpless extracorporeal interventional lung assist (ILA) should also be considered, not only as rescue therapies in refractory respiratory failure but also in lesser severe ALI to minimize mechanical stress on the lung [25].
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Publisher
PABST Science Publishers

470.

Usefulness of extracorporeal support systems during thoracic surgery.
Senturk M.
Applied Cardiopulmonary Pathophysiology. Conference: 28th Annual Meeting of the European Association of Cardiothoracic Anaesthesiologists, EACTA 2013. (28). Spain. Conference Publication: (234 pages). 17 (2) (pp 88-89) Date of Publication: 2013.
AN: 75005104
Improvements in medical technology offer new horizons in the treatment of critical ly ill patients. Extracorporeal lung support systems have existed for a long time. However new developments have been reported, whose efficacy has to be confirmed. Generally, there are two major indications for extracorporeal ventilation. It can be applied to give the injured or diseased lung a chance to heal (bridge to recovery) or in an end-stage lung disease, it might be used as a bridge to lung transplantation. Moreover, it is also indicated in the intra-operative period of complex trachea operations and combined cardiac and pulmonary procedures. It is also considered as a possible approach to hypoxaemia during one-lung ventilation; but

very rarely and only as a "final chance". On the other hand, it has been reported that there is an increased use of this technique in the treatment ARDS. Extracorporeal membrane oxygenators (ECMO) and pump-less extracorporeal lung support (interventional lung assist [iLA]) (NovaLungTM) have been increasingly used as bridges to transplantation. ECMO can be applied either in a "VV" (veno-venous) (mainly indicated in respiratory failure not responding to mechanical ventilation) or in "VA" (veno-arterial) (in cases where both respiratory and cardiac support are necessary) configuration. For iLA, an "AV" (arterio-venous) bypass system, into which a gas exchange membrane is integrated, is used. iLA provides effective CO2 elimination but only a moderate improvement in oxygenation. Both methods have advantages and disadvantages regarding their capabilities and technical difficulties. During and after thoracic surgery, both techniques are indicated mainly in patients with bronchopleural fistulas after lung resection, severe lung contusion in trauma patients, life-threatening hypoxaemia caused by pneumonia, lung transplantation as well as primary graft failure in order to prevent ventilator-induced lung injury and to reduce inspiratory peak pressures. During mechanical ventilation in the postoperative period of thoracic surgery, "protecting" the lung against ventilator injury (while still achieving adequate oxygenation and/or gas exchange) can be very challenging. In these cases, there are reports showing the beneficial effects of the extracorporeal techniques. However, more studies showing the effects (but also the unwarranted effects) are necessary. The use of these systems is appropriate only if it is considered that the lung failure is reversible with therapy and there would be gain time for recovery In irreversible cases, these systems can help as a bridge to transplant.
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Publisher
PABST Science Publishers

471.

The principals of pumpless extracorporeal lung assist. A minimalizalt extracorporalis tudotamogatas <A minimalizalt extracorporalis tudotamogatas.>
Gobolos L., Hejjel L., Imre J., Lindenmayer-G. R., Wiebe K., Foltan M., Thrum A., Ugocsai P., Toth Z., Farkasfalvi K., Sipos E., Kiss R., Gyorimolnar I., Philipp A.
Orvosi Hetilap. 149 (26) (pp 1233-1236), 2008. Date of Publication: 29 Jun 2008.
AN: 352055147
The recently introduced pumpless extracorporeal lung assist (PECLA) is a remarkable alternative to the conventional extracorporeal membrane oxygenation in case of severe lung failure. By establishing a shunt between femoral artery and vein using the arterio-venous pressure gradient as a driving force through a low-resistance membrane oxygenator, PECLA provides highly effective gas-exchange by preserved cardiac function. Due to its closed system, reduced priming volume and low heparin demand, the unfavourable effects of extracorporeal membrane oxygenation can be effectively diminished. Hence the small technical, financial and personal input, the PECLA can be ideally used in district hospitals and during transport as well. Our short summary demonstrates the advantages and safety of the system proven over 123 cases.
PMID
18565818 [http://www.ncbi.nlm.nih.gov/pubmed/?term=18565818]

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(Gobolos) Ifjusag u. 13, Pecs 7624, Hungary
Publisher
Akademiai Kiado Zrt. (H-1117 Budapest, Prielle Kornelia u. 19/D. 1516, Hungary)

472.

Extracorporeal lung support procedures (ECMO/iLA). Extrakorporale lungenunterstutzungsverfahren (ECMO/iLA) <Extrakorporale lungenunterstutzungsverfahren (ECMO/iLA).>
Bein T., Muller T., Weber-Carstens S.
Pneumologie. 62 (3) (pp 137-142), 2008. Date of Publication: March 2008.
AN: 351506927
The management of acute lung injury in adults requires specific therapeutic measures including techniques of extracorporeal lung support. In patients suffering from severe acute respiratory distress syndrome (ARDS) with life-threatening hypoxaemia, a pump-driven, veno-venous extracorporeal membrane oxygenation (ECMO) has been established. Recently, a pumpless extracorporeal lung support system was developed using an arterio-venous bypass into which a gas exchange membrane is integrated ("interventional lung assist" [iLA]). ILA provides effective CO2 elimination and a moderate improvement in oxygenation. In both techniques, an improvement in survival has not been demonstrated in prospective investigations. ECMO and iLA might be associated with serious complications (bleeding, ischaemia), thus further randomised prospective studies are warranted to elucidate specific indications. In patients with severe asthma or exacerbation of chronic obstructive pulmonary disease, iLA might represent an attractive rescue therapy in the future. © Georg Thieme Verlag KG Stuttgart.
PMID
18264892 [http://www.ncbi.nlm.nih.gov/pubmed/?term=18264892]
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473.

Extracorporeal lung assist. Extrakorporale lungenunterstutzung <Extrakorporale lungenunterstutzung.>
Bein T., Philipp A., Zimmermann M., Mueller T., Schmid F.-X.
Deutsche Medizinische Wochenschrift. 132 (10) (pp 488-491), 2007. Date of Publication: 09 Mar 2007.
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PMID
17327995 [http://www.ncbi.nlm.nih.gov/pubmed/?term=17327995]
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Publisher
Georg Thieme Verlag (Rudigerstrasse 14, Stuttgart D-70469, Germany)

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474.

Advances in Extracorporeal Ventilation.
Meyer A., Struber M., Fischer S.
Anesthesiology Clinics. 26 (2) (pp 381-391), 2008. Date of Publication: June 2008.
AN: 351626754
Mechanical ventilation remains the signature tool of critical care; however, within the past decade, a growing body of evidence suggests that positive pressure ventilation in acute respiratory failure is a double-edged sword that is associated with life-threatening complications such as nosocomial pneumonia and low cardiac performance. Essentially, solutions are required to provide adequate gas exchange and stable acid-base status while optimizing and maximizing pulmonary as well as remote organ protection. Recently, the first commercially available extracorporeal membrane ventilator was approved for clinical lung support, the Interventional Lung Assist. This article gives an overview of the potential indications for this device and the current clinical evidence in extracorporeal ventilation.
PMID
18456221 [http://www.ncbi.nlm.nih.gov/pubmed/?term=18456221]
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Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

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475.

Interventional lung assist: A new concept of protective ventilation in bridge to lung transplantation.
Fischer S., Hoeper M.M., Bein T., Simon A.R., Gottlieb J., Wisser W., Frey L., Van Raemdonck D., Welte T., Haverich A., Strueber M.
ASAIO Journal. 54 (1) (pp 3-10), 2008. Date of Publication: January-February 2008.
AN: 351131851
On March 22, 2006, the first Interventional Lung Assist (ILA) Consensus Meeting was held in Hannover, Germany, hosted by the Hannover Thoracic Transplant and Cardiac Assist Program at the Hannover Medical School. Leading experts in the field of lung transplantation, respiratory and critical care medicine, lung injury, mechanical ventilation, extracorporeal life support, and oxygenator engineering were formally invited to participate. The main goal was to translate previous clinical experience with the ILA into a consensus for the use of the ILA as a bridge to lung transplantation.

PMID
18204308 [http://www.ncbi.nlm.nih.gov/pubmed/?term=18204308]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

476.

Clinical experience with a pumpless extracorporeal lung assist device.
Hammell C., Forrest M., Barrett P.
Anaesthesia. 63 (11) (pp 1241-1244), 2008. Date of Publication: November 2008.
AN: 352495440
We present three patients with respiratory failure in whom conventional mechanical lung ventilation resulted in unacceptably high levels of carbon dioxide, severe acidosis and high vasopressor requirements. A pumpless arteriovenous extracorporeal carbon dioxide removal device (NovalungTM) was inserted. Arterial carbon dioxide levels were reduced rapidly with a corresponding increase in pH,

reduction in vasopressor requirements and reduction in inspiratory pressures. One patient required the additional use of high frequency oscillatory ventilation. There were no complications associated with use of the device. We conclude that use of extracorporeal carbon dioxide removal devices should be considered at an early stage in the management of respiratory failure refractory to conventional ventilatory techniques. © 2008 The Authors.
PMID
18717661 [http://www.ncbi.nlm.nih.gov/pubmed/?term=18717661]
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Publisher
Blackwell Publishing Ltd (9600 Garsington Road, Oxford OX4 2XG, United Kingdom)

Link to the Ovid Full Text or citation:
Click here for full text options

477.

Pumpless Extracorporeal Lung Assist: A 10-Year Institutional Experience.
Florchinger B., Philipp A., Klose A., Hilker M., Kobuch R., Rupprecht L., Keyser A., Puhler T., Hirt S., Wiebe K., Muller T., Langgartner J., Lehle K., Schmid C.
Annals of Thoracic Surgery. 86 (2) (pp 410-417), 2008. Date of Publication: August 2008.
AN: 351978044
Background: Pumpless extracorporeal lung assist (PECLA) was developed to support pulmonary function in patients with severe respiratory insufficiency.
Method(s): Since 1996, 159 patients with an age ranging from 7 to 78 years were provided with a PECLA system. Fifteen patients were referred to us by air or ground transport after insertion of the system in a peripheral hospital.
Result(s): Main underlying lung diseases were acute respiratory distress syndrome (70.4%) and pneumonia (28.3%). Pumpless extracorporeal lung assist lasted for 0.1 to 33 days, mean 7.0 +/- 6.2 days; cumulative experience was greater than 1,300 days. Successful weaning and survival to hospital discharge was achieved in 33.1% of patients after a mean PECLA support of 8.5 +/- 6.3 days. During PECLA therapy, 48.7% of patients died, mainly as a result of multiorgan failure after a mean interval of 4.8 +/- 5.1 days. Inability to stabilize pulmonary function was noted in 3% of patients only. After PECLA, 30-day mortality was 13.6%. In a subgroup analysis, best outcome was obtained in patients after trauma.
Conclusion(s): Pumpless extracorporeal lung assist is a simple and efficient method to support patients with deteriorating gas exchange for prolonged periods to allow the lung protective ventilation and transportation. Best indication for use of PECLA is severe hypercapnia and moderate hypoxia. © 2008 The Society of Thoracic Surgeons.
PMID
18640306 [http://www.ncbi.nlm.nih.gov/pubmed/?term=18640306]
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(Langgartner) Department of Internal Medicine I, University Hospital, Regensburg, Germany
Publisher
Elsevier USA (6277 Sea Harbor Drive, Orlando FL 32862 8239, United States)

478.

Bronchial fistulae in ARDS patients: Management with an extracorporeal lung assist device.
Hommel M., Deja M., Von Dossow V., Diemel K., Heidenhain C., Spies C., Weber-Carstens S.
European Respiratory Journal. 32 (6) (pp 1652-1655), 2008. Date of Publication: December 2008.
AN: 354120639
Patients with bronchial tree lesions feature, in particular, a high risk for developing bronchial fistulae after surgical repair when the clinical situation is complicated by acute lung injury (ALI)/acute respiratory distress syndrome (ARDS) and mechanical ventilation is needed. The current authors hypothesised that extracorporeal carbon dioxide removal would significantly decrease inspiratory airway pressures, thus promoting the protection of surgical bronchial reconstruction. Four patients were studied after surgical reconstruction of bronchial fistulae in whom ALI/ARDS developed and mechanical ventilation with positive end-expiratory pressure was required. Gas exchange, tidal volumes, airway pressures, respiratory frequency, vasopressor and sedation requirements were analysed before and after initiation of a pumpless extracorporeal lung assist device (pECLA; NovaLung, Talheim, Germany). Initiation of pECLA treatment enabled a reduction of inspiratory plateau airway pressures from 32.4 to 28.6 cmH2O (3.2 to 2.8 kPa), effectively treated hypercapnia (from 73.6 to 53.4 mmHg (9.8 to 7.1 kPa)) and abolished respiratory acidosis (from pH 7.24 to 7.41). All patients survived and were discharged to rehabilitation clinics. In patients after surgical bronchial reconstruction that was complicated by acute lung injury/acute respiratory distress syndrome, use of pumpless extracorporeal carbon dioxide removal was safe and efficient. Initiation of a pumpless extracorporeal lung assist device enabled a less invasive ventilator management, which may have contributed to healing of surgical bronchial repair. Copyright©ERS Journals Ltd 2008.
PMID
19043011 [http://www.ncbi.nlm.nih.gov/pubmed/?term=19043011]
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Publisher
European Respiratory Society (4 Ave Sainte-Luce, Lausanne CH-1003, Switzerland)

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479.

Extracorporeal carbon dioxide removal using the Novalung in a patient with intracranial bleeding.
Mallick A., Elliot S., Mckinlay J., Bodenham A.
Anaesthesia. 62 (1) (pp 72-74), 2007. Date of Publication: January 2007.
AN: 44869641
A neurosurgical patient who required repeated surgery for intracranial haematoma developed acute respiratory distress syndrome. Raised intracranial pressure proved difficult to manage whilst attempting to maintain optimal gas exchange. The resultant arterial partial pressure of carbon dioxide remained unacceptably high, and treatment by extracorporeal carbon dioxide removal was started. A pumpless arteriovenous interventional lung assist device (NovalungTM) was connected from the right femoral artery to left femoral vein and reduced the arterial carbon dioxide, corrected the respiratory acidosis and enabled control of the intracranial pressure. Subsequently the requirements for both respiratory and cardiovascular support were reduced. The patient made a complete neurological recovery. © 2007 The Authors Journal compilation © 2007 The Association of Anaesthetists of Great Britain and Ireland.
PMID
17156230 [http://www.ncbi.nlm.nih.gov/pubmed/?term=17156230]
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Publisher
Blackwell Publishing Ltd (9600 Garsington Road, Oxford OX4 2XG, United Kingdom)

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480.

Clinical experience with the iLA Membrane Ventilator pumpless extracorporeal lung-assist device.
Walles T.
Expert Review of Medical Devices. 4 (3) (pp 297-305), 2007. Date of Publication: May 2007.
AN: 46845742
Extracorporeal gas exchange by extracorporeal membrane oxygenation has been established clinically in patients with acute lung failure. The interventional lung-assist (iLA) Membrane Ventilator device (Novalung) is a sophisticated representative of a new generation of pumpless extracorporeal lung-assist devices that are driven by the patient's cardiac output and therefore, do not require extracorporeal pump assistance. The system is characterized by a new membrane gas exchange system with optimized blood flow that is integrated in an arteriovenous bypass established by vascular cannulation. This particular pumpless extracorporeal lung-assist device was applied in 1800 patients for artificial lung assistance with easy use and low cost. This article reviews the present state of clinical Novalung device implementation focusing on encountered limitations and conceivable future developments in the field. © 2007 Future Drugs Ltd.
PMID
17488224 [http://www.ncbi.nlm.nih.gov/pubmed/?term=17488224]

Institution
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Publisher
Expert Reviews Ltd. (2 Albert Place, London N3 1QB, United Kingdom)

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481.

Recent advances in extracorporeal lung assist.
Bein T.
International Journal of Intensive Care. 14 (3) (pp 93-96), 2007. Date of Publication: Autumn 2007.
AN: 350005846
The treatment of severe acute lung failure includes artificial ventilation with a lung protective concept, but in situations of life-threatening respiratory failure with persistent hypoxia/hypercapnia, the technique of extracorporeal lung assist has been employed. A veno-venous pump-driven extracorporeal membrane oxygenation (ECMO) is established in specialised centres - requiring extended equipment with technical and support staff and costs - for patients with severe acute respiratory distress syndrome (ARDS), while the use of a new technique of a pumpless interventional lung assist (ILA) using a femoral arterio-venous pressure gradient as the driving force for blood flow through a gas exchange membrane has been reported in patients suffering from severe lung failure due to trauma, sepsis or brain injury. ILA is a new and promising strategy for extracorporeal lung support allowing a de-escalation of injurious ventilation, but there may be a risk of potentially severe complications. Assessment of clinical perspectives and precise indications for both strategies aimed at restoring adequate gas exchange and supporting lung protective ventilation will be elucidated by multicentre prospective randomised clinical studies in the near future.
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Publisher
Greycoat Publishing (120 Dawes Road, London SW6 7EG, United Kingdom)

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482.

Extended use of ECC.
Foltan M., Philipp A., Birnbaum D.
Perfusion. 22 (3) (pp 173-178), 2007. Date of Publication: 2007.
AN: 350018038
PMID
18018396 [http://www.ncbi.nlm.nih.gov/pubmed/?term=18018396]

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Publisher
SAGE Publications Ltd (55 City Road, London EC1Y 1SP, United Kingdom)

483.

Use of a pumpless interventional lung-assist system in severe sepsis and recurrent pulmonary embolism. Einsatz eines interventionellen lungen-assistenten-systems (novalung) bei schwerer sepsis und rezidivierender lungenembolie <Einsatz eines interventionellen lungen-assistenten-systems (novalung) bei schwerer sepsis und rezidivierender lungenembolie.>
Hillmann A., Schmeier U., Sandner A., Bloching M., Bomplitz M., Soukup J.
Intensiv- und Notfallbehandlung. 32 (3) (pp 138-141), 2007. Date of Publication: Third Quarter 2007.
AN: 47607151
The recently available pumpless procedure for extracorporal CO2 elimination (interventional lung-assist devices, iLA) is an increasingly attractive option in the therapy of acute lung injury (ALI) and ARDS. We are reporting on the successful use of an iLA system (NovaLung) in a patient with recurrent pulmonary embolism and severe sepsis. In respect of the iLA-system, used as ultima ratio, the respiratory acidosis - no longer controllable by conventional means - could be recompensated and the unstable circulatory situation stabilized. The prognosis for intensive-care patients with recurrent pulmonary embolism may possibly be improved by the use of the iLA.
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Publisher
Dustri-Verlag Dr. Karl Feistle (P.O. Box 1351, Deisenhofen/ Munich D-82032, Germany)

484.

A new pumpless extracorporeal interventional lung assist in critical hypoxemia/hypercapnia.
Bein T., Weber F., Philipp A., Prasser C., Pfeifer M., Schmid F.-X., Butz B., Birnbaum

D., Taeger K., Schlitt H.J.
Critical Care Medicine. 34 (5) (pp 1372-1377), 2006. Date of Publication: May 2006.
AN: 43754558
Objective: Pump-driven extracorporeal gas exchange systems have been advocated in patients suffering from severe acute respiratory distress syndrome who are at risk for life-threatening hypoxemia and/or hypercapnia. This requires extended technical and staff support.
Design(s): We report retrospectively our experience with a new pumpless extracorporeal interventional lung assist (iLA) establishing an arteriovenous shunt as the driving pressure.
Setting(s): University hospital.
Patient(s): Ninety patients with acute respiratory distress syndrome.
Intervention(s): Interventional lung assist was inserted in 90 patients with acute respiratory distress syndrome.
Measurements and Main Results: Oxygenation improvement, carbon dioxide elimination, hemodynamic variables, and the amount of vasopressor substitution were reported before, 2 hrs after, and 24 hrs after implementation of the system. Interventional lung assist led to an acute and moderate increase in arterial oxygenation (PaO2/FIO2 ratio 2 hrs after initiation of iLA [median and interquartile range], 82 mm Hg [64-103]) compared with pre-iLA (58 mm Hg [47-78], p < .05). Oxygenation continued to improve for 24 hrs after implementation (101 mm Hg [74-142], p < .05). Hypercapnia was promptly and markedly reversed by iLA within 2 hrs (PaCO2, 36 mm Hg [30-44]) in comparison with before (60 mm Hg [48-80], p < .05], which allowed a less aggressive ventilation. For hemodynamic stability, all patients received continuous norepinephrine infusion. The incidence of complications was 24.4%, mostly due to ischemia in a lower limb. Thirty-seven of 90 patients survived, creating a lower mortality rate than expected from the Sequential Organ Failure Assessment score.
Conclusion(s): Interventional lung assist might provide a sufficient rescue measure with easy handling properties and low cost in patients with severe acute respiratory distress syndrome and persistent hypoxia/hypercapnia.
PMID
16540950 [http://www.ncbi.nlm.nih.gov/pubmed/?term=16540950]
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(Butz) Department of Radiology, University Hospital of Regensburg, Regensburg, Germany
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Publisher
Lippincott Williams and Wilkins (351 West Camden Street, Baltimore MD 21201-2436, United States)

485.

Treatment of West syndrome. Lijecenje Westovog sindroma <Lijecenje Westovog

sindroma.>
Cvitanovic-Sojat L., Gjergja R., Sabol Z., Hajnzic T.F., Sojat T.
Acta Medica Croatica. 59 (1) (pp 19-29), 2005. Date of Publication: 2005.
AN: 40388799
Purpose: West syndrome (WS) is one of the catastrophic epileptic syndromes in infancy characterized by a triad of infantile spasms, psychomotor deterioration and hypsarrhythmic EEG pattern. WS is commonly associated with poor long-term outcome, especially in symptomatic cases, with development of other seizure types, impaired cognitive and psychosocial functioning. The aim of our study was to evaluate the efficacy of the control of infantile spasms using synthetic ACTH or vigabatrin in newly diagnosed cases and to correlate it with the underlyning causes, outcome and adverse effects.
Patients and Methods: The database of children with WS seen at the Neuropediatric Unit and followed at outpatient clinics from January 1, 1994 until December 31, 2003 were reviewed. The diagnosis of WS following the criteria of ILAE was made in 32 patients.
Result(s): Data were collected for 32 children (9 girls and 23 boys). According to the etiology, 5 (15.6%) were cryptogenic, and 1 (3.1%) was idiopathic. In 26 (81.2%) symptomatic cases, hypoxic-ischemic encephalopathy (69.2%) was the most common etiologic factor, followed by central nervous system anomaly including malformation of cortical development (11.5%), and Sturge Weber syndrome (3.8%), and chromosomal translocation with Down syndrome (11.5%). In 65.1% of symptomatic cases birth occurred prematurely. The mean age at spasm onset was 5.8 months, and mean age at diagnosis and treatment 7.2 months. Between 1994 and 1996 synthetic ACTH was used for treatment of WS in 7 patients (1 cryptogenic and 6 symptomatic), spasm control was achieved in 6, hypsarrhythmia disappeared in 5, and vigabatrin was added after synthetic ACTH in 3 patients. In one child synthetic ACTH was stopped because of arterial hypertension. All children had Cushing syndrome. After 1996, vigabatrin was administrated to 5 children with cryptogenic and 20 children with symptomatic WS. In 22/32 spasm control was achieved within 15 days. Synthetic ACTH was added in 3 children with spasms and hypsarrhythmia disappeared in 1 child. There was no recurrence of WS. The mean follow-up in 27 children was 4.6 (0.5 to 9.9 years) whereas 5 were lost from follow-up. Of 6/27 children with cryptogenic WS, 1 had idiopathic WS, 3 had normal psychomotor development and 2 had psychomotor retardation, without epileptic fits and still receiving AED. Of 21/27 children with symptomatic WS 76,2% had severe psychomotor retardation, 42.8% had epilepsy, 23.8% had intractable epileptic fits, and 2 children with Down syndrome were without epilepsy and without AED. Lennox-Gastaut syndrome developed in 14.2% (3/21 children); 1 of them died at the age of 3.5 years from acute gastric bleeding during the administration of synthetic ACTH, and an other child died at the age of 5.5 years from infection and respiratory insufficiency. The mortality rate was 7.4% (2/27 children). Discussion and Conclusion(s): The cryptogenic etiology is associated with a very low risk of poor outcome in WS. In children with normal development and regular school performance an idiopathic etiology can be presumed. The children with Down syndrome had a relatively benign outcome with regard to seizure control compared with symptomatic infantile spasms in the general population. In symptomatic WS caused by hypoxic-ischemic encephalopathy the outcome was linked with coexistence of other forms of epilepsy and neurologic deficit. The poor prognosis concerning intractable nature of the seizures and serious neurologic deficit is recorded in children with malformation of cortical development and Sturge Weber syndrome. The outcome of these children is determined by the brain damage other than by epilepsy itself. Regarding the treatment with synthetic ACTH or vigabatrin, the control of WS was the same for cryptogenic and symptomatic forms, one drug may be effective if the other drug fails. Synthetic ACTH can have many side effects, even death. The visual field defect is associated with vigabatrin, but can be avoided with careful funduscopic follow-up. Vigabatrin can be suggested as the first drug for WS; if spasms persist after 15 days with a dose of 150 mg/kg, synthetic ACTH should be considered.

PMID
15813352 [http://www.ncbi.nlm.nih.gov/pubmed/?term=15813352]
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(Sabol) Dr. Sabol Pediat. Outpatient Clinic, Zagreb, Croatia
Publisher
Academy of Medical Sciences of Croatica (Praska2, Zagreb 10000, Croatia)

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486.

Extracorporeal lung assist in ARDS. Extrakorporaler lungenersatz bei ARDS <Extrakorporaler lungenersatz bei ARDS.>
Steltzer H.
Wiener Klinische Wochenschrift. 117 (23-24 SUPPL. 6) (pp 10-12), 2006. Date of Publication: 2006.
AN: 43205996
Institution
(Steltzer) Institut fur Anaesthesie und Intensivmedizin, AUVA-Wien-Meidling, Austria
Publisher
Springer Wien (Sachsenplatz 4-6, P.O. Box 89, Vienna A-1201, Austria)

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487.

Interhospital transportation of patients with severe lung failure on pumpless extracorporeal lung assist.
Zimmermann M., Bein T., Philipp A., Ittner K., Foltan M., Drescher J., Weber F., Schmid F.-X.
British Journal of Anaesthesia. 96 (1) (pp 63-66), 2006. Date of Publication: January 2006.
AN: 43124533
Background. To describe the use of pumpless extracorporeal interventional lung assist (iLA) for transportation of patients with severe life-threatening acute lung failure from tertiary hospitals to a specialized centre. Methods. Retrospective analysis in eight patients with severe lung failure requiring interhospital transport, in whom implementation of an iLA system at a tertiary hospital for air/ground transportation was performed. Results. After implementation of iLA, a rapid increase in CO2 -elimination (Paco2 before iLA: 8.92+/-2.9 kPa, immediately after implementation: 5.06+/-0.93 kPa, 24 h after implementation: 4.53+/-1.20 kPa [mean+/-SD], P<0.05) was observed and a significant improvement in oxygenation (Pao2 before iLA:

6.66+/-2.26 kPa, immediately after implementation: 10.39+/-3.33 kPa, 24 h after implementation: 10.25+/-5.46 kPa, P<0.05) was noted. During transport, no severe complications occurred. Four patients died during further treatment due to multiple trauma or multiple organ failure. Conclusions. Due to ease of handling, high effectiveness and relatively low costs, iLA seems to be a useful system for treatment and transportation of patients with severe acute lung injury or ARDS suffering from life-threatening hypoxia and/or hypercapnia.
PMID
16299045 [http://www.ncbi.nlm.nih.gov/pubmed/?term=16299045]
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(Zimmermann, Bein, Ittner, Drescher) German Air Rescue, Team DRF, Air Medical Rescue Center, Regensburg, Germany
(Bein) Klinik fur Anasthesiologie, Universitatsklinikum, D-93042 Regensburg, Germany
Publisher
Oxford University Press (Great Clarendon Street, Oxford OX2 6DP, United Kingdom)

488.

Role of extracorporeal lung assist in the treatment of acute respiratory failure.
Kopp R., Dembinski R., Kuhlen R.
Minerva Anestesiologica. 72 (6) (pp 587-595), 2006. Date of Publication: June 2006.
AN: 43918800
For patients with most severe acute respiratory distress syndrome (ARDS) conservative treatment with lung protective ventilation is often not sufficient to prevent life-threatening hypoxemia and additional strategies are necessary. Extracorporeal lung assist (ECLA) or extracorporeal membrane oxygenation (ECMO) using capillary membrane oxygenators can provide sufficient gas exchange and lung rest. In 2 randomized trials mortality was unchanged for ECMO. Today an technically enhanced ECMO is used for most severe ARDS using clinical algorithm and different case studies demonstrated a survival rate about 56%. Today miniaturized ECMO with optimized blood pumps and oxygenators are available and could enhance safety and clinical management. Another approach is an arterio-venous pumpless interventional lung assist (ILA) with a low resistance oxygenator. Advantages seem a simplified clinical management and less blood trauma. At present new devices are developed for chronic respiratory failure or bridge to lung transplant. oxygenatoors with even less flow resistance could be implanted paracorporeal using the right ventricle as driving force. An intravascular oxygenator has been developed using the combination of a miniaturized blood pump and an oxygenator for implantation in the vena cava. Well designed clinical trials are necessary to demons to a clinical benefit for these experimental devices.
PMID
16682933 [http://www.ncbi.nlm.nih.gov/pubmed/?term=16682933]
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Publisher
Edizioni Minerva Medica S.p.A. (Corso Bramante 83-85, Torino 10126, Italy)

489.

Pumpless extracorporal lung assist for interhospital transfer of a patient with severe pulmonary failure due to legionnaires' disease. Interhospitaltransfer eines patienten mit schwerer respiratorischer insuffizienz in folge einer legionellose mittels einsatz einer PECLA (pumpless extracorporal lung assist) <Interhospitaltransfer eines patienten mit schwerer respiratorischer insuffizienz in folge einer legionellose mittels einsatz einer PECLA (pumpless extracorporal lung assist).>
Brunnler T., Philipp A., Scholmerich J., Birnbaum D.E., Reng C.M.
Intensivmedizin und Notfallmedizin. 43 (7) (pp 589-592), 2006. Date of Publication: October 2006.
AN: 44581715
We report the first interhospital transfer applying pumpless extracorporal lung assist (PECLA) in a severe case of pulmonary failure of a young man. The patient, a 25-yr-old man, developed respiratory failure due to legionnaires' disease. The treatment regime included appropriate antibiotic treatment, mechanical ventilation and, finally, the transport of the patient after PECLA installation from the ICU of a county hospital to the medical ICU of a university hospital. The initiation of PECLA resulted in dramatic improvement within the next 6 days. The patient could be successfully weaned from PECLA after 12 days and from mechanical ventilation after another 5 days. In conclusion, pumpless extracorporal lung assist improved oxygenation and hemodynamic performance in this case of severe respiratory failure, so that the patient could be transported to a center for maximal intensive care treatment. © 2006 Steinkopff-Verlag.
Institution
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Publisher
D. Steinkopff-Verlag (P.O. Box 100462, Darmstadt D-64204, Germany)

490.

An update on interventional lung assist devices and their role in acute respiratory distress syndrome.
Von Mach M.-A., Kaes J., Omogbehin B., Sagoschen I., Wiechelt J., Kaiser K., Sauer O., Weilemann L.S.
Lung. 184 (3) (pp 169-175), 2006. Date of Publication: June 2006.
AN: 44222465
In recent years, pumpless arteriovenous systems for extracorporeal gas exchange

have become a new therapeutic option for the treatment of patients suffering from acute respiratory failure. Experiences with the pumpless extracorporeal membrane lung in animal experiments and in patients with adult respiratory distress syndrome published in the current literature are reviewed. In addition this article presents a case of varicella pneumonia with persistent hypoxemia and hypercapnia under mechanical ventilation that showed a significant improvement with treatment with a pumpless extracorporeal lung assist using an arteriovenous shunt for eight days. The patient made a complete recovery. This is the first report of a patient with a life-threatening varicella pneumonia successfully treated with pumpless extracorporeal lung assist device. This review provides an update on interventional lung assist devices and a critical discussion of their advantages and limitations. © Springer Science+Business Media, Inc. 2006.
PMID
16902842 [http://www.ncbi.nlm.nih.gov/pubmed/?term=16902842]
Institution
(Von Mach, Kaes, Omogbehin, Sagoschen, Wiechelt, Kaiser, Sauer, Weilemann) II. Medical Department, University Hospitals, Langenbeckstr. 1, 55131 Mainz, Germany
Publisher
Springer New York (233 Springer Street, New York NY 10013-1578, United States)

491.

Case report: The use of a new, pumpless extracorporeal interventional lung assistance system in a US-soldier with blast injury. Von bagdad nach regensburg: Behandlung eines lebensbedrohlich verletzten US-soldaten mit einem neuen system zur extrakorporalen, pumpenfreien lungenunterstutzung <Von bagdad nach regensburg: Behandlung eines lebensbedrohlich verletzten US-soldaten mit einem neuen system zur extrakorporalen, pumpenfreien lungenunterstutzung.>
Bein T., Philipp A., Dorlac W., Taeger K., Nerlich M., Schlitt H.J.
Deutsches Arzteblatt. 103 (42) (pp A2797-2801), 2006. Date of Publication: 20 Oct 2006.
AN: 44701560
History and clinical findings: The authors describe a new extracorporeal pumpless interventional lung assistance system (iLA) which was inserted in a young US soldier suffering from severe acute respiratory distress syndrome with critical hypoxemia/hypercapnia after blast injury in Baghdad. The system is characterized by a new membrane gas exchange system with optimized blood flow which is integrated in an arterial-venous bypass established by cannulation of the femoral artery and vein. After implementation of the system, gas exchange improved rapidly, and the patient was airlifted from Iraq to Regensburg University Hospital, where he recovered gradually. Treatment and clinical course: The system was removed after 15 days, and the patient was successfully weaned from mechanical ventilation.
Discussion(s): iLA serves as an enabling device for artificial lung assistance with easy use and low cost. However, bleeding complications and ischemia of the lower limb can occur as a consequence of wide bore cannulation of the femoral artery. Further prospective studies are needed to establish whether iLA can be adopted more widely.
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(Nerlich) Abteilung fur Unfallchirurgie, Universitatsklinikum Regensburg, Regensburg, Germany
(Schlitt) Klinik fur Chirurgie, Universitatsklinikum Regensburg, Regensburg, Germany
Publisher
Deutscher Arzte-Verlag GmbH (Dieselstrasse 2 (Postfach 0254), Cologne 50859, Germany)

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492.

Successful use of portable extracorporeal carbon-dioxide removal in a patient with uncontrollable hypercapnoea.
Beed M., Jayamaha J., Sherman R., Mahajan R.
British Journal of Intensive Care. 16 (1) (pp 24-26), 2006. Date of Publication: Spring 2006.
AN: 43806113
We report the case of a 23-year-old man who was admitted to intensive care for ventilation following a presumed community-acquired pneumonia and whose respiratory failure required the use of a novel piece of equipment (the Novalung) which allowed portable arterio-venous carbondioxide removal (AVCO2R).
Institution
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Publisher
Greycoat Publishing (120 Dawes Road, London SW6 7EG, United Kingdom)

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493.

Fatal outcome of varicella zoster sepsis in a 22-year old patient. Letaler verlauf einer varizella-zoster-sepsis bei einem 22-jahrigen patienten <Letaler verlauf einer varizella-zoster-sepsis bei einem 22-jahrigen patienten.>
Siebig S., Rogler G., Schlottmann K., Scholmerich J., Langgartner J.
Intensivmedizin und Notfallmedizin. 43 (6) (pp 512-518), 2006. Date of Publication: September 2006.
AN: 44408358
Infection with Varicella zoster virus (VZV) usually occurs in children up to 15 years with mild symptoms. We present a case of a 22-year old man with a fatal varicella zoster infection. He developed fulminant hepatitis with acute liver failure and an acute respiratory distress syndrom (ARDS). In this article the general aspects of VZV infection are discussed. Treatment options and previous publications are reviewed.
Institution
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Publisher
D. Steinkopff-Verlag (P.O. Box 100462, Darmstadt D-64204, Germany)

494.

Extracorporeal membrane oxygenation.
Mielck F., Quintel M.
Current Opinion in Critical Care. 11 (1) (pp 87-93), 2005. Date of Publication: February 2005.
AN: 40223724
Purpose of review: Extracorporeal membrane oxygenation (ECMO) has become a more or less accepted standard in the algorithm of advanced acute respiratory distress syndrome therapy in adult patients when all other treatment options have failed. This article reviews the current status of ECMO therapy with particular focus on new technical developments and their potential implications for performance and indications for ECMO therapy. Recent findings: A recently published review on a single-center experience in 255 adult ECMO patients identified using multivariate logistic regression analysis age, sex, initial pH 7.10 or lower and PaO2/FiO2 ratio, and days of mechanical ventilation before ECMO as a significant predictors of survival. Additionally, a careful cost-effectiveness study for neonatal ECMO relating a 4-year base to the UK neonatal ECMO trial has clearly demonstrated cost-effectiveness.
Summary: Over the years, the technique for ECMO therapy underwent substantial changes in indications and the materials used. Impressive technical progress has been made in pumps, oxygenators, and coating of artificial surfaces, leading to a higher biocompatibility and to a lower rate of procedure-related complications. The potential of new inline pumps in combination with a decreasing rate of procedure-related complications might lead to a re-evaluation of the role of extracorporeal lung support in acute respiratory distress syndrome therapy. A very recent development is the use of spontaneous arteriovenous devices for carbon dioxide removal, allowing significant reduction of ventilator settings at decreased carbon dioxide partial pressures and at increased pH values. Ongoing studies are looking at the potential of this approach to reduce side effects of mechanical ventilation further. © 2005 Lippincott Williams & Wilkins.
PMID
15659951 [http://www.ncbi.nlm.nih.gov/pubmed/?term=15659951]
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Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

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495.

Pumpless extracorporeal lung assist (pECLA) in patients with acute respiratory distress syndrome and severe brain injury.
Bein T., Scherer M.N., Philipp A., Weber F., Woertgen C.
Journal of Trauma - Injury, Infection and Critical Care. 58 (6) (pp 1294-1297), 2005.
Date of Publication: June 2005.
AN: 41020122
Background: A retrospective analysis was performed to estimate the practicability of a pumpless extracorporeal lung assist system (pECLA) in trauma patients suffering from severe brain injury and the acute respiratory distress syndrome (ARDS).
Method(s): Five patients with acute severe brain injury and ARDS, ventilated in a lung protective mode, were connected to pECLA to avoid the detrimental effects of hypercapnia on intracranial pressure (ICP) and cerebral outcome. With pECLA hypercapnia was eliminated in all patients while the minute volume of artificial ventilation could be reduced. Subsequently, ICP was reduced, systemic hemodynamics and cerebral perfusion pressure remained stable. One patient died due to multi-organ failure as a consequence of multi-trauma. The remaining patients survived showing a good neurologic function.
Conclusion(s): pECLA is a promising alternative compared with conventional pump-driven systems for patients with ARDS and brain injury, since the pECLA system has minor restrictions, limitations and side effects.
PMID
15995487 [http://www.ncbi.nlm.nih.gov/pubmed/?term=15995487]
Institution
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Lippincott Williams and Wilkins (351 West Camden Street, Baltimore MD 21201-2436, United States)

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496.

Extracorporeal lung assist using arteriovenous shunt and a newly developed low resistance lung assist device. Interventionelle extrakorporale lungenunterstutzung (ILA) mittels arterio-venosem shunt und einem neu entwickelten low resistance lung assist device (LAD) <Interventionelle extrakorporale lungenunterstutzung (ILA) mittels arterio-venosem shunt und einem neu entwickelten low resistance lung assist device (LAD).>
Philipp A., Foltan M., Gietl M., Reng M., Liebold A., Kobuch R., Keyl C., Bein T., Muller T., Schmid F.-X., Birnbaum D.E.
Kardiotechnik. 12 (1) (pp 7-13), 2003. Date of Publication: February 2003.
AN: 36277950
Extracorporeal lung assist strategies such as ECMO (Extracorporeal Membrane Oxygenation) or ECLA (Extracorporeal Lung Assist) are nowadays an established treatment option for acute severe respiratory failure. Traditionally, the veno-venous approach has been used, favouring the femoral and jugular veins and a roller or centrifugal pump provides blood flow through a membrane oxygenator. As a rule, heparin-coated systems are used, thus the degree of systemic heparinisation of the patient can be kept low, targeting an ACT (Activated Clotting Time) of around 170

sec. However, a pumping device generating between 1.5 to 4.5 l/min imposes a continuous mechanical stress on the cellular blood components, adversely affects physiologic clotting mechanisms and thereby increases the risk of bleeding complications. Conventional ECMO necessitates a high expenditure of technical and financial means as well as making high demands on perfusionist staffing levels, therefore it is used only in a few specialised centres [1,2]. At the University Hospital of Regensburg, Germany, a new interventional lung assist device (ILA, formerly known as PECLA) was developed in an interdisciplinary approach by perfusionists, cardiac surgeons and the departments of anaesthesiology and internal medicine. Distinguishing features of ILA are the omission of a pumping device and the adaptation in close proximity to the patient. Apart from an oxygen supply the system does not require additional energy or substrate sources [5]. A femo-femoral shunt flow, generated by the arterial blood pressure through the ILA (NovaLung GmbH, Hechingen, Germany) produces at a flow rate of approx. 1.0 to 2.5 l/min an almost complete CO2 extraction and a significant improvement of O2 availability [6,7]. ILA is suitable for patients with potentially reversible respiratory failure due to, for instance, trauma [8], aspiration, pancreatitis and sepsis. Contraindication is a haemodynamic depression of cardiac origin. In the following article the ILA system is described in detail, covering cannulation techniques, function and efficiency of the device, the anti-coagulation management, weaning, safety aspects as well as dangers and pitfalls. The possibility of implanting the device in an external hospital and transport of the patient is also discussed. Furthermore, two case studies are included. The first describes the initiation and course of an ILA application in a 22-yrs-old patient with cerebral trauma and severe aspiration pneumonia displaying all signs and symptoms of ARDS (Adult Respiratory Distress Syndrome). As a further complication this patient developed a heparin-induced-thrombocytopenia (HIT II), necessitating a system changeout and a different anti-coagulation regimen. After 12 days on ILA, the patient was successfully weaned and 3 weeks later discharged from hospital. The second case study reports on a 30-years-old patient, outlining the switch from a classically cannulated arterial-venous ILA (femoral artery, femoral vein) to firstly a veno-arterial pumped ECMO due to the onset of pulmonary hypertension and right heart failure, and secondly to a paracorporeal thoracic approach (pulmonary artery, left atrium) due to ongoing hypoxemia and hypercapnia. Although the gas exchange requirements of the patient could be met in this way and the blood gas status stabilised, he subsequently developed multiorgan failure and died on the 18th day on the assist system.

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(Muller) Klinik fur Innere Medizin II, Klinikum der Universitat Regensburg, 93042 Regensburg, Germany
(Keyl, Bein) Klinik fur Anasthesiologie, Klinikum der Universitat Regensburg, 93042 Regensburg, Germany
Publisher
Deutsche Gesellschaft fur Kardiotechnik e.V. (Unterstruth 59, Buseck 35418, Germany)

Extracorporeal carbon dioxide removal to control arterial pH and PaCO 2 in a heart-beating donor with acute lung injury.
Scott L.K., Grier L.R., Turnage R., Conrad S.A.
Transplantation. 76 (11) (pp 1630-1632), 2003. Date of Publication: 15 Dec 2003.
AN: 37549840
Background. Arteriovenous carbon dioxide (AVCO2R) removal is a technique of pumpless extracorporeal carbon dioxide removal. This system has been used successively to control pH and PaCO2 in patients with acute lung injury who could not be adequately ventilated. This report describes the use of this technology in an organ donor awaiting harvesting. Methods. AVCO2R was implanted using a hollow-fiber oxygenator attached to 12 F and 14 F vascular cannulas that were inserted into the femoral artery and vein, respectively. Oxygen was attached to the oxygenator to provide the sweep gas. Results. The PaCO2 and arterial pH promptly corrected after support was initiated (from 83-42 mm Hg and 7.18-7.38, respectively). Conclusion. This case describes the successful use of pumpless arteriovenous extracorporeal removal of CO2 in a heart-beating donor awaiting organ harvest.
PMID
14702538 [http://www.ncbi.nlm.nih.gov/pubmed/?term=14702538]
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(Turnage) Department of Surgery, LA State Univ. Hlth. Sci. Ctr., Shreveport, LA, United States
Publisher
Lippincott Williams and Wilkins (351 West Camden Street, Baltimore MD 21201-2436, United States)

498.

Aspiration of airway dead space.
Jonson B.
International Journal of Intensive Care. 9 (4) (pp 171-176), 2002. Date of Publication: Winter 2002.
AN: 35407820
Improving CO2 elimination is the aim of several techniques of rescue therapy in patients with critical lung disease. An extreme example is extracorporeal CO2 removal. Obviously, less invasive and costly means are preferred, provided they are efficient. The interest in enhanced CO2 elimination has increased since clinical utility of low tidal volume ventilation (LTVV) has been proven. LTW has long been considered important to avoid ventilator-associated lung injury. The rationale behind LTVV is to avoid tidal lung collapse and re-expansion that is associated with large shear forces in zones undergoing recruitment. In 1982, I suggested that '... a respiratory pattern should open up closed units and maintain aeration and stability throughout the respiratory cycle.' Extreme versions of LTVV, which meet these requirements, are high frequency jet ventilation or high frequency oscillation. These modes are efficient in providing adequate gas exchange, even in acute lung injury (ALI) and the acute respiratory distress syndrome (ARDS).
Institution
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Publisher
Greycoat Publishing (120 Dawes Road, London SW6 7EG, United Kingdom)

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499.

Total extracorporeal arteriovenous carbon dioxide removal in acute respiratory failure: A phase I clinical study.
Conrad S.A., Zwischenberger J.B., Grier L.R., Alpard S.K., Bidani A.
Intensive Care Medicine. 27 (8) (pp 1340-1351), 2001. Date of Publication: 2001.
AN: 32758932
Objective: To evaluate the safety and efficacy of pumpless extracorporeal arteriovenous carbon dioxide removal (AVCO2R) in subjects with acute respiratory failure and hypercapnia.
Design(s): A phase I within-group time series trial in which subjects underwent up to 72 h of support with AVCO2R in intensive care units of two university hospitals.
Patient(s): Eight patients with acute hypercapnic respiratory failure or hypoxemic respiratory failure managed with permissive hypercapnia.
Intervention(s): Extracorporeal CO2 removal was achieved through percutaneous cannulation of the femoral artery and vein, and a simple extracorporeal circuit using a commercially available membrane gas exchange device for carbon dioxide exchange. Measurements and results: Measurements of hemodynamics, blood gases, ventilatory settings, and laboratory values were made before initiation of AVCO2R, and at subsequent intervals for 72 h. PaCO2 decreased significantly from 90.8 +/- 7.5 mmHg to 52.3 +/- 4.3 and 51.8 +/- 3.1 mmHg at 1 and 2 h, respectively. This decrease occurred despite a decrease in minute ventilation from a baseline of 6.92 +/- 1.64 l/min to 4.22 +/- .46 and 3.00 +/- .53 l/min at 1 and 2 h. There was a normalization of pH, with an increase from 7.19 +/- .06 to 7.35 +/- .07 and 7.37 +/- .05 at 1 and 2 h. These improvements persisted during the full period of support with AVCO2R. Four subjects underwent apnea trials in which AVCO2R provided total carbon dioxide removal during apneic oxygenation, resulting in steady-state PaCO2 values from 57 to 85 mmHg. Hemodynamics were not significantly altered with the institution of AVCO2R. There were no major complications attributed to the procedure.
Conclusion(s): Pumpless extracorporeal AVCO2R is capable of providing complete extracorporeal removal of carbon dioxide during acute respiratory failure, while maintaining mild to moderate hypercapnia. Applied in conjunction with mechanical ventilation and permissive hypercapnia, AVCO2R resulted in normalization of arterial PCO2 and pH and permitted significant reductions in the level of mechanical ventilation.
PMID
11511947 [http://www.ncbi.nlm.nih.gov/pubmed/?term=11511947]
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(Zwischenberger) Shriner's Burn Institute, 815 Market Street, Galveston, TX 77550-2725, United States
(Bidani) Department of Medicine, University of Texas, Medical Branch, 301 University Boulevard, Galveston, TX 77555, United States
Publisher
Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

500.

The spatial distribution of pulmonary lesions in severe ARDS. An autopsy study of 35 cases.
Barth P.J., Holtermann W., Muller B.
Pathology Research and Practice. 194 (7) (pp 465-471), 1998. Date of Publication: 1998.
AN: 28393711
The present study was undertaken in order to describe the local distribution and temporal course of pulmonary lesions in severe ARDS. We investigated a total of 35 patients (22 females), ranging in age from 2 to 51 years, who suffered from ARDS III and IV and were treated by extracorporeal CO2 removal and low frequency positive pressure ventilation (ECCO2-R). The extent of acute and chronic diffuse alveolar damage was assessed on histologic gross sections in the ventral, central and dorsal zone of the upper and lower lobes. The lesions showed a characteristic uniform distribution. Areas with chronic DAD were predominantly situated in the ventral portions of the upper lobes. Acute DAD predominated in the dorsal and basal areas of the lung. The extent of acute and chronic DAD was virtually independent of the duration of disease. Hemorrhage occurred at the interface zone between chronic and acute DAD and made up a significant volume portion of the lung tissue, ranging between 8% (lower lobes) and 42% (upper lobes). We conclude that the progression of acute DAD to chronic DAD is mainly determined by local factors (hydrodynamic and hydrostatic forces, intraalveolar pressure) that differ within the lung, whereas the duration of disease plays a minor role. Parenchymal hemorrhage occurs at the interface between areas of acute and chronic DAD and may therefore primarily be due to an increased susceptibility of the pulmonary parenchyma to mechanical stress.
PMID
9728363 [http://www.ncbi.nlm.nih.gov/pubmed/?term=9728363]
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Publisher
Elsevier GmbH

501.

Is extracorporeal CO2 removal an option in the treatment of adult respiratory distress syndrome?.
Deslauriers J., Awad J.A.
Annals of Thoracic Surgery. 64 (6) (pp 1581-1582), 1997. Date of Publication: 1997.
AN: 28066521
PMID
9436538 [http://www.ncbi.nlm.nih.gov/pubmed/?term=9436538]
Institution
(Deslauriers, Awad) Centre de Pneumologie Hopital Laval, 2725, chemin Sainte-Foy, Sainte-Foy, Que. G1V 4G5, Canada
Publisher
Elsevier USA (6277 Sea Harbor Drive, Orlando FL 32862 8239, United States)

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502.

Mechanical ventilation in acute respiratory distress syndrome: Evolving concepts.
Mehta S., Slutsky A.S.
Monaldi Archives for Chest Disease. 53 (6) (pp 647-653), 1998. Date of Publication: 1998.
AN: 29080566
PMID
10063338 [http://www.ncbi.nlm.nih.gov/pubmed/?term=10063338]
Institution
(Mehta, Slutsky) Dept. of Medicine, Mount Sinai Hospital, Toronto, Ont., Canada
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Publisher
PI-ME Tipografia Editrice S.r.l.

Link to the Ovid Full Text or citation:
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503.

Arteriovenous pumpless extracorporeal lung assist as a new method in the treatment of respiratory failure. Arterio-venose pumpenlose extrakorporale lungenunter-stutzung als neues verfahren bei der behandlung des lungenversagens <Arterio-venose pumpenlose extrakorporale lungenunter-stutzung als neues verfahren bei der behandlung des lungenversagens.>
Philipp A., Reng M.C., Kaiser M., Pfeifer M., Aebert H., Behr R., Birnbaum D.E.
Kardiotechnik. 8 (1) (pp 3-7), 1999. Date of Publication: 1999.
AN: 29258029

Extracorporeal Membrane Oxygenation (ECMO) for temporary lung assistance (Extracorporeal Lung Assist, ECLA) has been used for nearly 25 years now for patients with severe acute respiratory failure [1, 2]. Adult respiratory distress syndrome (ARDS) carries a high mortality rate (70-80%) and the use of ECLA consisting of a membrane oxygenator and a roller or centrifugal pump has helped to improve survival rate in individual cases [3]. The introduction of heparin coating improved the biocompatibility of these systems with resultant decrease of bleeding and thrombotic complications. Major improvements have also been made in recent years concerning long term function of membrane oxygenators, at least in some models, decreasing the frequency of necessary oxygenator changes due to massive plasma leakages. However, ECLA with a pump remains a highly specialised form of treatment with many possible complications, an inherent problem of significant blood traumatisation and clotting disturbances. At our hospital the cardiothoracic department in conjunction with the medical department developed an alternative form of treatment for ARDS in the form of an arterial-venous pumpless ECLA (av-pECLA). Core piece of this system is a newly developed oxygenator by Jostra Medizintechnik AG, Hirrlingen. It is a special membrane oxygenator with a very low resistance to blood flow (dpMO) [9]. Prerequisite for the use of av-pECLA is a cardiac index greater than 4 l/min/m2 and a mean arterial pressure (MAP) greater than 80 mmHg to achieve an effective blood flow through the av-pECLA system. The femoral artery and vein are cannulated using Seldinger technique (cannula size 17 to 19 Fr) and the patient's MAP is the driving force through this artificial shunt. Blood flow rates of 2.0 to 2.5 l/min can be achieved, gas flow is regulated at 12 l/min with an FIO2 of 1.0. The blood is enriched with O2 and CO2 is eliminated. The oxygenator is placed between the patient's legs, it has no added heat exchanger as the shortness of tubing does not result in significant heat loss. The whole system is heparin-coated, total priming volume is 270 ml and total length from cannula tip to cannula tip is 130 cm. With the elimination of a pump and reduction of tubing length blood traumatisation and subsequent substitution of blood products could be significantly minimised. Being very simple the system entails fewer risks of complications inherent to extracorporeal circulations and also makes nursing care and positioning of the patient very straightforward as there are no fixed attachments to the bed. However, av-pECLA can only be used in a highly selective group of patients. The 'ideal candidate' for av-pECLA is therefore a patient on a medical ICU with acute severe reversible respiratory failure rather than a post cardiac surgical patient. Our experience to date comprises 15 patients. Mean assist time was 15.1 +/- 8.0 days with a cumulative assist time of 226 days. A total of 24 oxygenators was used (3 changes were due to a switch from a pump-assisted to a pumpless ECLA). One oxygenator had to be changed due to a plasma leakage on the 20th day of assistance. No oxygenator had to be changed due to a reduction in gas exchange capability. Two oxygenators were in continuous use for 27 days respectively 22 days without any problems. There were 7 longterm survivors, 3 patients died while on the system, 4 patients died after successful weaning from av-pECLA.

Institution
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Publisher
Deutsche Gesellschaft fur Kardiotechnik e.V. (Unterstruth 59, Buseck 35418, Germany)

504.

Botulism with respiratory insufficiency requiring extra corporeal carbon dioxide removal.
Buchmann T., Kabatnik M., Sander A., Peters J.
European Journal of Anaesthesiology. 16 (5) (pp 346-349), 1999. Date of Publication: 1999.
AN: 29286789
Despite a low incidence of botulism in the industrialized world some cases occasionally occur in Germany after eating contaminated food. Because botulism is rarely seen, most physicians are unfamiliar with its early recognition and treatment. However, immediate intensive care treatment is important. We report the case of a previously healthy 54-year-old female who developed signs of botulism after eating vacuum packed smoked fish and developed severe respiratory insufficiency with difficult carbon dioxide elimination in the days following.
PMID
10390672 [http://www.ncbi.nlm.nih.gov/pubmed/?term=10390672]
Publisher
Lippincott Williams and Wilkins (250 Waterloo Road, London SE1 8RD, United Kingdom)

Link to the Ovid Full Text or citation:
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505.

Acute respiratory failure, mechanical ventilation, and ECMO/ECCO2R: quo vadis?.
Kolobow T., Cereda M., Sparacino M.E., Trawoger R.
The International journal of artificial organs. 20 (6) (pp 301-303), 1997. Date of Publication: Jun 1997.
AN: 127297777
PMID
9259204 [http://www.ncbi.nlm.nih.gov/pubmed/?term=9259204]

Link to the Ovid Full Text or citation:
Click here for full text options

506.

Interest of a therapeutic optimization strategy in severe ARDS.
Guinard N., Beloucif S., Gatecel C., Mateo J., Payen D.
Chest. 111 (4) (pp 1000-1007), 1997. Date of Publication: 1997.
AN: 27171473
Study objective: Evaluate the interest of the response to a therapeutic optimization as a predictor of prognosis in ARDS.
Design(s): Prospective study.
Setting(s): ICU of a University Hospital.
Patient(s): Thirty-six consecutive patients with severe ARDS addressed for extracorporeal carbon dioxide removal (ECCO2R).
Intervention(s): We studied the response during the first 2 days after arrival to the

therapeutic optimization strategy consisting in a combination of the following: (1) decrease in extravascular lung water (diuretics or hemofiltration); (2) selection of the best ventilatory mode; (3) permissive hypercarbia; and (4) correction of hypoxemia by alveolar recruitment, additional continuous oxygen insufflation, body position changes (prone position), inhaled nitric oxide, enhancement of hypoxic pulmonary vasoconstriction with almitrine, and drainage of pleural or mediastinal effusions. In patients remaining severely hypoxemic despite these modalities, ECCO2R was then proposed. Measurements and results: Thirty-six patients were addressed after 8.3+/-5.5 days of mechanical ventilation. On arrival, mean simplified acute physiologic score was 46.8+/-14.2, multiple system organ failure score was 1.8+/-1.6, Murray score was 3.4+/-0.4, PaO2 was 75.3+/-31.3 (fraction of inspired oxygen [FIO2]=1) for a positive end-expiratory pressure level of 12.3+/-3.4 cm H2O. Nineteen of 36 patients improved their gas exchange within 2 days and their mortality was 21%. The seventeen remaining patients did not improve PaO2/FIO2; PaCO2 and airway pressures remained high and their mortality was 88%. This different response to therapeutic optimization appeared using stepwise logistic regression as the most predictive factor for mortality ($p<0.05$).
Conclusion(s): In patients, with severe ARDS, the response to an early performed therapeutic optimization used to improve hypoxemia appeared to be a highly discriminant factor distinguishing deceased from surviving patients.
PMID
9106581 [http://www.ncbi.nlm.nih.gov/pubmed/?term=9106581]
Institution
(Guinard, Beloucif, Gatecel, Mateo, Payen) Dept. Anesth. and Critical Care Med., Hop. Univ. Lariboisiere, Paris, France (Payen) Dept. Anenthesiology Critical C., Hospitall Univ. Lariboisiere, 2 Rue Ambroise Pare, 75475 Paris Cedex 10, France
Publisher
American College of Chest Physicians (3300 Dundee Road, Northbrook IL 60062-2348, United States)

507.

Randomized clinical trial of pressure- controlled inverse ratio ventilation and extracorporeal CO2 removal for adult respiratory distress syndrome [1] (multiple letters).
Falke K.J., Morris A.H.
American Journal of Respiratory and Critical Care Medicine. 156 (3 I) (pp 1016-1017), 1997. Date of Publication: 1997.
AN: 27396451
PMID
9310029 [http://www.ncbi.nlm.nih.gov/pubmed/?term=9310029]
Institution
(Falke, Morris) KAI, Universitatsklinikum Rudolf Virchow, Humboldt Universitat Berlin, Berlin, Germany
Publisher
American Thoracic Society (61 Broadway 4th Floor, New York NY 10006 - 2755, United States)

508.

Adjuncts to mechanical ventilation.
Nahum A., Shapiro R.
Clinics in Chest Medicine. 17 (3) (pp 491-511), 1996. Date of Publication: 1996.
AN: 26295187
Adjunctive ventilatory strategies have been developed to improve oxygenation and carbon dioxide (CO2) removal during mechanical ventilation of critically ill patients. These techniques allow clinicians to attain their clinical goals at lower levels of ventilatory support. In this article, the authors discuss extracorporeal CO2 removal, venovenous intravena caval oxygenator, and tracheal gas insufflation as adjuncts to CO2 removal and nitric oxide, surfactant replacement therapy, perflourocarbon-associated gas exchange, and prone positioning as adjuncts to oxygenation.
PMID
8875009 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8875009]
Institution
(Nahum, Shapiro) St. Paul-Ramsey Medical Center, 640 Jackson Street, St. Paul, MN 55101-2595, United States
Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

509.

The role of pressure and volume in ventilator induced lung injury.
Tremblay L.N., Slutsky A.S.
Applied Cardiopulmonary Pathophysiology. 6 (3) (pp 179-190), 1996. Date of Publication: 1996.
AN: 27170878
Mechanical ventilation is an indispensable therapeutic modality for the treatment of respiratory failure. It is now well recognized, however, that ventilation per se can lead to, or propagate, further lung injury. Numerous studies have assessed the role of various ventilator dependent parameters in causing this injury, and have concluded that ventilation that takes place at either extreme of alveolar volume (too high or too low) can lead to injury even in previously healthy lungs. In injured lungs, this 'balancing act' becomes more difficult, as there may be regional disparities in lung injury and ventilation. More recently, the role of cellular and inflammatory mediators in ventilator induced lung injury has also begun to be appreciated. In order to minimize or prevent VILI, it is likely that one or a combination of strategies aimed at addressing the above concerns will be needed. Among the proposed 'protective' ventilatory strategies suggested to date are: 1) strategies aimed at optimizing inflation pressures and lung volumes - conventional mechanical ventilation with sufficient PEEP, pressure controlled inverse ratio ventilation with relatively lower distending pressures, high frequency ventilation, low frequency positive pressure ventilation with extracorporeal CO2 removal, intravenous CO2 removal and oxygenation (IVOX), low tidal volume ventilation with permissive hypercapnia; 2) strategies aimed at providing a more even distribution of ventilation in injured lungs:

surfactant supplementation, perfluorocarbon assisted gas exchange (PAGE); and 3) novel strategies aimed at preventing adverse inflammatory responses of the lung at the cellular and molecular mediator level. Further research, and well controlled randomized clinical trials, are needed in order to determine the ideal ventilatory strategies to prevent ventilator induced lung injury.
Institution
(Tremblay, Slutsky) Division of Respiratory Medicine, Mount Sinai Hospital, University of Toronto, Toronto, Ont., Canada (Tremblay) Mount Sinai Hospital, 600 University Avenue, Toronto, Ont., Canada
Publisher
Pabst Science Publishers (Eichengrund 28, Lengerich D-49525, Germany)

Link to the Ovid Full Text or citation:
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510.

Barotrauma.
Tocino I., Westcott J.L.
Radiologic Clinics of North America. 34 (1) (pp 59-81), 1996. Date of Publication: 1996.
AN: 26025256
Barotrauma remains a significant complication of mechanical ventilation, particularly in ARDS. A number of alternative techniques for mechanical ventilation are being investigated with the purpose of minimizing ventilator- related lung injury and air leak phenomena while maintaining adequate oxygenation. Among them pressure-controlled inverse-ratio ventilation and extracorporeal carbon dioxide removal have not resulted in a definite reduction of barotrauma thus far. The radiologist plays an important role in the early recognition of barotrauma and may assist in the treatment of its sequelae.
PMID
8539354 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8539354]
Institution
(Tocino, Westcott) Department of Diagnostic Radiology, Yale University School of Medicine, 333 Cedar St, New Haven, CT 06520-8042, United States
Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

Link to the Ovid Full Text or citation:
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511.

New ventilatory strategies in acute respiratory failure.
Gowski D.T., Miro A.M.
Critical Care Nursing Quarterly. 19 (3) (pp 1-22), 1996. Date of Publication: 1996.
AN: 26347902
New management options for acute respiratory failure aim at avoiding ventilator-induced lung injury while maintaining adequate gas exchange. Selected approaches

examined in this article included methods to augment carbon dioxide elimination with tracheal gas insufflation, venovenous extracorporeal carbon dioxide removal, and intravascular oxygenation. Improving oxygenation can be accomplished by judicious use of positive end- expiratory pressure, venoarterial extracorporeal membrane oxygenation, and pharmacologic intervention with inhaled nitric oxide.
PMID
8981848 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8981848]
Institution
(Gowski) Department of Anesthesiology, University of South Florida, Tampa, FL, United States (Miro) Department of Anesthesiology, Univ. of Pittsburgh Medical Center, Pittsburgh, PA, United States
Publisher
Lippincott Williams and Wilkins (351 West Camden Street, Baltimore MD 21201-2436, United States)

Link to the Ovid Full Text or citation:
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512.

Present status of extracorporeal membrane oxygenation for adult respiratory failure.
Kobayashi K.
Rinsho kyobu geka = Japanese annals of thoracic surgery. 14 (3) (pp 179-183), 1994. Date of Publication: Jun 1994.
AN: 128200448
In 1970s, survival rate in patients undergoing extracorporeal membrane oxygenation (ECMO) for acute respiratory failure was some around 10% even in sophisticated institutions. Most of them were treated by veno-arterial bypass along with mechanical ventilation with high air way pressure. Problems seen in this treatment modality were; difficulty in controlling bleeding and superimposed infection, mechanical problems of equipment (membrane lung, pumps, bypass circuit etc.), inadequate understanding of pathophysiology of respiratory failure. Lung injuries were also caused by high air way pressure and high fraction of inspired oxygen used in these patients. Above experience induced Kolobow and Gattinoni to use veno-venous bypass to extract metabolically produced carbon dioxide through membrane lungs and to supply oxygen through patient's own lung which is mechanically ventilated several times per minute with minimum concentration of inspired oxygen. Thus, lung damage caused by high air way pressure and oxygen can be preventable by giving lung time to rest and to heal. This treatment modality is called low frequency positive pressure ventilation with extracorporeal carbon dioxide removal (LFPPV-ECCO2R). The LFPPV-ECCO2R contributed much to raise the survival rate from 10% to 50%. Also better understanding of pathophysiology of acute respiratory failure and use of biocompatible materials like heparin-coated membrane lung and bypass circuit to minimize bleeding problem help much for better result. Successful cases are seen in younger patients with short duration of respiratory failure with reversible lung diseases. Bypass time is shorter in successful cases than that in unsuccessful cases. ECMO has revisited as Bartlett says.
PMID
9423088 [http://www.ncbi.nlm.nih.gov/pubmed/?term=9423088]
Institution
(Kobayashi) Department of Surgery, School of Medicine, Keio University, Tokyo.

Link to the Ovid Full Text or citation:

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513.

Efficacy of low-frequency positive-pressure ventilation-extracorporeal CO2 removal.
Brunet F., Mira J.P., Dhainaut J.F., Dall'ava-Santucci J.
American journal of respiratory and critical care medicine. 151 (4) (pp 1269-1270), 1995. Date of Publication: Apr 1995.
AN: 125045855
PMID
7697266 [http://www.ncbi.nlm.nih.gov/pubmed/?term=7697266]

Link to the Ovid Full Text or citation:
Click here for full text options

514.

Extracorporeal CO2 removal in ARDS. EXTRACCION EXTRACORPOREA DE CO2 EN EL SDRA <EXTRACCION EXTRACORPOREA DE CO2 EN EL SDRA.>
Gandia Martinez F., Tamayo Lomas L., Alvarez Ruiz A., Alvarez Martinez B., Duque Medina J.L., Rubia Palacios M.
Medicina Intensiva. 19 (7) (pp 385-389), 1995. Date of Publication: 1995.
AN: 25240444
We report the clinical course of three patients diagnosed of severe adult respiratory distress syndrome (ARDS), treated with conventional respiratory support and extracorporeal oxygenation (ECMO) due to extreme hypoxemia. We basically used a technique combining a low respiratory rate with extracorporeal CO2 removal (LFPPV-ECCO2R). In two survivors, by-pass was performed 24 and 26 hours after ICU admission, respectively, and was maintained during 48 and 68 hours, respectively. In the nonsurvivor, treatment was started in a septic patient with no signs of organ failure and persistent severe hypoxemia, after 40 days on mechanical ventilation. We describe the technique used in these patients, and discuss the role of LFPPV-ECCO2R in selected ARDS cases as a technique of respiratory support to correct hypoxemia and/or prevent barotrauma.
Institution
(Gandia Martinez, Tamayo Lomas, Alvarez Ruiz, Alvarez Martinez, Duque Medina, Rubia Palacios) Servicio de Medicina Intensiva, Hospital Universitario, C-Ramon y Cajal s-n, 47011 Valladolid, Spain
Publisher
Ediciones Doyma, S.L. (Travesera de Gracia 17-21, Barcelona 08021, Spain)

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515.

ECCO2R: an experimental approach to treating ARDS.

Chillcott S., Sheridan P.S.
Critical care nurse. 15 (2) (pp 50-56), 1995. Date of Publication: Apr 1995.
AN: 125074533
PMID
7774247 [http://www.ncbi.nlm.nih.gov/pubmed/?term=7774247]

Link to the Ovid Full Text or citation:
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516.

Prevention and therapy of the adult respiratory distress syndrome.
Temmesfeld-Wollbruck B., Walmrath D., Grimminger F., Seeger W.
Lung. 173 (3) (pp 139-164), 1995. Date of Publication: 1995.
AN: 25117608
The complex pathophysiology of adult respiratory distress syndrome (ARDS) makes preventive and therapeutic concepts difficult. Ample experimental evidence indicates that ARDS can be prevented by blocking systemic inflammatory agents. Clinically, only heparin, for inhibition of coagulation phenomena, is presently used among this array of approaches. Corticosteroids have not proven to be beneficial in ARDS. Alternative antiinflammatory agents are being proposed and are under current clinical investigation (e.g. indomethacin, acetylcysteine, alpha1-proteinase inhibitor, antitumor necrosis factor, interleukin 1 receptor antagonist, platelet-activating factor antagonists). Symptomatic therapeutic strategies in early ARDS include selective pulmonary vasodilation (preferably by inhaled vasorelaxant agents) and optimal fluid balance. Transbronchial surfactant application, presently tested in pilot studies, may be available for ARDS patients in the near future and may have acute beneficial effects on gas exchange, pulmonary mechanics, and lung hemodynamics; its impact on survival cannot be predicted at the present time. Strong efforts should be taken to reduce secondary nosocomial pneumonia in ARDS patients and thus avoid the vicious circle of pneumonia, sepsis from lung infection, and perpetuation of multiple organ dysfunction syndrome. Optimal respirator therapy should be directed to ameliorate gas-exchange conditions acutely but at the same time should aim at minimizing potentially aggravating side effects of artificial ventilation (barotrauma, O2 toxicity). Several new techniques of mechanical ventilation and the concept of permissive hypercapnia address these aspects. Approaches with extracorporeal CO2 removal and oxygenation are being used in specialized centers.
PMID
7616757 [http://www.ncbi.nlm.nih.gov/pubmed/?term=7616757]
Institution
(Temmesfeld-Wollbruck, Walmrath, Grimminger, Seeger) Department of Internal Medicine, Justus-Liebig-University, Klinikstrasse 36, D-35392 Giessen, Germany
Publisher
Springer New York (233 Springer Street, New York NY 10013-1578, United States)

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517.

Staphylococcal septicemia and adult respiratory distress syndrome in pregnancy treated with extracorporeal carbon dioxide removal.
Greenberg L.R., Moore T.R.
Obstetrics and Gynecology. 86 (4 II SUPPL.) (pp 657-660), 1995. Date of Publication: 1995.
AN: 25290687
Background: Septicemia in pregnancy may take an especially fulminant course. Adult respiratory distress syndrome (RDS) and disseminated intravascular coagulation (DIC) are associated life-threatening complications. Treatment consists of appropriate antibiotic coverage and supportive measures. Case: A previously healthy 21-year-old woman presented at 26 weeks' gestation with staphylococcal sepsis of undetermined origin. Her course was complicated by the rapid onset of adult RDS, DIC, and multi- organ-system failure, resulting in preterm delivery. Despite maximal ventilatory support, her pulmonary status continued to deteriorate. She was treated ultimately with extracorporeal carbon dioxide removal and survived without serious sequelae.
Conclusion(s): Extracorporeal carbon dioxide removal may improve survival in gravidas with adult RDS by decreasing the required airway pressures for ventilation, thus permitting pulmonary recovery.
PMID
7675403 [http://www.ncbi.nlm.nih.gov/pubmed/?term=7675403]
Institution
(Greenberg, Moore) 4094 4th Avenue, San Diego, CA 92103, United States
Publisher
Lippincott Williams and Wilkins (250 Waterloo Road, London SE1 8RD, United Kingdom)

Link to the Ovid Full Text or citation:
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518.

Low blood flow extracorporeal carbon dioxide removal (ECCO2R): A review of the concept and a case report.
Habashi N.M., Borg U.R., Reynolds H.N.
Intensive Care Medicine. 21 (7) (pp 594-597), 1995. Date of Publication: 1995.
AN: 25227283
Despite advances in respiratory and critical care medicine, the mortality from ARDS remains unchanged. Recent research suggests current ventilatory therapy may produce additional lung injury, retarding the recovery process of the lung. alternative supportive therapies, such as ECMO and ECCO2R, ultimately may result in less ventilator induced lung injury. Due to the invasiveness of ECMO/ECCO2R, these modalities are initiated reluctantly and commonly not until patients suffer from terminal or near-terminal respiratory failure. Low flow ECCO2R may offer advantages of less invasiveness and be suitable for early institution before ARDS becomes irreversible. We describe a patient with ARDS and severe macroscopic barotrauma supported with low flow ECCO2R resulting in significant CO2 clearance, reduction of peak, mean airway pressures and minute ventilation.
PMID
7593903 [http://www.ncbi.nlm.nih.gov/pubmed/?term=7593903]
Institution
(Habashi, Borg, Reynolds) Department of Critical Care Medicine, R. Adams Cowley Shock Trauma Center, 22 S. Green Street, Baltimore, MD 21201-1595, United States
Publisher

Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

Link to the Ovid Full Text or citation:
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519.

Low flow veno-venous ECMO: An experimental study.
Calderon M., Verdin R., Galvan J., Gonzalez M., Cardenas H., Campos R., Vidrio H., Amezcua J.
Journal of Extra-Corporeal Technology. 26 (2) (pp 75-78), 1994. Date of Publication: 1994.
AN: 24219748
Clinical use of extracorporeal membrane oxygenation (ECMO) and carbon dioxide removal (ECCO2R) have become well established techniques for the treatment of severe respiratory failure; however they require full cardiopulmonary bypass, representing major procedures with high morbidity. We theorized the possibility of an efficient low flow veno-venous extracorporeal membrane gas exchange method. Four mongrel 12kg dogs were submitted to veno- venous extracorporeal membrane gas exchange via a jugular dialysis catheter using a low flow (10 ml/min) roller pump and a membrane oxygenator for a period of four hours. Respiratory rate was set at 4 breaths/min with a FiO2 of 21% and ventilatory dead space was increased. Adequate gas exchange was obtained (pO2 139, pCO2 24, Sat 99.4%), without major hemodynamic changes or hematuria. Our results demonstrate the feasibility of a low flow, less aggressive system. Further research should be considered.
PMID
10147372 [http://www.ncbi.nlm.nih.gov/pubmed/?term=10147372]
Institution
(Calderon, Verdin, Galvan, Gonzalez, Cardenas, Campos, Vidrio, Amezcua) Department of Circulatory Support, 'La Raza' Medical Center-IMSS, Paseo de la Soledad 69, La Herradura 53920, Mexico
Publisher
American Society of Extra-Corporeal Technology (P.O. Box 11086, Richmond VA 23230, United States)

Link to the Ovid Full Text or citation:
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520.

Successful vaginal delivery of a male infant during extracorporeal carbon dioxide removal: A case report.
Jandhyala R., Haydon P., Czaplicka C., Claprood C., Casey K.
Journal of Extra-Corporeal Technology. 26 (2) (pp 87-90), 1994. Date of Publication: 1994.
AN: 24219750
Extracorporeal carbon dioxide removal (ECCO2R) has become an effective strategy for the support of newborn infants with severe respiratory failure, but the survival rate for children and adults undergoing this procedure is only 50%. We initiated ECCO2R in a 20 year old, gravida 3, white female who developed severe respiratory distress

after seeking treatment for a fever of four days duration and a nonproductive cough. Uterine contractions began shortly after ECCO2R was initiated. Nine hours later a male infant was delivered vaginally. Both mother and baby survived. To our knowledge, ECCO2R had never been used before to support a woman during labor and vaginal delivery.
Institution
(Jandhyala, Haydon, Czaplicka, Claprood, Casey) Oakwood Medical Office Building, 18181 Oakwood Boulevard, Dearborn, MI 48124, United States
Publisher
American Society of Extra-Corporeal Technology (P.O. Box 11086, Richmond VA 23230, United States)

521.

Randomized clinical trial of pressure-controlled inverse ratio ventilation and extracorporeal CO2 removal for Adult Respiratory Distress Syndrome.
Morris A.H., Wallace C.J., Menlove R.L., Clemmer T.P., Orme Jr. J.F., Weaver L.K., Dean N.C., Thomas F., East T.D., Pace N.L., Suchyta M.R., Beck E., Bombino M., Sittig D.F., Bohm S., Hoffmann B., Becks H., Butler S., Pearl J., Rasmusson B.
American Journal of Respiratory and Critical Care Medicine. 149 (2 I) (pp 295-305), 1994. Date of Publication: February 1994.
AN: 24068971
The impact of a new therapy that includes pressure-controlled inverse ratio ventilation followed by extracorporeal CO2 removal on the survival of patients with severe ARDS was evaluated in a randomized controlled clinical trial. Computerized protocols generated around-the-clock instructions for management of arterial oxygenation to assure equivalent intensity of care for patients randomized to the new therapy limb and those randomized to the control, mechanical ventilation limb. We randomized 40 patients with severe ARDS who met the ECMO entry criteria. The main outcome measure was survival at 30 days after randomization. Survival was not significantly different in the 19 mechanical ventilation (42%) and 21 new therapy (extracorporeal) (33%) patients (p = 0.8). All deaths occurred within 30 days of randomization. Overall patient survival was 38% (15 of 40) and was about four times that expected from historical data (p = 0.0002). Extracorporeal treatment group survival was not significantly different from other published survival rates after extracorporeal CO2 removal. Mechanical ventilation patient group survival was significantly higher than the 12% derived from published data (p = 0.0001). Protocols controlled care 86% of the time. Average Pa(O2) was 59 mm Hg in both treatment groups. Intensity of care required to maintain arterial oxygenation was similar in both groups (2.6 and 2.6 PEEP changes/day; 4.3 and 5.0 Fl(O2) changes/day). We conclude that there was no significant difference in survival between the mechanical ventilation and the extracorporeal CO2 removal groups. We do not recommend extracorporeal support as a therapy for ARDS. Extracorporeal support for ARDS should be restricted to controlled clinical trials.
PMID
8306022 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8306022]
Institution
(Beck, Bombino) Inst. di Anestesia e Rianimazione, Universita di Milano, Milan, Italy
(Sittig) Center for Biomedical Informatics, Vanderbilt University, Nashville, TN, United States
(Bohm, Hoffmann) Institut fur Physiologie, Medizinische Fakultat, Rheinisch-

Westfalische Techniche H., Aachen, Germany
(Morris) Pulmonary Division, LDS Hospital, Salt Lake City, UT 84143, United States
Publisher
American Thoracic Society (61 Broadway 4th Floor, New York NY 10006 - 2755, United States)

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522.

Human polymorphonuclear leukocyte metabolism and lipoperoxidation during adult respiratory distress syndrome treated by extracorporeal carbon dioxide removal.
Lefevre G., Brunet F., Bonneau C., Vaxelaire J.-F., Roch-Arveiller M., Fontagne J., Dhainaut J.-F., Raichvarg D., Giroud J.-P.
Pathophysiology. 1 (1) (pp 13-19), 1994. Date of Publication: 1994.
AN: 24229330
Circulating polymorphonuclear leukocyte (PMNs) oxidative metabolism and lipoperoxidation were evaluated in patients with the adult respiratory distress syndrome (ARDS) treated with low-frequency positive-pressure ventilation and extracorporeal carbon dioxide removal. Chemiluminescence (CL) of resting PMNs from ARDS patients was significantly enhanced relative to controls ($P < 0.001$). A significant decrease in CL of resting PMNs from ARDS patients was observed after cell incubation with serum from ARDS patients and healthy controls ($P < 0.05$). CL of normal opsonized zymosan (OZ)-stimulated PMNs was significantly enhanced ($P < 0.01$) after preincubation with ARDS serum. A significant decrease ($P < 0.05$) in control PMN O2-/. production was observed after pre-incubation with normal and ARDS serum. Plasma malondialdehyde (MDA) and alpha1 proteinase inhibitor-elastase levels were significantly increased in ARDS patients plasma ($P < 0.05$), whereas erythrocyte glutathione peroxidase was significantly higher in patients who survived ARDS episodes than in those who died ($P < 0.01$). CL of resting ARDS PMNs correlated with elastase levels ($r = 0.824$; $P < 0.001$), and MDA levels correlated with the 'injury severity score' ($r = 0.46$; $P = 0.056$). Our results show that oxygen metabolism and plasma elastase levels in circulating PMNs from ARDS patients are significantly enhanced. Furthermore, ARDS PMN functions are not enhanced by exogenous stimuli. No correlation between PMN functions and peroxidation was found in ARDS sera. These findings confirm that PMNs are primed during ARDS, but free radical production seems to be only one of the events responsible for the increased lipoperoxidation.
Institution
(Lefevre, Brunet, Bonneau, Vaxelaire, Roch-Arveiller, Fontagne, Dhainaut, Raichvarg, Giroud) Service de Biochimie, Hopital Tenon, 4, rue de la Chine, 75020 Paris, France
Publisher
Elsevier (P.O. Box 211, Amsterdam 1000 AE, Netherlands)

Link to the Ovid Full Text or citation:
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523.

Extracorporeal carbon dioxide removal technique improves oxygenation without causing overinflation.
Brunet F., Mira J.-P., Belghith M., Monchi M., Renaud B., Fierobe L., Hamy I., Dhainaut J.-F., Dall'Ava-Santucci J.
American Journal of Respiratory and Critical Care Medicine. 149 (6) (pp 1557-1562), 1994. Date of Publication: June 1994.
AN: 24175975
Extracorporeal CO2 removal combined with low frequency positive pressure ventilation (ECCO2R-LFPPV) improves gas exchange and decreases peak pressures, respiratory rates, and tidal volumes in animals and in humans. Recent evidence suggests that pulmonary barotrauma results from lung overinflation rather than from high pressures. This study was to test the hypothesis whether ECCO2R-LFPPV could improve gas exchange without causing lung overinflation, despite the use of higher levels of PEEP, when compared with conventional mechanical ventilation. Eleven patients with severe adult respiratory distress syndrome (ARDS) who failed to respond to different modes of mechanical ventilation were treated with ECCO2R-LFPPV. Risk of pulmonary barotrauma was evaluated by static pressure-volume (P-V) curves and dynamic changes in volumes monitored by respiratory inductive plethysmography (Respitrace). ECCO2R-LFPPV Pa(O2)/FIO2 increased from 79 +/- 21 to 207 +/- 108 (p = 0.003). Risk of barotrauma, as shown by the shape of the P-V curve, was present in all patients receiving mechanical ventilation even though most of them were treated with permissive hypoventilation. By contrast, no evidence of persistent lung overinflation could be detected by either static P-V curves or dynamic measurements in nine of 11 patients who were treated by ECCO2R-LFPPV. The two remaining patients had severe airway obstruction because of bleeding, and they remained ventilated with persistent risk of barotrauma. We conclude that ECCO2R-LFPPV improves gas exchange without causing lung overinflation in a majority of patients with ARDS.
PMID
8004313 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8004313]
Institution
(Brunet, Mira, Belghith, Monchi, Renaud, Fierobe, Hamy, Dhainaut, Dall'Ava-Santucci) Intensive Care Unit, Department of Physiology, Cochin-Port-Roy. University Hospital, Paris, France (Brunet) Serv. de Reanimation Med., Hopital Cochin, 27 rue du Fbg St Jacques, Paris 75014, France
Publisher
American Thoracic Society (61 Broadway 4th Floor, New York NY 10006 - 2755, United States)

524.

Role of extracorporeal circulation in adult respiratory distress syndrome management.
Gattinoni L., Pesenti A., Bombino M., Pelosi P., Brazzi L.
New horizons (Baltimore, Md.). 1 (4) (pp 603-612), 1993. Date of Publication: Nov 1993.
AN: 24947414
Long-term extracorporeal support for acute lung failure was introduced in 1972. In the 1970s, much effort was concentrated on technical improvements. However, a multicenter study comparing continuous positive-pressure ventilation and continuous

positive-pressure ventilation plus extracorporeal circulation failed to show improvement in survival rates. In the 1980s, new physiopathologic concepts were developed, such as extracorporeal CO2 removal coupled with lung rest. The main complication of the technique was bleeding due to systemic heparinization. However, the technology used in that period was the same as in the 1970s. Recently, technological improvement--such as percutaneous cannulation and surface-heparinized artificial lungs--has allowed clinical performances to improve substantially. "Lung rest" philosophy, coupled with safe technology, may provide a rational basis to test this technique in a randomized fashion for widespread use.
PMID
8087580 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8087580]
Institution
(Gattinoni, Pesenti, Bombino, Pelosi, Brazzi) Istituto di Anestesiologia e Rianimazione, Universita degli Studi di Milano, Italy.

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525.

Extracorporeal carbon dioxide removal and low-frequency positive-pressure ventilation: Improvement in arterial oxygenation with reduction of risk of pulmonary barotrauma in patients with adult respiratory distress syndrome.
Brunet F., Belghith M., Mira J.-P., Lanore J.J., Vaxelaire J.F., Santucci J.D., Dhainaut J.F.
Chest. 104 (3) (pp 889-898), 1993. Date of Publication: 1993.
AN: 23268967
Mortality of the adult respiratory distress syndrome (ARDS) remains high and could be increased by pulmonary barotrauma induced by positive-pressure mechanical ventilation. Extracorporeal CO2 removal combined with low- frequency positive-pressure ventilation (ECCO2R-LFPPV) has been proposed to reduce lung injury while supporting respiratory failure. Use of this technique in 23 patients resulted in the following: a dramatic and highly significant increase of PaO2 obtained rapidly with ECCO2R-LFPPV, allowing subsequent reduction in inspired oxygen fraction; a reduction of the risk of barotrauma evidenced by a significant decrease in pressures and insufflated volumes; a survival rate of 50 percent. Bleeding was the only complication related to the technique and was the cause of death in four patients. This method allowed improvement in gas exchange along with reduction of the risk of barotrauma caused by the ventilator.
PMID
8365306 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8365306]
Institution
(Brunet, Belghith, Mira, Lanore, Vaxelaire, Santucci, Dhainaut) Hopital Cochin, 27 rue du Fbg St Jacques, Paris 75014, France
Publisher
American College of Chest Physicians (3300 Dundee Road, Northbrook IL 60062-2348, United States)

Link to the Ovid Full Text or citation:
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526.

Low frequency positive-pressure ventilation and extracorporeal CO2 removal. Treatment of acute respiratory distress syndrome in adults. Ventilation apneique et epuration extracorporelle de CO2. Traitement du syndrome de detresse respiratoire aigue de l'adulte <Ventilation apneique et epuration extracorporelle de CO2. Traitement du syndrome de detresse respiratoire aigue de l'adulte.>
Belghith M., Brunet F.
La Revue du praticien. 43 (16) (pp 2089-2092), 1993. Date of Publication: 15 Oct 1993.
AN: 24884595
PMID
8134790 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8134790]
Institution
(Belghith, Brunet) Service de reanimation medicale de l'hopital Cochin, Paris.

Link to the Ovid Full Text or citation:
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527.

Venovenous single lumen cannula extracorporeal lung support in neonates. A five year experience.
Chevalier J.Y., Couprie C., Larroquet M., Renolleau S., Durandy Y., Costil J.
ASAIO Journal. 39 (3) (pp M654-M658), 1993. Date of Publication: 1993.
AN: 23311780
The authors have developed a venovenous extracorporeal lung support technique with an original single lumen cannula to avoid the carotid ligation of venoarterial extracorporeal membrane oxygenation (ECMO). During a 5 year period, the authors have used the technique in 107 neonates (weight: 3.045 +/- 0.61 kg; gestational age: 38.1 +/- 2.2 weeks). All of the neonates had severe respiratory failure despite maximal conventional treatment and the same indications as those for ECMO. The venovenous technique associates extracorporeal CO2 removal and apneic oxygenation. The system includes a single lumen cannula, an alternating clamp that generates a tidal flow, and an original non-occlusive roller pump that avoids the use of a venous bladder. The PaCO2 was normal (34.6 +/- 3.9 mmHg) with a blood flow of 40- 50% of the total cardiac output. Under apneic oxygenation, PaO2 improved rapidly, allowing a decrease in FIO2 and mean airway pressure, minimizing barotrauma. The mean duration of bypass was 117.8 +/- 83.9 hr, and 91 of the 107 (85%) neonates were weaned from AREC. The technical complications were less important than those associated with venoarterial ECMO. The authors conclude that AREC is as effective as venoarterial ECMO and is easier to use.
PMID
8268619 [http://www.ncbi.nlm.nih.gov/pubmed/?term=8268619]
Institution
(Chevalier, Couprie, Larroquet, Renolleau, Durandy, Costil) Neonatal/Pediat. Intensive Care Unit, Hopital d'Enfants Armand Trousseau, 26 Avenue du Dr Arnold Notter, 75012 Paris, France
Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

Link to the Ovid Full Text or citation:
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528.

Extracorporeal membrane oxygenation (ECMO) for pulmonary parenchymal disease in older children.
Klein M.D., Whittlesey G.C., Lieh-Lai M.
Pediatric Surgery International. 8 (4) (pp 283-293), 1993. Date of Publication: 1993.
AN: 23213863
Extracorporeal membrane oxygenation (ECMO) for the support of children outside the newborn period who have pulmonary failure is only recently becoming accepted. It is again being applied, after earlier failures, because well-trained teams and improved equipment and techniques are available following the success of neonatal ECMO. In addition, in Europe extracorporeal CO2 removal (ECCO2R) in adults has been more successful. The use of ECMO for pulmonary failure in children does not have fixed indications and has had considerably less success than neonatal ECMO. Patients who require inspired oxygen fractions of over 0.5 and positive end-expiratory pressures of over 6 cm H2O for more than 12 h after being treated for more than 48 h should be considered candidates, given the high mortality of children with ARDS (70%). Survival averages 50% to 60%. Circuits and patient management techniques are very similar to those for newborn ECMO, but patients usually require longer times on ECMO. There are many more options for cannulation for both venoarterial and venovenous techniques than in neonatal and cardiac ECMO. The improving results indicate that ECMO will play a part in treating children with pulmonary failure. Further studies will be required to determine which patients can benefit from ECMO as well as the exact application in each case.
Institution
(Klein, Whittlesey, Lieh-Lai) Department of Surgery, Wayne State Univ School of Medicine, Children's Hospital of Michigan, 3901 Beaubien Boulevard, Detroit, MI 48201, United States
Publisher
Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

Link to the Ovid Full Text or citation:
Click here for full text options

529.

Percutaneous extracorporeal CO2 removal in a patient with bullous emphysema with recurrent bilateral pneumothoraces and respiratory failure.
Pesenti A., Rossi G.P., Pelosi P., Brazzi L., Gattinoni L.
Anesthesiology. 72 (3) (pp 571-573), 1990. Date of Publication: 1990.
AN: 20095380
PMID
2106807 [http://www.ncbi.nlm.nih.gov/pubmed/?term=2106807]
Institution
(Pesenti, Rossi, Pelosi, Brazzi, Gattinoni) Institute of Anesthesia and Intensive Care, University of Milan, Milan Italy
Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA

19106-3621, United States)

Link to the Ovid Full Text or citation:
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530.

Extracorporeal CO2-removal with a heparin coated artificial lung.
Peters J., Radermacher P., Kuntz M.E., Rosenbauer K.A., Breulmann M., Burrig K.F., Hopf H.B., Rossaint R., Schulte H.D., Olsson P., Falke K.J.
Intensive Care Medicine. 14 (5) (pp 578-584), 1988. Date of Publication: 1988.
AN: 18206501
Treatment of severe acute respiratory failure with extracorporeal gas exchange necessitating near complete systemic anticoagulation requires a delicate balance to be maintained between disseminated intravascular coagulation and hemorrhagic complications. The present study describes our first experience using a heparin coated extracorporeal artificial lung and circuitry during clinical extracorporeal CO2 removal. In spite of a partial thromboplastin time and activated clotting time within or close to the normal range, neither laboratory evidence for disseminated intravascular coagulation induced by the extracorporeal circuit nor thrombi in the pulmonary vasculature were found. Scanning electron microscopy of the heparin coated hollow fiber gas exchanger demonstrated only minor deposits on the surface. Use of a heparin coated artificial lung may enhance the margin of safety of extracorporeal gas exchange and ultimately broaden its indications.
PMID
3221012 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3221012]
Institution
(Peters, Radermacher, Kuntz, Rosenbauer, Breulmann, Burrig, Hopf, Rossaint, Schulte, Olsson, Falke) Department of Anesthesiology, University of Dusseldorf, D-4000 Dusseldorf 1 Germany
Publisher
Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

Link to the Ovid Full Text or citation:
Click here for full text options

531.

Treatment of acute pulmonary failure with extracorporeal support: 100% Survival in a pediatric population.
Ryan D.P., Doody D.P.
Journal of Pediatric Surgery. 27 (8) (pp 1111-1117), 1992. Date of Publication: 1992.
AN: 22253642
Since February 1990, five children, aged 10 days to 6.5 years, were treated with extracorporeal lung support at our hospital for acute, unrelenting pulmonary failure. Two had viral pneumonia: one with respiratory syncytial virus (RSV) bronchiolitis, and one with herpes simplex virus pneumonia, encephalitis, and disseminated intravascular coagulation. One presented with a febrile illness followed by a pulmonary hemorrhage. Two patients had adult respiratory distress syndrome (ARDS) complicating severe systemic illnesses, toxic epidermal necrolysis in one

and cat scratch disease with encephalitis in the other. All children had diffuse parenchymal lung disease by chest x-ray. On maximum medical management all patients were developing carbon dioxide retention and progressive hypoxemia, exceeding previously established NIH study criteria for extracorporeal treatment. Three children (10 days, 2 months, 13 months) were placed on venoarterial support and two children (20 months and 6.5 years) were placed on venovenous extracorporeal support (ECCO2R). Three of the five had open lung biopsies performed, which showed findings consistent with a moderate to severe cellular phase of ARDS. No viral inclusions were found in the patient with RSV infection. One hundred percent immediate survival was achieved in this patient population. Average duration of support was 330 hours (range, 89 to 840). Following completion of extracorporeal support, all children were successfully weaned from the ventilator with an average time to extubation of 23.2 days (range, 2 to 58 days). One child died of congestive heart failure following palliative surgery for a complex noncyanotic congenital cardiac lesion 35 days after successfully weaning from extracorporeal support for an acute febrile illness and pulmonary hemorrhage. All remaining children have been discharged home, are doing well, and have not shown any complications of therapy. Follow-up pulmonary function tests have shown return of normal compliance and lung volumes. While extracorporeal life support has previously been thought to be ineffective in the treatment of primary pulmonary parenchymal failure, these data suggest that this therapy can result in improved survival with return of normal pulmonary function.
PMID
1328587 [http://www.ncbi.nlm.nih.gov/pubmed/?term=1328587]
Institution
(Ryan, Doody) Department of Pediatric Surgery, Massachusetts General Hospital, Fruit St, Boston, MA 02114, United States
Publisher
W.B. Saunders (Independence Square West, Philadelphia PA 19106-3399, United States)

532.

Effects of aprotinin on hemorrhagic complications in ARDS patients during prolonged extracorporeal CO2 removal.
Brunet F., Mira J.P., Belghith M., Lanore J.J., Schlumberger S., Toulon P., Dhainaut J.F.
Intensive Care Medicine. 18 (6) (pp 364-367), 1992. Date of Publication: 1992.
AN: 22327900
The effects of aprotinin, a broad-based proteinase inhibitor, in the management of hemorrhagic complications during prolonged venovenous extracorporeal CO2 removal in patients with adult respiratory distress syndrome are not evaluated. In two patients, aprotinin infusion was added to heparin to treat bleeding, occurring after few days of bypass and responsible for respiratory and hemodynamic deterioration. After aprotinin infusion (loading dose of 2 x 106 kIU followed by a continuous infusion of 5 x 105 kIU/h) combined with heparin, bleeding vanished until the end of bypass.
PMID
1281849 [http://www.ncbi.nlm.nih.gov/pubmed/?term=1281849]
Institution
(Brunet, Mira, Belghith, Lanore, Schlumberger, Toulon, Dhainaut) Service de Reanimation Medicale, Hopital Cochin, F-75674 Paris Cedex 14, France

Publisher
Springer Verlag (Tiergartenstrasse 17, Heidelberg D-69121, Germany)

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533.

Intravascular oxygenation for advanced respiratory failure.
Jurmann M.J., Demertzis S., Schaefers H.-J., Wahlers T., Haverich A.
ASAIO Journal. 38 (2) (pp 120-124), 1992. Date of Publication: 1992.
AN: 22160375
Severe acute respiratory failure of varying etiology may require the temporary use of artificial gas exchange devices. So far, extracorporeal membrane oxygenation and extracorporeal carbon dioxide removal have been used successfully for this purpose. A totally implantable intravascular oxygenator (IVOX) recently became available. The authors have used IVOX in three patients who presented with severe respiratory failure secondary to pneumonia (n = 2) and post-traumatic adult respiratory distress syndrome (n = 1). At the time of implantation, all patients had hypoxemia (PaO2 < 60) despite a 100% inspired oxygen concentration and forced mechanical ventilation. The duration of IVOX therapy ranged from 12 to 71 hr. All patients initially showed improvement in arterial oxygenation, allowing for moderate reduction of ventilator therapy after several hours. In one patient the pulmonary status deteriorated further, and she died from multiple organ failure despite IVOX therapy. One patient could be stabilized but died from other causes. The third patient is a long-term survivor 18 months after IVOX therapy. Gas transfer capabilities of IVOX are limited when compared to extracorporeal membrane oxygenation, and this may restrict its clinical applicability in cases of severe adult respiratory distress syndrome. However, IVOX may be used successfully in selected patients with less severe respiratory failure.
PMID
1421605 [http://www.ncbi.nlm.nih.gov/pubmed/?term=1421605]
Institution
(Jurmann, Demertzis, Schaefers, Wahlers, Haverich) Thoracic and Cardiovasc. Surg. Div., Surgical Center, Hannover Medical School, Konstanty-Gutschow-Strasse 8, D-3000 Hannover 61, Germany
Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

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534.

Extracorporeal carbon dioxide removal performed with surface-heparinized equipment in patients with ARDS.
Bindslev L., Bohm C., Jolin A., Hambraeus Jonzon K., Olsson P., Ryniak S.
Acta anaesthesiologica Scandinavica. Supplementum. 95 (pp 125-130; discussion 130-131), 1991. Date of Publication: 1991.
AN: 21876642

To avoid the drawbacks of systemic anticoagulation during prolonged extracorporeal circulation in patients with adult respiratory distress syndrome (ARDS) a heparinization technique has been developed by which partially degraded heparin can be covalently end-point attached to the surface of the equipment constituting the extracorporeal circuit (Carmeda Bio-Active Surface, CBAS) thereby localizing the anticoagulatory effect. Since 1986 we have used extracorporeal circuits and membrane lungs coated with the CBAS for extracorporeal lung assistance (ECLA) in 14 patients suffering from ARDS. The patients were on ECLA for 3 to 55 days with a survival rate of 43%. Our experience so far is that by using equipment coated with CBAS it is possible to perform long-term extracorporeal circulation with a minimum of intravenously administered heparin, thus avoiding the risk of major coagulation defects.
PMID
1927222 [http://www.ncbi.nlm.nih.gov/pubmed/?term=1927222]
Institution
(Bindslev, Bohm, Jolin, Hambraeus Jonzon, Olsson, Ryniak) Department of Anaesthesiology, Karolinska Hospital, Stockholm, Sweden.

Link to the Ovid Full Text or citation:
Click here for full text options

535.

Support when gas exchange fails - ECMO, ECCO2R and IVOX.
Lanigan C.J., Withington P.S.
Clinical Intensive Care. 2 (4) (pp 210-216), 1991. Date of Publication: 1991.
AN: 21278422
PMID
10148882 [http://www.ncbi.nlm.nih.gov/pubmed/?term=10148882]
Institution
(Lanigan, Withington) The Hospitals for Sick Children, Great Ormond Street, London WC1N 3JH United Kingdom
Publisher
Taylor and Francis Ltd. (4 Park Square, Milton Park, Abingdon, Oxfordshire OX14 4RN, United Kingdom)

Link to the Ovid Full Text or citation:
Click here for full text options

536.

The prognostic value of extracellular matrix component concentrations in serum during treatment of adult respiratory distress syndrome with extracorporeal CO2 removal.
Kropf J., Grobe E., Knoch M., Lammers M., Grossner A.M., Lennartz H.
European Journal of Clinical Chemistry and Clinical Biochemistry. 29 (12) (pp 805-812), 1991. Date of Publication: 1991.
AN: 22061291
The time-dependent concentrations of hyaluronan, aminoterminal propeptide of type III procollagen, and laminin were determined in sera of 16 patients with severe adult

respiratory distress syndrome during treatment with an extracorporeal CO2 removal device. Patients were classified according to lung parameters as responders (n = 10) and non-responders (n = 6) to extracorporeal CO2 removal. At the beginning of treatment strongly elevated serum concentrations of all studied extracellular matrix components were found. During the first 6 - 11 days of treatment the concentrations of aminoterminal propeptide of type III procollagen and hyaluronan increased further in non-responders but decreased in the majority of responders, while laminin decreased in both groups. No significant correlations were found between the serum concentrations of connective tissue components and the parameters of lung function. By non-parametric analysis of variance, significant differences between responders and non-responders according to treatment time could be established. By analysing the time course of the serum concentrations of hyaluronan and aminoterminal propeptide of type III procollagen, a total differentiation between responders and non-responders was made possible by the trends of these analytes as early as three days after the start of treatment. The determination of aminoterminal propeptide of type III procollagen and hyaluronan in serum of patients with adult respiratory distress syndrome might therefore have prognostic significance in extracorporeal CO2 removal.
PMID
1797106 [http://www.ncbi.nlm.nih.gov/pubmed/?term=1797106]
Institution
(Kropf, Grobe, Knoch, Lammers, Grossner, Lennartz) Dept of Clinical Chemistry, Philipps University, Baldingerstrasse, W-3550 Marburg, Germany
Publisher
Walter de Gruyter and Co. (Genthiner Strasse 13, Berlin D-10785, Germany)

537.

Interhospital transfer of a patient undergoing extracorporeal carbon dioxide removal.
Kee S.S., Sedgwick J., Bristow A.
British Journal of Anaesthesia. 66 (1) (pp 141-144), 1991. Date of Publication: 1991.
AN: 21056381
Extracorporeal circulation techniques are being used increasingly in patients with acute cardiac or pulmonary failure. Some of these patients may subsequently require transportation, which has limited the use of these techniques in hospitals without on site transplantation facilities. We report a case of adult respiratory distress syndrome that demonstrates a solution to this problem.
PMID
1900013 [http://www.ncbi.nlm.nih.gov/pubmed/?term=1900013]
Institution
(Kee, Sedgwick, Bristow) Department of Anaesthesia, St Bartholomew's Hospital, West Smithfield, London, United Kingdom
Publisher
Oxford University Press (Great Clarendon Street, Oxford OX2 6DP, United Kingdom)

538.

Low-frequency positive-pressure ventilation with extracorporeal carbon dioxide removal.
Abrams J.H., Gilmour I.J., Kriett J.M., Bitterman P.B., Irmiter R.J., McComb R.C., Cerra F.B.
Critical Care Medicine. 18 (2) (pp 218-220), 1990. Date of Publication: 1990.
AN: 20053019
Successful use of a new technique, low-frequency positive-pressure ventilation with extracorporeal CO2 removal (LFPPV-ECCR) is presented. The association of fulminant respiratory failure with CNS hemangioblastoma, described in the present patient, has been reported only once before, in 1928.
PMID
2105181 [http://www.ncbi.nlm.nih.gov/pubmed/?term=2105181]
Institution
(Abrams, Gilmour, Kriett, Bitterman, Irmiter, McComb, Cerra) Department of Surgery, University of Minnesota, Minneapolis, MN United States
Publisher
Lippincott Williams and Wilkins (351 West Camden Street, Baltimore MD 21201-2436, United States)

Link to the Ovid Full Text or citation:
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539.

Extracorporeal gas exchange in adult respiratory distress syndrome: Associated morbidity and its surgical treatment.
Wagner P.K., Knoch M., Sangmeister C., Muller E., Lennartz H., Rothmund M.
British Journal of Surgery. 77 (12) (pp 1395-1398), 1990. Date of Publication: 1990.
AN: 21030105
Extracorporeal carbon dioxide removal (ECCO2-R) over a membrane lung is a new therapy for patients with adult respiratory distress syndrome (ARDS) who frequently suffer from lung complications caused by long-term artificial ventilation and who may require major thoracic surgery. This is a report of 76 patients with severe ARDS who were treated by ECCO2-R. Twenty-six of these 76 patients required thoracotomy: 19 for pneumothorax and pneumatocele, and seven for haemothorax, infected lung necrosis or oesophagotracheal fistula. Most pneumothoraces were bilateral. Ten of these 26 patients required reoperation, usually for extensive persisting alveolar air leaks. Sixteen (62 per cent) of the 26 patients who had a thoracotomy and 22 (44 per cent) of the 50 patients without surgery survived. These results demonstrate that performing a thoracotomy, if necessary, does not diminish the survival change of high-risk patients with severe ARDS.
PMID
2276027 [http://www.ncbi.nlm.nih.gov/pubmed/?term=2276027]
Institution
(Wagner, Knoch, Sangmeister, Muller, Lennartz, Rothmund) Klinik fur Allgemeinchirurgie, Baldingerstrasse, D-3550 Marburg, Germany
Publisher
John Wiley and Sons Ltd (Southern Gate, Chichester, West Sussex PO19 8SQ, United Kingdom)

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540.

Extracorporeal CO2 removal therapy for adult respiratory distress syndrome patients: A computerized protocol controlled trial.
Morris A.H., Wallace C.J., Clemmer T.P., Orme Jr. J.F., Weaver L.K., Dean N.C., Butler S., Suchyta M.R., East T.D., Sittig D.F.
Reanimation Soins Intensifs Medecine d'Urgence. 6 (7) (pp 485-490), 1990. Date of Publication: 1990.
AN: 21012894
Institution
(Morris, Wallace, Clemmer, Orme Jr., Weaver, Dean, Butler, Suchyta, East, Sittig) Pulmonary Division, LDS Hospital, Salt Lake City, UT 84143 United States
Publisher
Expansion Scientifique Publications S.A. (15 Rue St-Benoit, Paris Cedex 06 75278, France)

Link to the Ovid Full Text or citation:
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541.

A controlled clinical trial of a new 3-step therapy that includes extracorporeal CO2 removal for ARDS.
Morris A.H., Menlove R.L., Rollins R.J., Wallace C.J., Beck E.
ASAIO Transactions. 34 (1) (pp 48-53), 1988. Date of Publication: 1988.
AN: 18094593
PMID
3132189 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3132189]
Institution
(Morris, Menlove, Rollins, Wallace, Beck) Pulmonary Division, LDS Hospital, Salt Lake City, UT 84143 United States
Publisher
Lippincott Williams and Wilkins (530 Walnut Street,P O Box 327, Philadelphia PA 19106-3621, United States)

Link to the Ovid Full Text or citation:
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542.

Prolonged extracorporeal CO2 - Removal in severe adult respiratory distress syndrome. Neuropathological observations in two cases.
Krajewski S., Seitz R.J., Schober R.
Intensive Care Medicine. 13 (1) (pp 26-29), 1987. Date of Publication: 1987.

AN: 17027850
Extracorporeal CO2-removal (EC-CO2-R) using a membrane lung system was applied for 12 and 20 days respectively to two young men with adult respiratory distress syndrome (ARDS). Neuropathological examination revealed only moderate hypoxic changes of unusual distribution. In the first case nerve cell loss in Sommer's sector of the hippocampus and focal incomplete necroses in both putamina were interpreted as the result of cardiac arrest at the onset of the disease rather than of chronic hypoxia. Findings in the second case were confined to nerve cell necroses of a minor degree in the cerebral cortex. Remarkably, the cerebellum was spared in both cases. Our observations suggest that EC-CO2-R was not associated with neuropathological findings which could be attributed specifically to this procedure.
PMID
3104430 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3104430]
Institution
(Krajewski, Seitz, Schober) Department of Neuropathology, University of Dusseldorf, D-4000 Dusseldorf Germany

Link to the Ovid Full Text or citation:
Click here for full text options

543.

Extracorporeal CO2 removal in severe adult respiratory distress syndrome.
Hickling K.G.
Anaesthesia and Intensive Care. 14 (1) (pp 46-53), 1986. Date of Publication: 1986.
AN: 16085520
Sixty-five per cent survival has been achieved in a group of patients with severe ARDS and a predicted mortality of 92%, by the use of Gattinoni's technique of extracorporeal CO2 removal. In patients and animals the technique has usually resulted in rapid improvement in the radiographic appearance and lung function. There are several possible mechanisms by which the technique may facilitate lung repair, including improvement of lung tissue oxygenation, the avoidance of high airway pressures and regional alkalosis in the lung, a reduction in oxygen toxicity, and the frequently observed reduction in pulmonary artery pressure. The apparent effectiveness of the technique and other associated evidence have implications which should lead us to reconsider some aspects of our conventional management of patients with severe ARDS.
PMID
3082238 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3082238]
Institution
(Hickling) Department of Intensive Care, Christchurch Hospital, Christchurch New Zealand

Link to the Ovid Full Text or citation:
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544.

Lung function during successful 10-day extracorporeal CO2 removal in acute lung injury: Case report. LUNGENFUNKTION WAHREND 10-TAGIGER

ERFOLGREICHER EXTRAKORPORALER CO2-ELIMINATION BEI SCHWEREM AKUTEN LUNGENVERSAGEN. FALLBERICHT <LUNGENFUNKTION WAHREND 10-TAGIGER ERFOLGREICHER EXTRAKORPORALER CO2-ELIMINATION BEI SCHWEREM AKUTEN LUNGENVERSAGEN. FALLBERICHT.>
Thies W.R., Breulmann M., Lehnsen U.
Anaesthesist. 34 (4) (pp 197-202), 1985. Date of Publication: 1985.
AN: 15088941
Extracorporeal CO2-removal (ECCO2-R) with low-frequency positive-pressure ventilation (LFPPV) may relieve the acutely injured lung from the burden and the risks of excessively high ventilatory minute volumes and airway pressures. It was the purpose of this study to document the evolution of lung function during clinical ECCO2-R with special emphasis on extravascular lung water. ECCO2-R was applied in a 21-year-old female patient suffering from severe post-traumatic infectious adult respiratory distress syndrome. The indication for ECCO2-R was based on the following findings: total static lung compliance 25 cm x cm H2O-1; arterial pO2 50 mm Hg with an inspiratory oxygen concentration of 100%; intrapulmonary right-to-left shunt over 50% of the cardiac output; and extravascular lung water 24 ml x kg-1 (normal 4.5-7 ml x kg-1). ECCO2-R was shown to provide satisfactory conditions for improving the above mentioned abnormal parameters of pulmonary function. Pressure-limited low- frequency mechanical ventilation allowed successful management of several pneumothoraces with bronchopleural fistulas which occurred during the procedure. It is concluded that these complications of positive airway pressure would have led to the patient's death under the conditions of conventional mechanical ventilation.
PMID
3923858 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3923858]
Institution
(Thies, Breulmann, Lehnsen) Institut fur Anasthesiologie, Chirurgische Klinik B fur Herz und Thoraxchirurgie, Universitat Dusseldorf, D 4000 Dusseldorf 1 Germany

545.

Extracorporeal carbon dioxide removal in acute respiratory failure.
Gattinoni L., Pesenti A., Pelizzola A.
Annales Chirurgiae et Gynaecologiae. 71 (Suppl. 196) (pp 77-79), 1982. Date of Publication: 1982.
AN: 13182793
PMID
6818890 [http://www.ncbi.nlm.nih.gov/pubmed/?term=6818890]
Institution
(Gattinoni, Pesenti, Pelizzola) Ist. Anest. Rianim., Univ. Studi Milano, 20122 Milano Italy

546.

Extracorporeal CO2 removal by hemodialysis in patients with chronic respiratory failure.
Matsunobe S., Isobe J., Mizuno H., Shimizu Y.
ASAIO transactions / American Society for Artificial Internal Organs. 33 (3) (pp 441-445), 1987. Date of Publication: 1987 Jul-Sep.
AN: 17817870
PMID
3118918 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3118918]
Institution
(Matsunobe, Isobe, Mizuno, Shimizu) Respiratory Center, Shiga Health Insurance Hospital, Japan.

Link to the Ovid Full Text or citation:
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547.

Low-frequency positive-pressure ventilation with extracorporeal CO2 removal in severe acute respiratory failure.
Gattinoni L., Pesenti A., Mascheroni D.
Journal of the American Medical Association. 256 (7) (pp 881-886), 1986. Date of Publication: 1986.
AN: 16077399
Forty-three patients were entered in an uncontrolled study designed to evaluate extracorporeal membrane lung support in severe acute respiratory failure of parenchymal origin. Most of the metabolic carbon dioxide production was cleared through a low-flow venovenous bypass. To avoid lung injury from conventional mechanical ventilation, the lungs were kept 'at rest' (three to five breaths per minute) at a low peak airway pressure of 35 to 45 cm H2O (3.4 to 4.4 kPa). The entry criteria were based on gas exchange under standard ventilatory conditions (expected mortality rate, > 90%). Lung function improved in thirty-one patients (72.8%), and 21 patients (48.8%) eventually survived. The mean time on bypass for the survivors was 5.4 +/- 3.5 days. Improvement in lung function, when present, always occurred within 48 hours. Blood loss averaged 1800 +/- 850 mL/d. No major technical accidents occurred in more than 8000 hours of perfusion. Extracorporeal carbon dioxide removal with low-frequency ventilation proved a safe technique, and we suggest it as a valuable tool and an alternative to treating severe acute respiratory failure by conventional means.
PMID
3090285 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3090285]
Institution
(Gattinoni, Pesenti, Mascheroni) Istituto di Anestesia e Rianimazione, Universita di Milano, Milano Italy

Link to the Ovid Full Text or citation:
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548.

Management of severe ARDS with low frequency positive pressure ventilation and extracorporeal CO2 removal.
Hickling K.G., Downward G., Davis F.M., A'Court G.
Anaesthesia and Intensive Care. 14 (1) (pp 79-83), 1986. Date of Publication: 1986.
AN: 16085525
PMID
3082239 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3082239]
Institution
(Hickling, Downward, Davis, A'Court) Department of Intensive Care, Christchurch Hospital, Christchurch New Zealand

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549.

Ventilatory impact of partial extracorporeal CO2 removal (PECOR) in ARF patients.
Marcolin R., Mascheroni D., Pesenti A., Bombino M., Gattinoni L.
ASAIO transactions / American Society for Artificial Internal Organs. 32 (1) (pp 508-510), 1986. Date of Publication: 1986 Jul-Sep.
AN: 17660453
PMID
3096360 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3096360]

Link to the Ovid Full Text or citation:
Click here for full text options

550.

Tracheal and alveolar gas composition during low-frequency positive pressure ventilation with extracorporeal CO2-removal (LFPPV-ECCO2R).
Peters J., Radermacher P., Pesenti A.
Intensive Care Medicine. 11 (4) (pp 213-217), 1985. Date of Publication: 1985.
AN: 15043007
Tracheal and alveolar gas composition was studied by mass spectrometry in a patient with severe ARDS treated by low frequency positive pressure ventilation/extracorporeal CO2-removal (LFPPV-ECCO2R). Measured alveolar gas concentrations were compared with values derived from standard respiratory equations. As a result we found that during LFPPV-ECCO2R with a constant endotracheal O2-flow, alveolar gas composition cannot be predicted reliably from standard equations. The reasons for this finding are discussed. We conclude that monitoring of alveolar gas composition by mass spectrometry is of great value during LFPPV-ECCO2R if P(A)PO2, P(A-a)O2 and Q(va)/Q(t) are to be determined correctly.
PMID
3900167 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3900167]
Institution
(Peters, Radermacher, Pesenti) Institute of Anesthesiology, University of Dusseldorf, D-4000 Dusseldorf Germany

551.

New therapeutic and diagnostic aspects in artificial respiration of intensive-care patients. NEUERE THERAPEUTISCHE UND DIAGNOSTISCHE ASPEKTE BEI BEATMUNG VON INTENSIVPATIENTEN <NEUERE THERAPEUTISCHE UND DIAGNOSTISCHE ASPEKTE BEI BEATMUNG VON INTENSIVPATIENTEN.>
Wolff G.
Praxis und Klinik der Pneumologie. 39 (SUPPL. 1) (pp 557-560), 1985. Date of Publication: 1985.
AN: 16141748
During the past ten years the strategy of artificial respiration because of acute respiration insufficiency had to be changed. It is first of all necessary to minimise the airway pressure (because of haemodynamics and barotrauma). This led to 1.) various suggestions for determining an 'optimal' PEEP; 2.) attempts to limit the high airway pressure in unilateral affections by lateral positioning and unilateral PEEP (differential ventilation); 3.) the tendency to rapidly utilise the pressure-reducing effect of spontaneous respiration, i.e. to combine as quickly as possible artificial respiration with spontaneous respiration (IMV, spontaneous respiration with supporting pressure) or to extubate and allow the patient to effect spontaneous respiration with CPAP via a face-mask (CPPB); 4.) special methods such as high-frequency respiration (HFV) and 5.) extracorporal CO2 removal (ECCO2R). HFV has proved its worth in bronchopleural fistulas and endobronchial surgery, but not in pneumonia or ARDS. The initiators of ECCO2R were successful with it, but the method is technically complicated and costly and has not been generally accepted. The method that has come to stay is that of differentiated respiration with lowest possible respiration pressure, i.e. low frequency and minimum inspiration flow (also known as 'inversed-ratio ventilation'). To fully utilise the possibilities offered by differentiated respiration, new diagnostic procedures are required: 1.) In research, determination of V/Q distribution; 2.) in routine working, continuous computer-assisted real time breath-by-breath analysis of gas exchange, of pulmonary compliance, and of the pulmonary volume.
Institution
(Wolff) Klinik fur Herz- und Thoraxchirurgie, Klinische Physiologie, Kantonsspital, CH-4031 Basel Switzerland

552.

Multidisciplinary approach to extracorporeal respiratory assist for acute pulmonary failure.
Solca M., Pesenti A., Iapichino G.
International Surgery. 70 (1) (pp 9-11), 1985. Date of Publication: 1985.
AN: 15120145
A case of acute post-traumatic pulmonary failure was treated by extracorporeal respiratory assist, after conventional therapy had failed. Veno-venous bypass was

established, with low extracorporeal blood flow (1.6-2 l min-1), and high exchange surface area membrane lungs (7 m2), according to the technique of low-frequency positive-pressure ventilation with extracorporeal carbon-dioxide removal. After a first disconnection, the evolution of the lung disease necessitated a second surgical procedure, during which a chest tube perforated the patient's right lower, pulmonary lobe. A two-stage right thoracotomy was performed, with the patient connected to the extracorporeal system, and receiving full heparinization. Massive bleeding and severe hypoxia were encountered, but successfully overcome. The patient is now a long-term survivor.
PMID
3894272 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3894272]
Institution
(Solca, Pesenti, Iapichino) Rianimazione 'E. Vecla', Ospedale Maggiore, 1-20122 Milano Italy

553.

Studies of complement activation in ARDS patients treated by long-term extracorporeal CO2 removal.
Gardinali M., Cicardi M., Frangi D.
International Journal of Artificial Organs. 8 (3) (pp 135-140), 1985. Date of Publication: 1985.
AN: 15047771
PMID
3928501 [http://www.ncbi.nlm.nih.gov/pubmed/?term=3928501]
Institution
(Gardinali, Cicardi, Frangi) Istituto di Scienze Biomediche, Ospedale S. Paolo, Clinica Medica V, Universita degli Studi, Milano Italy

554.

Complement activation in adult respiratory distress syndrome treated with long-term extracorporeal CO2 removal.
Agostoni A., Cicardi M., Bergamaschini L., Gardinali M., Frangi D., Gattinoni L., Pesenti A.
Transactions - American Society for Artificial Internal Organs. 29 (pp 227-230), 1983. Date of Publication: 1983.
AN: 14727616
PMID
6424303 [http://www.ncbi.nlm.nih.gov/pubmed/?term=6424303]

555.

Low frequency positive pressure ventilation with extracorporeal CO2 removal (LEPPV-ECCO2R) in acute respiratory failure (ARF): technique.
Pesenti A., Pelizzola A., Mascheroni D., Uziel L., Pirovano E., Fox U., Gattinoni L., Kolobow T.
Transactions - American Society for Artificial Internal Organs. 27 (pp 263-266), 1981.
Date of Publication: 1981.
AN: 12610139
PMID
6800095 [http://www.ncbi.nlm.nih.gov/pubmed/?term=6800095]

Link to the Ovid Full Text or citation:
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556.

Reversal of terminal acute respiratory failure by low frequency positive pressure ventilation with extracorporeal removal of CO2 (LFPPV-ECCO2R).
Gattinoni L., Pesenti A., Pelizzola A., Caspani M.L., Iapichino G., Agostoni A., Damia G., Kolobow T.
Transactions - American Society for Artificial Internal Organs. 27 (pp 289-293), 1981.
Date of Publication: 1981.
AN: 12610145
PMID
6800099 [http://www.ncbi.nlm.nih.gov/pubmed/?term=6800099]

Link to the Ovid Full Text or citation:
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