Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) <1946 to February 04, 2021>
Search Strategy:
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1 "interventional lung assist*".mp. (84)
2 (extracorporeal adj (CO2 or "carbon dioxide") adj removal).mp. (423)
3 ILA*.mp. (3781)
4 novalung*.mp. (77)
5 PECLA*.mp. (39)
6 "percutaneous extracorporeal lung assist*".mp. (2)
7 "partial extracorporeal support*".mp. (0)
8 (("carbon dioxide" or CO2) adj dialysis*).mp. (7)
9 ECCO2R*.mp. (184)
10 "low flow ECCO2R*".mp. (19)
11 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 (4303)
12 exp Respiratory Distress Syndrome, Adult/ (20112)
13 "respiratory failure".mp. (33544)
14 "acute lung injury".mp. (15790)
15 12 or 13 or 14 (62944)
16 11 and 15 (340)
17 limit 16 to humans (256)

****

1.

Increased respiratory morbidity in individuals with interstitial lung abnormalities.
Hoyer N; Thomsen LH; Wille MMW; Wilcke T; Dirksen A; Pedersen JH; Saghir Z; Ashraf H; Shaker SB.
BMC Pulmonary Medicine. 20(1):67, 2020 Mar 19.
[Journal Article]
UI: 32188453
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.
METHODS: 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.
RESULTS: 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.
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Author NameID
Hoyer, Nils; ORCID: http://orcid.org/0000-0003-4395-1837
Authors Full Name
Hoyer, Nils; Thomsen, Laura H; Wille, Mathilde M W; Wilcke, Torgny; Dirksen, Asger; Pedersen, Jesper H; Saghir, Zaigham; Ashraf, Haseem; Shaker, Saher B.
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Year of Publication
2020

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

2.

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):691-697, 2020 06.
[Journal Article. Observational Study]
UI: 31425258
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 m). 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 PCO2 from 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 CO2 removal 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 CO2 resulting in a decreased arterial PCO2, an increased arterial pH, and in a reduced ventilatory load.
Version ID
1
Status
MEDLINE
Authors Full Name
Grasselli, Giacomo; Castagna, Luigi; Bottino, Nicola; Scaravilli, Vittorio; Corcione, Nadia; Guzzardella, Amedeo; Bonifazi, Matteo; Rossi, Nicola; Zanella, Alberto; Pesenti, Antonio.
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Year of Publication
2020

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

3.

Extracorporeal CO2 Removal and the Alveolar Gas Equation.

Dickstein ML.
American Journal of Respiratory & Critical Care Medicine. 202(7):1057-1058, 2020 10 01.
[Letter. Comment]
UI: 32502357
Version ID
1
Status
MEDLINE
Authors Full Name
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Dickstein, Marc L. Columbia University, New York, New York.
Comments
Comment on (CON) Comment in (CIN)
Year of Publication
2020

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

4.

Reply to Dickstein: Extracorporeal CO2 Removal and the Alveolar Gas Equation.
Abrams D; Pesenti A; Brochard L; Brodie D.
American Journal of Respiratory & Critical Care Medicine. 202(7):1058-1059, 2020 10 01.
[Letter. Comment]
UI: 32502355
Version ID
1
Status
MEDLINE
Authors Full Name
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Institution
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Comments
Comment on (CON) Comment on (CON)
Year of Publication
2020

5.

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 FJG; Gottschalk A; Hilty MP; Pestana D; Sousa E; Tully R; Goldstein J; Harenski K.
Critical Care (London, England). 24(1):490, 2020 08 07.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 32768001
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.
METHODS: 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.
RESULTS: 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 (Pplat; >= 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 Pplat (< 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.
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Author NameID
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Combes, Alain; Auzinger, Georg; Capellier, Gilles; du Cheyron, Damien; Clement, Ian; Consales, Guglielmo; Dabrowski, Wojciech; De Bels, David; de Molina Ortiz, Francisco Javier Gonzalez; Gottschalk, Antje; Hilty, Matthias P; Pestana, David; Sousa, Eduardo; Tully, Redmond; Goldstein, Jacques; Harenski, Kai.

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Harenski, Kai. Baxter, Baxter Deutschland GmbH, Unterschleissheim, Germany.
Year of Publication
2020

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

6.

Extracorporeal Membrane Oxygenation for Respiratory Failure. [Review]
Quintel M; Bartlett RH; Grocott MPW; Combes A; Ranieri MV; Baiocchi M; Nava S;

Brodie D; Camporota L; Vasques F; Busana M; Marini JJ; Gattinoni L.
Anesthesiology. 132(5):1257-1276, 2020 05.
[Journal Article. Research Support, N.I.H., Extramural. Review]
UI: 32149776

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.

Version ID
1
Status
MEDLINE

Authors Full Name
Quintel, Michael; Bartlett, Robert H; Grocott, Michael P W; Combes, Alain; Ranieri, Marco V; Baiocchi, Massimo; Nava, Stefano; Brodie, Daniel; Camporota, Luigi; Vasques, Francesco; Busana, Mattia; Marini, John J; Gattinoni, Luciano.
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Year of Publication
2020

7.

[Update Extracorporeal Lung Support]. [Review] [German] Organersatzverfahren: Update Lungenersatzverfahren.
Reyher C; Muellenbach RM; Lepper PM; Mutlak H.
Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 55(3):165-177, 2020 Mar.
[Journal Article. Review]
UI: 32191970
Extracorporeal lung support is increasingly implemented worldwide in clinical practice in patients with severe acute respiratory distress syndrome (ARDS) and is required when mechanical ventilation is unable to establish sufficient pulmonary gas exchange or if the respirator settings are persistent elevated with an increased risk for ventilator induced lung injury (VILI). Besides that, hypercapnic respiratory failure in patients with acute exacerbation of COPD (AECOPD) or acute respiratory syndrome (ARDS) is common and may require extracorporeal elimination of carbon dioxide by ECCO2R, which also has been increasingly used in the clinical setting. For both therapeutic regimes there is up to date no clear evidence for a significant reduction in mortality in patients with ARDS. Therefore extracorporeal lung support should be still considered as a rescue therapy. In this review, based on a selective literature research and clinical experience of the authors, management of patients with extracorporeal lung assist, focusing on ECMO and ECCO2R is summarized.

Version ID
1
Status
MEDLINE
Authors Full Name
Reyher, Christian; Muellenbach, Ralf Michael; Lepper, Philipp Moritz; Mutlak, Haitham.
Other Abstract
Publisher
Das akute Lungenversagen des Erwachsenen (ARDS) ist nach wie vor mit einer hohen Mortalitat von ca. 40% belastet - eine grose Herausforderung fur die Intensivmedizin. Dieser Beitrag erlautert, bei welchen Befundkonstellationen die Lungenersatzverfahren ECMO (extrakorporale Membranoxygenierung) und ECCO2R (extrakorporale CO2-Elimination) als Rescue-Therapie zum Einsatz kommen konnen und worauf dabei zu achten ist.
Language: German
Year of Publication
2020

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

8.

Guidelines on the management of acute respiratory distress syndrome.
Griffiths MJD; McAuley DF; Perkins GD; Barrett N; Blackwood B; Boyle A; Chee N; Connolly B; Dark P; Finney S; Salam A; Silversides J; Tarmey N; Wise MP; Baudouin SV.

BMJ open respiratory research. 6(1):e000420, 2019.
[Journal Article. Practice Guideline]
UI: 31258917
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 cmH2O) 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.
Version ID
1
Status
MEDLINE
Author NameID
Griffiths, Mark J D; ORCID: https://orcid.org/0000-0002-1615-1896 Finney, Simon; ORCID: https://orcid.org/0000-0001-8219-1952
Authors Full Name
Griffiths, Mark J D; McAuley, Danny Francis; Perkins, Gavin D; Barrett, Nicholas; Blackwood, Bronagh; Boyle, Andrew; Chee, Nigel; Connolly, Bronwen; Dark, Paul; Finney, Simon; Salam, Aemun; Silversides, Jonathan; Tarmey, Nick; Wise, Matt P; Baudouin, Simon V.
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Year of Publication
2019

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

9.

Extracorporeal Life Support in Adults with Acute Respiratory Failure: Current Evidence-Based Practices. [Review]
Abbasi A; Devers C; Sodha NR; Ventetuolo CE.
Rhode Island Medicine. 102(10):39-42, 2019 Dec 02.
[Journal Article. Review]
UI: 31795533
There has been rapid adoption of extracorporeal life support (ECLS) in adult patients with severe acute respiratory failure. Extracorporeal membrane oxygenation (ECMO) is used to rescue patients with severe hypoxemic and hypercapnic respiratory failure refractory to optimal therapy and extracorporeal carbon dioxide removal (ECCO2R) supports hypercapnic respiratory failure and allows very low tidal volume ventilation to minimize the risk of ventilator-induced lung injury. Currently over 3,000 cases of ECLS (ECMO and ECCO2R) in adults with respiratory failure are reported annually to the Extracorporeal Life Support Organization registry. Advances in the care of patients with acute respiratory distress syndrome, technological innovations in extracorporeal circuitry, and insights from modern clinical trials of ECLS have led to favorable outcomes and a renewed interest in the use of this technology. Significant gaps in knowledge about best practices remain, however. This review will summarize indications for respiratory support in adults, current evidence available from clinical trials and our institution's experience with adult respiratory ECLS.
Version ID
1
Status
MEDLINE
Authors Full Name
Abbasi, Adeel; Devers, Cynthia; Sodha, Neel R; Ventetuolo, Corey E.
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Sodha, Neel R. Department of Surgery, Warren Alpert Medical School of Brown University, Providence, RI.
Ventetuolo, Corey E. Department of Medicine, Warren Alpert Medical School of Brown University; Department of Health Services, Policy & Practice, Brown School of Public Health, Providence, RI.
Year of Publication
2019

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

10.

Feasibility and safety of ultra-low tidal volume ventilation without extracorporeal circulation in moderately severe and severe ARDS patients.
Richard JC; Marque S; Gros A; Muller M; Prat G; Beduneau G; Quenot JP; Dellamonica J; Tapponnier R; Soum E; Bitker L; Richecoeur J; REVA research network.
Intensive Care Medicine. 45(11):1590-1598, 2019 11.
[Journal Article]
UI: 31549225
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.
METHODS: 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.
RESULTS: 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: 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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1
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Year of Publication
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11.

Efficacy and safety of lower versus higher CO2 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 VM.
Thorax. 74(12):1179-1181, 2019 12.
[Clinical Trial, Phase II. Journal Article. Multicenter Study. Research Support, Non-U.S. Gov't]
UI: 31409646
Retrospective analysis of the SUPERNOVA trial exploring the hypothesis that efficacy and safety of extracorporeal carbon dioxide removal (ECCO2R) to facilitate reduction of tidal volume (VT) to 4 mL/kg in patients with acute respiratory distress syndrome (ARDS) may differ between systems with lower (area of membrane length 0.59 m2; blood flow 300-500 mL/min) and higher (membrane area 1.30 m2; blood flow between 800 and 1000 mL/min) CO2 extraction capacity. Ninety-five patients with moderate ARDS were included (33 patients treated with lower and 62 patients treated with higher CO2 extraction devices). We found that (1) VT 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 ECCO2R-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 CO2 extraction capacity.

Version ID
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Year of Publication
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12.

Importance of carbon dioxide in the critical patient: Implications at the cellular and clinical levels. [Review] 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):234-242, 2019 05.
[Journal Article. Review]
UI: 29486904
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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13.

New Approaches to Respiratory Assist: Bioengineering an Ambulatory, Miniaturized Bioartificial Lung. [Review]
Novosel E; Borchers K; Kluger PJ; Mantalaris A; Matheis G; Pistolesi M; Schneider J; Wenz A; Lelkes PI.
ASAIO Journal. 65(5):422-429, 2019 07.
[Journal Article. Research Support, Non-U.S. Gov't. Review]
UI: 30044238
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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Year of Publication
2019

14.

Extracorporeal Strategies in Acute Respiratory Distress Syndrome. [Review]
Cavayas YA; Thakore A; Fan E.
Seminars in Respiratory & Critical Care Medicine. 40(1):114-128, 2019 02.
[Journal Article. Research Support, Non-U.S. Gov't. Review]
UI: 31060093
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-ECCO2R). 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 ECCO2R in the management of ARDS remain to be determined.

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Year of Publication
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15.

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 VM; European Society of Intensive Care Medicine Trials Group and the "Strategy of Ultra-Protective lung ventilation with Extracorporeal CO2 Removal for New-Onset moderate to severe ARDS" (SUPERNOVA) investigators.
Intensive Care Medicine. 45(5):592-600, 2019 05.
[Journal Article. Multicenter Study]
UI: 30790030
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).
METHODS: 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).
RESULTS: 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.
CONCLUSIONS: 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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16.

Extracorporeal Life Support: The Next Step in Moderate to Severe ARDS-A Review and Meta-Analysis of the Literature. [Review]
Aretha D; Fligou F; Kiekkas P; Karamouzos V; Voyagis G.
BioMed Research International. 2019:1035730, 2019.
[Journal Article. Meta-Analysis. Review]
UI: 31662961
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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Year of Publication
2019

17.

Extracorporeal carbon dioxide removal for acute hypercapnic exacerbations of chronic obstructive pulmonary disease: study protocol for a randomised controlled trial.
Barrett NA; Kostakou E; Hart N; Douiri A; Camporota L.
Trials [Electronic Resource]. 20(1):465, 2019 Jul 30.
[Clinical Trial Protocol. Journal Article]
UI: 31362776
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: 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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Year of Publication
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18.

Prevalence of and risk factors for pulmonary complications after curative resection in otherwise healthy elderly patients with early stage lung cancer.
Im Y; Park HY; Shin S; Shin SH; Lee H; Ahn JH; Sohn I; Cho JH; Kim HK; Zo JI; Shim YM; Lee HY; Kim J.
Respiratory Research. 20(1):136, 2019 Jul 04.
[Journal Article]
UI: 31272446
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.
METHODS: 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.
RESULTS: 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.
CONCLUSIONS: 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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19.

Mechanical Ventilation for Acute Respiratory Distress Syndrome during Extracorporeal Life Support. Research and Practice. [Review]
Abrams D; Schmidt M; Pham T; Beitler JR; Fan E; Goligher EC; McNamee JJ; Patroniti N; Wilcox ME; Combes A; Ferguson ND; McAuley DF; Pesenti A; Quintel M; Fraser J; Hodgson CL; Hough CL; Mercat A; Mueller T; Pellegrino V; Ranieri VM; Rowan K; Shekar K; Brochard L; Brodie D.
American Journal of Respiratory & Critical Care Medicine. 201(5):514-525, 2020 03 01.
[Journal Article. Review]
UI: 31726013
Ventilator-induced lung injury remains a key contributor to the morbidity and mortality of acute respiratory distress syndrome (ARDS). Efforts to minimize 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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1
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Comments
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Year of Publication
2020

20.

Recent advances in understanding and treating acute respiratory distress syndrome. [Review]
Nanchal RS; Truwit JD.
F1000Research. 7, 2018.
[Journal Article. Review]
UI: 30210781
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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1
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MEDLINE
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Year of Publication
2018

21.

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 KB; Siersch V; Rabitsch W; Fuhrmann V; Bojic A; Robak O; Sperr WR; Laczika K; Locker GJ; Staudinger T.
Wiener Klinische Wochenschrift. 123(7-8):209-14, 2011 Apr.
[Journal Article]
UI: 21465083
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 (PaO(2)/FiO(2)-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 (ECCO(2)-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.
Version ID
1
Status
MEDLINE
Authors Full Name
Schellongowski, Peter; Ullrich, Roman; Hieber, Cornelia; Hetz, Hubert; Losert, Heidrun; Hermann, Maria; Hermann, Alexander; Gattringer, Klaus-Bernhard; Siersch, Viktoria; Rabitsch, Werner; Fuhrmann, Valentin; Bojic, Andja; Robak, Oliver; Sperr, Wolfgang R; Laczika, Klaus; Locker, Gottfried J; Staudinger, Thomas.
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Year of Publication
2011

22.

Extracorporeal lung support for patients who had severe respiratory failure secondary to influenza A (H1N1) 2009 infection in Canada.
Freed DH; Henzler D; White CW; Fowler R; Zarychanski R; Hutchison J; Arora RC; Manji RA; Legare JF; Drews T; Veroukis S; Kesselman M; Guerguerian AM; Kumar A; Canadian Critical Care Trials Group.
Canadian Journal of Anaesthesia. 57(3):240-7, 2010 Mar.
[Journal Article]
UI: 20082167
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).
METHODS: 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.
RESULTS: 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: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Freed, Darren H; Henzler, Dietrich; White, Chris W; Fowler, Robert; Zarychanski, Ryan; Hutchison, Jamie; Arora, Rakesh C; Manji, Rizwan A; Legare, Jean-Francois; Drews, Tanya; Veroukis, Stasa; Kesselman, Murray; Guerguerian, Anne-Marie; Kumar, Anand; Canadian Critical Care Trials Group.
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2010

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Click here for full text options

23.

[Extracorporeal lung support]. [Review] [German] Extrakorporale Verfahren zur Lungenunterstutzung.
Braune S; Sieweke A; Jarczak D; Kluge S.
Medizinische Klinik, Intensivmedizin Und Notfallmedizin. 112(5):426-436, 2017 Jun. [Journal Article. Review]
UI: 28555443
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.
Version ID
1
Status
MEDLINE
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Year of Publication
2017

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24.

[Hypercapnic respiratory failure. Pathophysiology, indications for mechanical ventilation and management]. [Review] [German] Hyperkapnisches Atemversagen. Pathophysiologie, Beatmungsindikationen und -durchfuhrung.

Kreppein U; Litterst P; Westhoff M.
Medizinische Klinik, Intensivmedizin Und Notfallmedizin. 111(3):196-201, 2016 Apr. [Journal Article. Review]
UI: 26902369
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: Presentation of the current knowledge on indications and management of mechanical ventilation in patients with hypercapnic respiratory failure.
MATERIAL AND METHODS: Review of the literature.
RESULTS: 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: 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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Year of Publication
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Click here for full text options

25.

[Current techniques for extracorporeal decarboxylation]. [Review] [German] Moderne Decarboxylierungssysteme.
Nentwich J; John S.

Medizinische Klinik, Intensivmedizin Und Notfallmedizin. 114(8):733-740, 2019 Nov.
[Journal Article. Review]
UI: 31020339
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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Year of Publication
2019

26.

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.
Fernandez-Mondejar E; Fuset-Cabanes MP; Grau-Carmona T; Lopez-Sanchez M; Penuelas O; Perez-Vela JL; Perez-Villares JM; Rubio-Munoz JJ; Solla-Buceta M.
Medicina Intensiva. 43(2):108-120, 2019 03.
[Journal Article. Practice Guideline]
UI: 30482406
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.

Version ID
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Year of Publication
2019

Minimal-flow ECCO2R in patients needing CRRT does not facilitate lung-protective ventilation.
Moerer O; Harnisch LO; Barwing J; Heise D; Heuer JF; Quintel M.
Journal of Artificial Organs. 22(1):68-76, 2019 Mar.
[Journal Article]
UI: 30284167
Extracorporeal CO2 removal (ECCO2R) is intended to facilitate lung protective ventilation in patients with hypercarbia. The combination of continuous renal replacement therapy (CRRT) and minimal-flow ECCO2R offers a promising concept for patients in need of both. We hypothecated that this system is able to remove enough CO2 to facilitate lung protective ventilation in mechanically ventilated patients. In 11 ventilated patients with acute renal failure who received either pre- or postdilution CRRT, minimal-flow ECCO2R was added to the circuit. During 6 h of combined therapy, CO2 removal and its effect on facilitation of lung-protective mechanical ventilation were assessed. Ventilatory settings were kept in assisted or pressure-controlled mode allowing spontaneous breathing. With minimal-flow ECCO2R significant decreases in minute ventilation, tidal volume and paCO2 were found after one and three but not after 6 h of therapy. Nevertheless, no significant reduction in applied force was found at any time during combined therapy. CO2 removal was 20.73 ml CO2/min and comparable between pre- and postdilution CRRT. Minimal-flow ECCO2R in combination with CRRT is sufficient to reduce surrogates for lung-protective mechanical ventilation but was not sufficient to significantly reduce force applied to the lung. Causative might be the absolute amount of CO2 removal of only about 10% of resting CO2 production in an adult as we found. The benefit of applying minimal flow ECCO2R in an uncontrolled setting of mechanical ventilation might be limited.
Version ID
1
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Year of Publication
2019

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28.

[Update: acute hypercapnic respiratory failure]. [Review] [German] Update: akute hyperkapnische respiratorische Insuffizienz.
Seiler F; Trudzinski FC; Kredel M; Lotz C; Lepper PM; Muellenbach RM.
Medizinische Klinik, Intensivmedizin Und Notfallmedizin. 114(3):234-239, 2019 Apr. [Journal Article. Review]
UI: 28707030
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: Summarizing the state of the art in the management of hypercapnic respiratory failure with special regard to the role of ECCO2R.
METHODS: Review based on a selective literature search and the clinical and scientific experience of the authors.
RESULTS: 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: 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.
Version ID
1
Status
MEDLINE
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Year of Publication
2019

29.

Extracorporeal carbon dioxide removal for lowering the risk of mechanical ventilation: research questions and clinical potential for the future. [Review]
Boyle AJ; Sklar MC; McNamee JJ; Brodie D; Slutsky AS; Brochard L; McAuley DF; International ECMO Network (ECMONet).
The Lancet Respiratory Medicine. 6(11):874-884, 2018 11.
[Journal Article. Review]
UI: 30484429
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.

Version ID
1
Status
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Authors Full Name
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Year of Publication
2018

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

30.

Extracorporeal carbondioxide removal (ECCO2R): case series and review of literature. [Review] Ekstrakorporeal karbondioksit uzaklastirma (ECCO2R): olgu serisi ve literatur esliginde degerlendirme.
Bozkus F; Bilal B; Oksuz H.
Tuberkuloz ve Toraks. 66(3):258-265, 2018 Sep.
[Journal Article. Review]
UI: 30479235
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.
Materials and Methods: Subjects that were admitted to intensive care unit between March 2014 to November 2015 due to hypercapnic respiratory failure were treated using ECCO2R.
Result: 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.
Conclusions: 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.
Version ID
1
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Oksuz, Hafize. Kahramanmaras Sutcu Imam Universitesi Tip Fakultesi, Anesteziyoloji ve Reanimasyon Anabilim Dali, Kahramanmaras, Turkiye.
Year of Publication
2018

31.

Extracorporeal Lung Support for Hypercapnic Ventilatory Failure. [Review]
Pisani L; Polastri M; Pacilli AMG; Nava S.
Respiratory Care. 63(9):1174-1179, 2018 Sep.
[Journal Article. Review]
UI: 30166412
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.

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1
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Year of Publication
2018

32.

Extracorporeal organ support (ECOS) in critical illness and acute kidney injury: from native to artificial organ crosstalk. [Review]
Husain-Syed F; Ricci Z; Brodie D; Vincent JL; Ranieri VM; Slutsky AS; Taccone FS; Gattinoni L; Ronco C.
Intensive Care Medicine. 44(9):1447-1459, 2018 Sep.
[Journal Article. Review]
UI: 30043276
The complex nature of single organ failure potentially leading to multiple organ dysfunction syndrome (MODS) in critically ill patients necessitates integrated supportive therapy. Rather than a primary disease, acute kidney injury (AKI) is considered a window to a potentially serious underlying systemic disease, which may partially explain the high morbidity and mortality rates associated with the condition. Renal replacement therapy (RRT) has been routinely used for more than a decade in various intensive care settings and there has also been an increase in the use of extracorporeal membrane oxygenation and extracorporeal carbon dioxide removal. When these renal and cardiopulmonary modalities are used together, a multidisciplinary approach is necessary to minimize negative interactions and unwanted adverse effects. In this review, we describe the patterns of organ crosstalk between the native and artificial organs, the incidence of AKI and need for RRT and associated mortality after extracorporeal organ support (ECOS) therapy, including the potential short- and long-term advantages and disadvantages of organ support in terms of renal function. We also review potential indications of RRT outside its conventional indications in patients with MODS, as well as technical considerations when RRT is used alongside other organ support therapies. Overall, available literature has not definitely established the ideal timing of these interventions, and whether early implementation impacts organ recovery and optimizes resource utilization is still a matter of open debate: it is possible that future research will be devoted to identify patient groups that may benefit from short- and long-term multiple organ support.
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1
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Authors Full Name
Husain-Syed, Faeq; Ricci, Zaccaria; Brodie, Daniel; Vincent, Jean-Louis; Ranieri, V Marco; Slutsky, Arthur S; Taccone, Fabio Silvio; Gattinoni, Luciano; Ronco, Claudio.
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Year of Publication
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33.

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 [Electronic Resource]. 13(6):e0198392, 2018.
[Journal Article]
UI: 29856834
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.
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Year of Publication
2018

34.

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 (London, England). 22(1):122, 2018 05 10.
[Journal Article]
UI: 29743094
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).
METHODS: 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.
RESULTS: 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%. CONCLUSIONS: 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.
TRIAL REGISTRATION: ClinicalTrials.gov, NCT02606240. Registered on 17 November 2015.
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Year of Publication
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35.

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; Ranieri VM.
American Journal of Respiratory & Critical Care Medicine. 198(5):687-690, 2018 09 01.
[Letter. Research Support, Non-U.S. Gov't]
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Year of Publication
2018

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36.

Acute Respiratory Distress Syndrome: Advances in Diagnosis and Treatment. [Review]
Fan E; Brodie D; Slutsky AS.
JAMA. 319(7):698-710, 2018 02 20.
[Journal Article. Research Support, Non-U.S. Gov't. Review]
UI: 29466596
Importance: Acute respiratory distress syndrome (ARDS) is a life-threatening form of respiratory failure that affects approximately 200000 patients each year in the United States, resulting in nearly 75000 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 (200 mm Hg<Pao2/Fio2<=300 mm Hg), moderate (100 mm Hg<Pao2/Fio2<=200 mm Hg), and severe (Pao2/Fio2 <=100 mm Hg), 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 150 mm Hg, 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.
Version ID
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37.

The Evolution of Extracorporeal Membrane Oxygenation for Adult Respiratory Failure.
Brodie D.
Annals of the American Thoracic Society. 15(Suppl 1):S57-S60, 2018 02.
[Journal Article]
UI: 29461889
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.
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1
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Year of Publication
2018

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38.

Patient selection for extracorporeal CO2 removal: a task as challenging as for ECMO therapy.
Hilty MP; Riva T; Cottini SR; Kleinert EM; Maggiorini A; Maggiorini M.
Minerva Anestesiologica. 84(3):410-411, 2018 03.
[Letter. Comment]
UI: 29405675
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1
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Comments
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39.

Reply to Morales-Quinteros et al.: Precision Medicine for Extracorporeal CO2 Removal for Acute Respiratory Distress Syndrome: CO2 Physiological Considerations.
Goligher EC; Amato MBP; Slutsky AS.
American Journal of Respiratory & Critical Care Medicine. 197(8):1091-1092, 2018 04 15.
[Letter. Comment]
UI: 29211496
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40.

Precision Medicine for Extracorporeal CO2 Removal for Acute Respiratory Distress Syndrome: CO2 Physiological Considerations.
Morales-Quinteros L; Artigas A; Kaufman DA.
American Journal of Respiratory & Critical Care Medicine. 197(8):1090-1091, 2018 04 15.
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Comments
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41.

Right patient selection and management in veno-venous extracorporeal carbon dioxide removal.
Pettenuzzo T; Del Sorbo L.
Minerva Anestesiologica. 84(3):409-410, 2018 03.
[Letter. Comment]
UI: 29152939
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1
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MEDLINE
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42.

When the momentum has gone: what will be the role of extracorporeal lung support in the future?. [Review]
Abrams D; Bacchetta M; Brodie D.
Current Opinion in Critical Care. 24(1):23-28, 2018 Feb.
[Journal Article. Review]
UI: 29140963
PURPOSE OF REVIEW: 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.
Version ID
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MEDLINE
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Year of Publication
2018

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Click here for full text options

43.

Intermittent extracorporeal CO2 removal in chronic obstructive pulmonary disease patients: a fiction or an option. [Review]
Alessandri F; Pugliese F; Mascia L; Ranieri MV.
Current Opinion in Critical Care. 24(1):29-34, 2018 Feb.
[Journal Article. Review]
UI: 29135616
PURPOSE OF REVIEW: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
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Year of Publication
2018

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44.

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):155, 2017 Nov 28.
[Journal Article]
UI: 29179681
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).
METHODS: This was a prospective pilot study, using the Abylcap R (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).
RESULTS: 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.
CONCLUSIONS: 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.
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Year of Publication
2017

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45.

Acquired von Willebrand syndrome in respiratory extracorporeal life support: a systematic review of the literature.
Malfertheiner MV; Pimenta LP; Bahr VV; Millar JE; Obonyo NG; Suen JY; Pellegrino V; Fraser JF.

Critical Care & Resuscitation. 19(Suppl 1):45-52, 2017 Oct.
[Journal Article. Systematic Review]
UI: 29084501
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: 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.
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1
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Year of Publication
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46.

Fifty Years of Research in ARDS. Vt Selection in Acute Respiratory Distress Syndrome. [Review]
Sahetya SK; Mancebo J; Brower RG.
American Journal of Respiratory & Critical Care Medicine. 196(12):1519-1525, 2017 12 15.

[Journal Article. Review. Research Support, N.I.H., Extramural]
UI: 28930639
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.
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1
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Brower, Roy G. 1 Pulmonary and Critical Care Medicine, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland; and.
Year of Publication
2017

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47.

Do we need randomized clinical trials in extracorporeal respiratory support? Yes.
Combes A; Pesenti A; Brodie D.
Intensive Care Medicine. 43(12):1862-1865, 2017 Dec.
[Editorial]
UI: 28914339
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.
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Year of Publication
2017

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48.

Adjunctive extracorporeal carbon dioxide removal in refractory status asthmaticus.
Jiang C; Galaydick J; Fernandez H; Caronia J.
BMJ Case Reports. 2017, 2017 Jul 27.
[Case Reports. Journal Article]
UI: 28754757
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 patienta TMs condition deteriorated rapidly. Veno-venous ECMO (VV-ECMO) was provided for respiratory support. The patienta TMs clinical condition improved over the following 72ahours 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.

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Year of Publication
2017

49.

Focus on ECMO and ECCO2R in ARDS patients. [Review]
Bein T; Aubron C; Papazian L.
Intensive Care Medicine. 43(9):1424-1426, 2017 09.
[Editorial. Review]
UI: 28717835
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Year of Publication
2017

50.

Low-Flow Extracorporeal Carbon Dioxide Removal Using the Hemolung Respiratory Dialysis System R to Facilitate Lung-Protective Mechanical Ventilation in Acute Respiratory Distress Syndrome.
Akkanti B; Rajagopal K; Patel KP; Aravind S; Nunez-Centanu E; Hussain R; Shabari FR; Hofstetter WL; Vaporciyan AA; Banjac IS; Kar B; Gregoric ID; Loyalka P.
Journal of Extra-Corporeal Technology. 49(2):112-114, 2017 06.
[Case Reports. Journal Article]
UI: 28638160
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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1
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Akkanti, Bindu; Rajagopal, Keshava; Patel, Kirti P; Aravind, Sangeeta; Nunez-Centanu, Emmanuel; Hussain, Rahat; Shabari, Farshad Raissi; Hofstetter, Wayne L; Vaporciyan, Ara A; Banjac, Igor S; Kar, Biswajit; Gregoric, Igor D; Loyalka, Pranav.
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Year of Publication
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51.

Applying Precision Medicine to Trial Design Using Physiology. Extracorporeal CO2 Removal for Acute Respiratory Distress Syndrome. [Review]
Goligher EC; Amato MBP; Slutsky AS.
American Journal of Respiratory & Critical Care Medicine. 196(5):558-568, 2017 09 01.
[Journal Article. Review. Research Support, Non-U.S. Gov't]
UI: 28636403
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 ventilator-induced 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 in whom 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.
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Comments
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Year of Publication
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52.

Extracorporeal CO2 removal in the ICU: an effective treatment awaiting proper indications.
Arnal JM; Garnero A.
Minerva Anestesiologica. 83(8):784-786, 2017 08.
[Editorial. Comment]
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Comments
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53.

Comments on Morelli et al.: Extracorporeal carbon dioxide removal (ECCO2R) in patients with acute respiratory failure.
Allardet-Servent J; Castanier M; Signouret T; Seghboyan JM; Morelli A.
Intensive Care Medicine. 43(8):1171-1172, 2017 08.
[Letter. Comment]
UI: 28573390
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Comments
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54.

[The role of extracorporeal removal of CO2 (ECCO2R) in the management of respiratory diseases]. [Review] [French] Place de l'epuration extracorporelle de CO2 (ECCO2R) dans la prise en charge des pathologies respiratoires.
Diehl JL; Boisrame-Helms J; Chardon-Couteau A; Commereuc M; Augy JL; Sokoloff A; Rivet N; Gaussem P; Smadja DM; Aissaoui N.
Revue des Maladies Respiratoires. 34(6):598-606, 2017 Jun.
[Journal Article. Review]
UI: 28506729
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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1
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MEDLINE
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Year of Publication
2017

55.

Fifty Years of Research in ARDS. Is Extracorporeal Circulation the Future of Acute Respiratory Distress Syndrome Management?. [Review]
Combes A; Pesenti A; Ranieri VM.
American Journal of Respiratory & Critical Care Medicine. 195(9):1161-1170, 2017 05 01.
[Historical Article. Journal Article. Review]
UI: 28459322
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.
Version ID
1
Status
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Comments
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2017

56.

[Extracorporeal CO2 Elimination (ECCO2R) for Hypercapnic Respiratory Failure: From Pathophysiology to Clinical Application]. [Review] [German] 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):215-220, 2017 Apr.
[Journal Article. Review]
UI: 28407675
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.

Version ID
1
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MEDLINE
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Year of Publication
2017

57.

Extracorporeal CO2 removal in critically ill patients: a systematic review.
Taccone FS; Malfertheiner MV; Ferrari F; Di Nardo M; Swol J; Broman LM; Vercaemst L; Barrett N; Pappalardo F; Belohlavek J; Mueller T; Lorusso R; Belliato M; EuroELSO Workgroup "Innovation on ECMO and ECLS".
Minerva Anestesiologica. 83(7):762-772, 2017 07.
[Journal Article. Systematic Review]
UI: 28402093
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 CO2 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.
CONCLUSIONS: 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.
Version ID
1
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MEDLINE
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Taccone, Fabio S; Malfertheiner, Maximilian V; Ferrari, Fiorenza; Di Nardo, Matteo;

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58.

Low flow veno-venous extracorporeal CO2 removal for acute hypercapnic respiratory failure.
Hilty MP; Riva T; Cottini SR; Kleinert EM; Maggiorini A; Maggiorini M.
Minerva Anestesiologica. 83(8):812-823, 2017 Aug.
[Journal Article]
UI: 28275225
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).
METHODS: 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.
CONCLUSIONS: 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.
Version ID
1
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59.

Mechanical ventilation in patients subjected to extracorporeal membrane oxygenation (ECMO). [Review] Ventilacion mecanica en pacientes tratados con membrana de oxigenacion extracorporea (ECMO).
Lopez Sanchez M.
Medicina Intensiva. 41(8):491-496, 2017 Nov.
[Journal Article. Review]

UI: 28188062
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 6ml/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.

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Year of Publication
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60.

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):666-671, 2017 Sep/Oct.
[Journal Article]
UI: 28187047
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."
Version ID
1
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Year of Publication
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Click here for full text options

61.

Extracorporeal carbon dioxide removal (ECCO2R) in patients with acute respiratory failure. [Review]
Morelli A; Del Sorbo L; Pesenti A; Ranieri VM; Fan E.
Intensive Care Medicine. 43(4):519-530, 2017 Apr.
[Journal Article. Review]
UI: 28132075
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).
METHODS: Expert opinion and review of the literature.
RESULTS: 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 CONCLUSIONS: ECCO2R is currently an experimental technique rather than an accepted therapeutic strategy in ARF-its safety and efficacy require confirmation in clinical trials.
Version ID
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Status
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Year of Publication
2017

62.

The Homburg Lung: Efficacy and Safety of a Minimal-Invasive Pump-Driven Device for Veno-Venous Extracorporeal Carbon Dioxide Removal.
Seiler F; Trudzinski FC; Hennemann K; Niermeyer T; Schmoll C; Kamp A; Bals R; Muellenbach RM; Haake H; Lepper PM.
ASAIO Journal. 63(5):659-665, 2017 Sep/Oct.
[Journal Article]
UI: 28114193
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 m 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.
Version ID
1

Status
MEDLINE
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Seiler, Frederik; Trudzinski, Franziska C; Hennemann, Kai; Niermeyer, Tom; Schmoll, Christian; Kamp, Annegret; Bals, Robert; Muellenbach, Ralf M; Haake, Hendrik; Lepper, Philipp M.
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Comments
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63.

Assessment of the optimal operating parameters during extracorporeal CO2 removal with the Abylcap R system.
Eloot S; Peperstraete H; De Somer F; Hoste E.
International Journal of Artificial Organs. 39(11):580-585, 2017 01 13.
[Journal Article]
UI: 28085171
PURPOSE: Lung protective ventilation is recommended in patients with acute respiratory distress syndrome (ARDS) needing mechanical ventilation. This can however be associated with hypercapnia and respiratory acidosis, such that extracorporeal CO2 removal (ECCO2R) can be applied. The aim of this study was to derive optimal operating parameters for the ECCO2R Abylcap R system (Bellco, Italy).
METHODS: We included 4 ARDS patients with a partial arterial oxygen tension over the fraction of inspired oxygen (PaO2/FiO2) lower than 150 mmHg, receiving lung-protective ventilation and treated with the Abylcap R via a double lumen 13.5-Fr dialysis catheter in the femoral vein. Every 24 hours during 5 consecutive days, blood was sampled at the Abylcap R inlet and outlet for different blood flows (QB:200-300-400 mL/min) with 100% O2 gas flow (QG) of 7 L/min, and for different QG (QG: 0.5-1-1.5-3-6-8 L/min) with QB400 mL/min. CO2 and O2 transfer remained constant over 5 days for a fixed QB.
RESULTS: We found that, for a fixed QG of 7 L/min, CO2 transfer linearly and significantly increased with QB (i.e. from 58 +/- 8 to 98 +/- 16 mL/min for QB 200 to 400 mL/min). For a fixed QB of 400 mL/min, CO2 transfer non-linearly increased with QG (i.e. from 39 +/- 9 to 98 +/- 16 mL/min for QG 0.5 to 8 L/min) reaching a plateau at QG of 6 L/min.
CONCLUSIONS: Hence, when using the Abylcap R ECCO2R in the treatment of ARDS patients the O2 flow should be at least 6 L/min while QB should be set at its maximum.
Version ID

1
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Year of Publication
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64.

Should we use driving pressure to set tidal volume?. [Review]
Grieco DL; Chen L; Dres M; Brochard L.
Current Opinion in Critical Care. 23(1):38-44, 2017 Feb.
[Journal Article. Review]
UI: 27875410
PURPOSE OF REVIEW: Ventilator-induced lung injury (VILI) can occur despite use of tidal volume (VT) limited to 6 ml/kg of predicted body weight, especially in patients with a smaller aerated compartment (i.e. the baby lung) in which, indeed, tidal ventilation takes place. Because respiratory system static compliance (CRS) is mostly affected by the volume of the baby lung, the ratio VT/CRS (i.e. the driving pressure, DELTAP) may potentially help tailoring interventions on VT setting.
RECENT FINDINGS: Driving pressure is the ventilatory variable most strongly associated with changes in survival and has been shown to be the key mediator of the effects of mechanical ventilation on outcome in the acute respiratory distress syndrome. Observational data suggest an increased risk of death for patients with DELTAP more than 14 cmH2O, but a well tolerated threshold for this parameter has yet to be identified. Prone position along with simple ventilatory adjustments to facilitate CO2 clearance may help reduce DELTAP in isocapnic conditions. The safety and feasibility of low-flow extracorporeal CO2 removal in enhancing further reduction in VT and DELTAP are currently being investigated.
SUMMARY: Driving pressure is a bedside available parameter that may help identify patients prone to develop VILI and at increased risk of death. No study had prospectively evaluated whether interventions on DELTAP may provide a relevant clinical benefit, but it appears physiologically sound to try titrating VT to minimize DELTAP, especially when it is higher than 14 cmH2O and when it has minimal costs in terms of CO2 clearance.
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Year of Publication
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65.

Interventional lung assist and extracorporeal membrane oxygenation in a patient with near-fatal asthma.
Lee SJ; Cha YS; Byun CS; Kim SH; Lee MK; Yong SJ; Lee WY.
American Journal of Emergency Medicine. 35(2):374.e3-374.e4, 2017 Feb.
[Case Reports. Journal Article]
UI: 27553829
Version ID
1
Status
MEDLINE
Authors Full Name
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Year of Publication
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Click here for full text options

66.

Extracorporeal Support for Chronic Obstructive Pulmonary Disease: A Bright Future. [Review]
Trahanas JM; Lynch WR; Bartlett RH.
Journal of Intensive Care Medicine. 32(7):411-420, 2017 Aug.
[Journal Article. Review]
UI: 27509917
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.
Version ID
1
Status
MEDLINE
Authors Full Name
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Year of Publication
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67.

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. 32(1):44-49, 2017 Jan.
[Case Reports. Journal Article]
UI: 27440800
The iLA-activve R 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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1
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Authors Full Name
Romagnoli, Stefano; Zagli, Giovanni; Ricci, Zaccaria; Villa, Gianluca; Barbani, Francesco; Pinelli, Fulvio; De Gaudio, Raffaele; Chelazzi, Cosimo.
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Year of Publication
2017

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68.

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 JF; Botha J.
Critical Care & Resuscitation. 18(4):261-269, 2016 Dec.
[Journal Article. Multicenter Study]
UI: 27903208
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.
Version ID
1
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Authors Full Name
Tiruvoipati, Ravindranath; Buscher, Hergen; Winearls, James; Breeding, Jeff; Ghosh, Debasish; Chaterjee, Shimonti; Braun, Gary; Paul, Eldho; Fraser, John F; Botha, John.
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Botha, John. Department of Intensive Care Medicine, Frankston Hospital, Melbourne, VIC, Australia.
Year of Publication
2016

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69.

[Severe hypercapnic respiratory failure in acute exacerbation of COPD: significance of ventilation and extracorporal CO2 removal]. [Review] [German] Schweres hyperkapnisches Atmungsversagen bei akuter COPD-Exazerbation: Stellenwert von Beatmung und ECCO2R.
Westhoff M; Bachmann M; Braune S; Karagiannidis C; Kluge S; Lepper PM; Muller T; Schonhofer B.
Deutsche Medizinische Wochenschrift. 141(24):1758-1762, 2016 Nov.
[Journal Article. Review]
UI: 27903026
In acute exacerbations of COPD with acute hypercapnic respiratory failure and a pH 7.25 - 7.35, the initiation of non-invasive ventilation is the gold standard. However, absolute and relative contraindications have to be taken into account. The implementation of non-invasive ventilation in case of a severe respiratory acidosis necessitates a skilled therapeutic team and a close monitoring in order to avoid or perceive a NIV failure in time. In this case, the intubation and invasive mechanical ventilation is recommended. Ventilator settings have to aim at the prevention of an overinflation and increase of intrinsic PEEP. If severe hypercapnia and respiratory acidosis cannot be managed by mechanical ventilation, extracorporeal CO2 removal (ECCO2R) is a new treatment option. There are some reports about its use in awake patients in order to avoid an intubation. However, its general and primary use without optimizing medical therapy and mechanical ventilation is not indicated. ECCO2R is an experimental therapy in COPD with acute hypercapnic respiratory failure, its significance is still ambiguous. Therefore, it should only be applied in individual situations by a specialist team trained in its use.

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Authors Full Name
Westhoff, Michael; Bachmann, Martin; Braune, Stephan; Karagiannidis, Christian; Kluge, Stefan; Lepper, Philipp M; Muller, Thomas; Schonhofer, Bernd.
Year of Publication
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Click here for full text options

70.

Extracorporeal Gas Exchange: The Expanding Role of Extracorporeal Support in Respiratory Failure. [Review]
Bhatt N; Osborn E.
Clinics in Chest Medicine. 37(4):765-780, 2016 Dec.

[Journal Article. Review]
UI: 27842755
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.

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1
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Year of Publication
2016

71.

[Extracorporeal CO2 removal as life support system for a severe organizing pneumonia]. [French] Epuration extracorporelle du CO2 pour suppleance d'une pneumonie organisee severe.
Rival G; Millet O; Capellier G.
Revue de Pneumologie Clinique. 72(6):373-376, 2016 Dec.
[Case Reports. Journal Article]
UI: 27836209
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.

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1
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Capellier, G. Service de reanimation medicale adulte, pole urgences-SAMU-reanimation, centre hospitalier regional universitaire, 4, boulevard Fleming, 25000 Besancon, France.
Year of Publication
2016

72.

Varicella-Zoster Virus Infections in Pediatric Malignancy Patients: A Seven-Year Analysis. Pediatrik Malignite Hastalarinda Varicella Zoster Virus Enfeksiyonlari: Yedi Yillik Analiz.
Duzgol M; Ozek G; Bayram N; Oymak Y; Kara A; Demirag B; Karapinar TH; Ay Y; Vergin C; Devrim I.
Turkish Journal of Haematology. 33(4):346-348, 2016 Dec 01.
[Journal Article]
UI: 27751970
Primary varicella-zoster virus (VZV) infection is a benign self-limited disease. In this study, we review our experience in focusing on the outcome and treatment of VZV infection in pediatric malignancy patients. During the study period, a total of 41 patients with pediatric malignancy had been hospitalized with the diagnosis of VZV infection. All the patients were treated with intravenous acyclovir for a median of 7 days (ranging from 5 to 21 days). The calculated attributable delay of chemotherapy due to VZV infections was 8 days (ranging from 2 to 60 days). VZV-related complications were observed in 3 of 41 patients (7%) who suffered from acute respiratory distress syndrome, and one of them with hemophagocytic lymphohistiocytosis died due to respiratory failure despite acyclovir and broad-spectrum antimicrobial treatment plus supportive treatment. VZV infections are still important contagious diseases in pediatric cancer patients, because they cause not only significant mortality but also a delay in chemotherapy.
Version ID
1
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Authors Full Name
Duzgol, Mine; Ozek, Gulcihan; Bayram, Nuri; Oymak, Yesim; Kara, Ahu; Demirag, Bengu; Karapinar, Tuba Hilkay; Ay, Yilmaz; Vergin, Canan; Devrim, Ilker.
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Duzgol, Mine. Dr. Behcet Uz Children Training and Research Hospital, Clinic of Pediatric Infectious Diseases, Izmir, Turkey, Phone: +90 232 489 56 56, E-mail: mineduzgol@gmail.com.
Other Abstract
Publisher: Primer varisella zoster virus (VZV) enfeksiyonu benign, kendi kendini sinirlayan bir hastaliktir. Bu calismada pediatrik malignitesi olan hastalarda VZV enfeksiyonu ve tedavisine odakli tecrubelerimizi gozden gecirmeyi amacladik. Calisma suresi boyunca; VZV enfeksiyonu tanisi alan pediatrik maligniteli toplam 41 hasta hastaneye yatirildi. Tum hastalar ortalama 7 gun (5 ila 21 gun arasinda degisen) intravenoz asiklovir ile tedavi edildi. VZV enfeksiyonlarina bagli olarak hesaplanan atfedilebilir kemoterapi gecikmesi ortalama 8 gundu (2 ile 60 gun arasinda degisen). VZV enfeksiyonuna bagli komplikasyonlar 41 hastadan 3'unde (%7) akut solunum distres sendromu olarak goruldu ve bu hastalardan hemofagositik lenfohistiyositozu olan bir tanesi asiklovir, genis spektrumlu antibiyotik ve destekleyici tedaviye ragmen solunum yetmezligi nedeniyle kaybedildi. VZV enfeksiyonlari, pediatrik malignite hastalarinda hala onemli bulasici hastaliklardan biridir, cunku sadece ciddi mortaliteye sebep olmakla kalmayip kemoterapi baslangicini da geciktirmektedir.; Language: Turkish
Year of Publication
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73.

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 & Diffuse Lung Diseases. 33(2):186-90, 2016 Aug 01.
[Case Reports. Journal Article]
UI: 27537725
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 R 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Vianello, Andrea; Arcaro, Giovanna; Paladini, Luciana; Iovino, Silvia.
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Year of Publication
2016

74.

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):1437-44, 2016 Sep.
[Journal Article. Multicenter Study]
UI: 27456703
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).
METHODS: Case-control study. Patients with acute hypercapnic respiratory failure refractory to NIV being treated with a pump-driven veno-venous ECCO2R system (iLA-Activve(R); 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.
RESULTS: 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 %.
CONCLUSIONS: 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.
Version ID
1
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Authors Full Name
Braune, Stephan; Sieweke, Annekatrin; Brettner, Franz; Staudinger, Thomas; Joannidis, Michael; Verbrugge, Serge; Frings, Daniel; Nierhaus, Axel; Wegscheider, Karl; Kluge, Stefan.
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Year of Publication
2016

75.

Update in Critical Care 2015. [Review]
Dres M; Mancebo J; Curley GF.
American Journal of Respiratory & Critical Care Medicine. 194(1):19-25, 2016 07 01. [Journal Article. Review]
UI: 27367886
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.
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1
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Year of Publication
2016

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76.

Adverse effects of extracorporeal carbon dioxide removal (ECCO2R) for acute respiratory failure: a systematic review protocol.
Liu Z; Duarte RV; Bayliss S; Bramley G; Cummins C.
Systematic Reviews. 5:98, 2016 Jun 07.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 27267600
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.
METHODS: 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: 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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1
Status
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Year of Publication
2016

77.

A Retrospective Observational Case Series of Low-Flow Venovenous Extracorporeal Carbon Dioxide Removal Use in Patients with Respiratory Failure.
Moss CE; Galtrey EJ; Camporota L; Meadows C; Gillon S; Ioannou N; Barrett NA.
ASAIO Journal. 62(4):458-62, 2016 Jul-Aug.
[Journal Article. Observational Study]
UI: 27195746
We aimed to describe the use of venovenous extracorporeal carbon dioxide removal (ECCO2R) 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 ECCO2R from August 2013 to February 2015. Fourteen patients received ECCO2R. Demographic data, physiologic data (including pH and partial pressure of carbon dioxide in arterial blood [PaCO2]) when starting ECCO2R (t = 0), at 4 hourly intervals for the first 24 hours, then at 24 hour intervals until cessation of ECCO2R, and overall outcome were recorded. Patients are reported separately depending on whether the indication for ECCO2R 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 ECCO2R (Hemolung, ALung Inc, Pittsburgh, PA). Median duration of ECCO2R was 5 days. Four complications related to ECCO2R 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 ECCO2R 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Moss, Caroline E; Galtrey, Eleanor J; Camporota, Luigi; Meadows, Chris; Gillon, Stuart; Ioannou, Nicholas; Barrett, Nicholas A.
Institution
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Year of Publication

2016

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Click here for full text options

78.

Ultra-protective ventilation and hypoxemia.
Gattinoni L.
Critical Care (London, England). 20(1):130, 2016 May 12.
[Journal Article]
UI: 27170273
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.
Version ID
1
Status
MEDLINE
Authors Full Name
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Year of Publication
2016

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

79.

Intraoperative Management of Hypercapnia With an Extracorporeal Carbon Dioxide Removal Device During Giant Bullectomy.
Dell'Amore A; D'Andrea R; Caroli G; Mazzoli CA; Rocca A; Stella F; Bini A; Melotti R.

Innovations: Technology & Techniques in Cardiothoracic & Vascular Surgery. 11(2):142-5, 2016 Mar-Apr.
[Case Reports. Journal Article]
UI: 27088168
Extracorporeal CO2-removal devices have been introduced in clinical practice to provide protective and ultraprotective ventilation strategies in different settings to avoid retention of carbon dioxide. The need to facilitate lung-protective ventilation is

required not only for the treatment of acute respiratory distress syndrome but also in thoracic surgery during complex operations, especially in respiratory compromised patients. This report describes a case of giant bullectomy for vanishing lung syndrome in which intraoperative hypercapnia secondary to protective ventilation was managed with a CO2-removal device (Decap-Hemodec s.r.l., Salerno, Italy). To the best of our knowledge, this is the first report in the literature of the intraoperative use of the Decap system for giant bullectomy.
Version ID
1
Status
MEDLINE
Authors Full Name
Dell'Amore, Andrea; D'Andrea, Rocco; Caroli, Guido; Mazzoli, Carlo Alberto; Rocca, Alberto; Stella, Franco; Bini, Alessandro; Melotti, Rita.
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Year of Publication
2016

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

80.

Novel Extracorporeal Therapies for Combined Renal-Pulmonary Dysfunction. [Review]
Romagnoli S; Ricci Z; Ronco C.
Seminars in Nephrology. 36(1):71-7, 2016 Jan.
[Journal Article. Review]
UI: 27085737
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.

Version ID
1

Status
MEDLINE
Authors Full Name
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Institution
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Year of Publication
2016

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

81.

Experts' opinion on management of hemodynamics in ARDS patients: focus on the effects of mechanical ventilation. [Review]
Vieillard-Baron A; Matthay M; Teboul JL; Bein T; Schultz M; Magder S; Marini JJ.
Intensive Care Medicine. 42(5):739-749, 2016 May.
[Journal Article. Review]
UI: 27038480
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.
RESULTS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Vieillard-Baron, A; Matthay, M; Teboul, J L; Bein, T; Schultz, M; Magder, S; Marini, J J.
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Year of Publication
2016

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

82.

Control of Respiratory Drive and Effort in Extracorporeal Membrane Oxygenation Patients Recovering from Severe Acute Respiratory Distress Syndrome.
Mauri T; Grasselli G; Suriano G; Eronia N; Spadaro S; Turrini C; Patroniti N; Bellani G; Pesenti A.
Anesthesiology. 125(1):159-67, 2016 Jul.
[Journal Article. Randomized Controlled Trial]
UI: 26999639
BACKGROUND: The amount of extracorporeal carbon dioxide removal may influence respiratory drive in acute respiratory distress syndrome (ARDS) patients undergoing extracorporeal membrane oxygenation (ECMO). The authors evaluated the effects of different levels of extracorporeal carbon dioxide removal in patients recovering from severe ARDS undergoing pressure support ventilation (PSV) and neurally adjusted ventilatory assist (NAVA).
METHODS: The authors conducted a prospective, randomized, crossover study on eight spontaneously breathing ARDS patients undergoing venovenous ECMO since 28 +/- 20 days. To modulate carbon dioxide extraction, ECMO gas flow (GF) was decreased from baseline resting protective conditions (i.e., GF100%, set to obtain pressure generated in the first 100 ms of inspiration against an occluded airway less than 2 cm H2O, respiratory rate less than or equal to 25 bpm, tidal volume less than 6 ml/kg, and peak airway pressure less than 25 cm H2O) to GF50%-GF25%-GF0% during both PSV and NAVA (random order for ventilation mode). Continuous recordings of airway pressure and flow and esophageal pressure were obtained and analyzed during all study phases.
RESULTS: At higher levels of extracorporeal carbon dioxide extraction, pressure generated in the first 100 ms of inspiration against an occluded airway decreased from 2.8 +/- 2.7 cm H2O (PSV, GF0%) and 3.0 +/- 2.1 cm H2O (NAVA, GF0%) to 0.9 +/- 0.5 cm H2O (PSV, GF100%) and 1.0 +/- 0.8 cm H2O (NAVA, GF100%; $P < 0.001$) and patients' inspiratory muscle pressure passed from 8.5 +/- 6.3 and 6.5 +/- 5.5 cm H2O to 4.5 +/- 3.1 and 4.2 +/- 3.7 cm H2O ($P < 0.001$). In time, decreased inspiratory drive and effort determined by higher carbon dioxide extraction led to reduction of tidal volume from 6.6 +/- 0.9 and 7.5 +/- 1.2 ml/kg to 4.9 +/- 0.8 and 5.3 +/- 1.3 ml/kg ($P < 0.001$) and of peak airway pressure from 21 +/- 3 and 25 +/- 4 cm H2O to 21 +/- 3 and 21 +/- 5 cm H2O ($P < 0.001$). Finally, transpulmonary pressure linearly decreased when the amount of carbon dioxide extracted by ECMO increased ($R = 0.823$, $P < 0.001$).
CONCLUSIONS: In patients recovering from ARDS undergoing ECMO, the amount of carbon dioxide removed by the artificial lung may influence spontaneous breathing. The effects of carbon dioxide removal on spontaneous breathing during the earlier acute phases of ARDS remain to be elucidated.
Version ID
1
Status
MEDLINE
Authors Full Name
Mauri, Tommaso; Grasselli, Giacomo; Suriano, Grazia; Eronia, Nilde; Spadaro, Savino; Turrini, Cecilia; Patroniti, Nicolo'; Bellani, Giacomo; Pesenti, Antonio.
Institution
Mauri, Tommaso. From the Department of Anesthesia, Critical Care and Emergency, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy (T.M., G.G., C.T., A.P.); Department of Health Sciences, University of Milan-Bicocca, Monza, Italy (G.S., N.E., N.P., G.B.); Section of Anesthesia and Intensive Care, Department of Morphology, Surgery and Experimental Medicine, University of Ferrara, Ferrara, Italy (S.S., C.T.); and Department of Pathophysiology and Transplantation, University of Milan, Milan, Italy (A.P.).
Year of Publication
2016

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Click here for full text options

83.

Current Applications for the Use of Extracorporeal Carbon Dioxide Removal in Critically Ill Patients. [Review]
Camporota L; Barrett N.
BioMed Research International. 2016:9781695, 2016.
[Journal Article. Review]
UI: 26966691
Mechanical ventilation in patients with respiratory failure has been associated with secondary lung injury, termed ventilator-induced lung injury. Extracorporeal venovenous carbon dioxide removal (ECCO2R) appears to be a feasible means to facilitate more protective mechanical ventilation or potentially avoid mechanical ventilation in select patient groups. With this expanding role of ECCO2R, we aim to describe the technology and the main indications of ECCO2R.
Version ID
1
Status
MEDLINE
Authors Full Name
Camporota, Luigi; Barrett, Nicholas.
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Year of Publication
2016

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

84.

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 MV; Mancebo J; Moerer O; Quintel M; Morley S; Moran I; Parrilla F; Costamagna A; Gaudiosi M; Combes A.
Critical Care (London, England). 20:36, 2016 Feb 10.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 26861596
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).

METHODS: 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.
RESULTS: 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).
CONCLUSIONS: The low-flow ECCO2R system safely facilitates a low volume, low pressure ultra-protective mechanical ventilation strategy in patients with moderate ARDS.
Version ID
1
Status
MEDLINE
Authors Full Name
Fanelli, Vito; Ranieri, Marco V; Mancebo, Jordi; Moerer, Onnen; Quintel, Michael; Morley, Scott; Moran, Indalecio; Parrilla, Francisco; Costamagna, Andrea; Gaudiosi, Marco; Combes, Alain.
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Hopitaux de Paris, Paris, France.
Year of Publication
2016

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

85.

Role of extracorporeal membrane oxygenation in adult respiratory failure: an overview. [Review]
Anand S; Jayakumar D; Aronow WS; Chandy D.
Hospital practice (1995) Hospital practice. 44(2):76-85, 2016.
[Journal Article. Review]
UI: 26848884
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.
Version ID
1
Status
MEDLINE
Authors Full Name
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Year of Publication
2016

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

86.

Adult venovenous extracorporeal membrane oxygenation for severe respiratory failure: Current status and future perspectives. [Review]
Sen A; Callisen HE; Alwardt CM; Larson JS; Lowell AA; Libricz SL; Tarwade P; Patel BM; Ramakrishna H.
Annals of Cardiac Anaesthesia. 19(1):97-111, 2016 Jan-Mar.
[Journal Article. Review]
UI: 26750681
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Sen, Ayan; Callisen, Hannelisa E; Alwardt, Cory M; Larson, Joel S; Lowell, Amelia A; Libricz, Stacy L; Tarwade, Pritee; Patel, Bhavesh M; Ramakrishna, Harish.
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Year of Publication
2016

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

87.

The clinical management of patients on partial/total extracorporeal support. [Review]
Abrams D; Brodie D.
Current Opinion in Critical Care. 22(1):73-9, 2016 Feb.
[Comparative Study. Journal Article. Review]
UI: 26645552
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.
Version ID
1
Status
MEDLINE
Authors Full Name
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Year of Publication
2016

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

88.

Effect of extracorporeal CO2 removal on right ventricular and hemodynamic parameters in a patient with acute respiratory distress syndrome.
Cherpanath TG; Landburg PP; Lagrand WK; Schultz MJ; Juffermans NP.
Perfusion. 31(6):525-9, 2016 Sep.
[Case Reports. Journal Article]
UI: 26643882

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.

Version ID
1
Status
MEDLINE
Authors Full Name
Cherpanath, Thomas G V; Landburg, Pearl P; Lagrand, Wim K; Schultz, Marcus J; Juffermans, Nicole P.
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Juffermans, Nicole P. Department of Intensive Care Medicine, Academic Medical Centre, University of Amsterdam, Amsterdam, The Netherlands.
Year of Publication
2016

89.

Management of acute hypercapnic respiratory failure. [Review]
Pisani L; Corcione N; Nava S.
Current Opinion in Critical Care. 22(1):45-52, 2016 Feb.
[Journal Article. Review]
UI: 26627537
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.
Version ID
1
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MEDLINE
Authors Full Name
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Year of Publication
2016

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

90.

Extracorporeal CO2 removal: Technical and physiological fundaments and principal indications. [Review]
Romay E; Ferrer R.
Medicina Intensiva. 40(1):33-8, 2016 Jan-Feb.
[Journal Article. Review]
UI: 26432628
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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1
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Year of Publication
2016

91.

Applying a low-flow CO2 removal device in severe acute hypercapnic respiratory failure.
Sharma AS; Weerwind PW; Strauch U; van Belle A; Maessen JG; Wouters EF.
Perfusion. 31(2):149-55, 2016 Mar.
[Journal Article]
UI: 26040584
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.

Version ID
1
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Year of Publication
2016

92.

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 (London, England). 19:381, 2015 Oct 30.
[Journal Article]
UI: 26518584
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).
METHODS: 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.
RESULTS: 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).
CONCLUSIONS: 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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1
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Year of Publication
2015

93.

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 JM.
Critical Care Medicine. 43(12):2570-81, 2015 Dec.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 26488219
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: Prospective human observational study.
SETTINGS: 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.
PATIENTS: Eleven patients presenting with both acute respiratory distress syndrome and acute kidney injury required renal replacement therapy.
INTERVENTIONS: A membrane oxygenator (0.65 m) 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.
CONCLUSIONS: 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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1

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Comments
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Year of Publication
2015

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Click here for full text options

94.

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 WR; Staudinger T.
Intensive Care Medicine. 41(10):1773-80, 2015 Oct.
[Journal Article]
UI: 26170097
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(R), 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(R) due to hypercapnic respiratory failure.
METHODS: 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.
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 46-85) 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 ($p < 0.0001$).
CONCLUSIONS: 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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1
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Hermann, Alexander; Riss, Katharina; Schellongowski, Peter; Bojic, Andja; Wohlfarth, Philipp; Robak, Oliver; Sperr, Wolfgang R; Staudinger, Thomas.

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Year of Publication
2015

95.

Acidic sweep gas with carbonic anhydrase coated hollow fiber membranes synergistically accelerates CO2 removal from blood.
Arazawa DT; Kimmel JD; Finn MC; Federspiel WJ.
Acta Biomaterialia. 25:143-9, 2015 Oct.
[Journal Article. Research Support, N.I.H., Extramural. Research Support, Non-U.S. Gov't]
UI: 26159104
UNLABELLED: The use of extracorporeal carbon dioxide removal (ECCO2R) is well established as a therapy for patients suffering from acute respiratory failure. Development of next generation low blood flow (<500 mL/min) ECCO2R devices necessitates more efficient gas exchange devices. Since over 90% of blood CO2 is transported as bicarbonate (HCO3(-)), we previously reported development of a carbonic anhydrase (CA) immobilized bioactive hollow fiber membrane (HFM) which significantly accelerates CO2 removal from blood in model gas exchange devices by converting bicarbonate to CO2 directly at the HFM surface. This present study tested the hypothesis that dilute sulfur dioxide (SO2) in oxygen sweep gas could further increase CO2 removal by creating an acidic microenvironment within the diffusional boundary layer adjacent to the HFM surface, facilitating dehydration of bicarbonate to CO2. CA was covalently immobilized onto poly (methyl pentene) (PMP) HFMs through glutaraldehyde activated chitosan spacers, potted in model gas exchange devices (0.0151 m(2)) and tested for CO2 removal rate with oxygen (O2) sweep gas and a 2.2% SO2 in oxygen sweep gas mixture. Using pure O2 sweep gas, CA-PMP

increased CO2 removal by 31% (258 mL/min/m(2)) compared to PMP (197 mL/min/m(2)) (P<0.05). Using 2.2% SO2 acidic sweep gas increased PMP CO2 removal by 17% (230 mL/min/m(2)) compared to pure oxygen sweep gas control (P<0.05); device outlet blood pH was 7.38 units. When employing both CA-PMP and 2.2% SO2 sweep gas, CO2 removal increased by 109% (411 mL/min/m(2)) (P<0.05); device outlet blood pH was 7.35 units. Dilute acidic sweep gas increases CO2 removal, and when used in combination with bioactive CA-HFMs has a synergistic effect to more than double CO2 removal while maintaining physiologic pH. Through these technologies the next generation of intravascular and paracorporeal respiratory assist devices can remove more CO2 with smaller blood contacting surface areas.
STATEMENT OF SIGNIFICANCE: A clinical need exists for more efficient respiratory assist devices which utilize low blood flow rates (<500 mL/min) to regulate blood CO2 in patients suffering from acute lung failure. Literature has demonstrated approaches to chemically increase hollow fiber membrane (HFM) CO2 removal efficiency by shifting equilibrium from bicarbonate to gaseous CO2, through either a bioactive carbonic anhydrase enzyme coating or bulk blood acidification with lactic acid. In this study we demonstrate a novel approach to local blood acidification using an acidified sweep gas in combination with a bioactive coating to more than double CO2 removal efficiency of HFM devices. To our knowledge, this is the first report assessing an acidic sweep gas to increase CO2 removal from blood using HFM devices.

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1
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Year of Publication
2015

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Click here for full text options

96.

Extracorporeal carbon dioxide removal in patients with chronic obstructive pulmonary disease: a systematic review. [Review]

Sklar MC; Beloncle F; Katsios CM; Brochard L; Friedrich JO.
Intensive Care Medicine. 41(10):1752-62, 2015 Oct.
[Journal Article. Review. Systematic Review]
UI: 26109400
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.
METHODS: 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.
RESULTS: 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: 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.
Version ID
1
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97.

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):765-73, 2015 Sep.
[Clinical Trial. Comparative Study. Journal Article]
UI: 25921195
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) > 53 s led to a higher need for transfusions compared with the group with a mean aPTT < 53 s, whereas the average durability of membrane oxygenators was not affected. Need for red blood cell (RBC) transfusion was highest in patients with extrapulmonary sepsis (257 mL/day), and was significantly lower in primary pulmonary adult respiratory distress syndrome (ARDS) (102 mL/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.

Version ID
1
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Year of Publication
2015

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Click here for full text options

98.

Update on the role of extracorporeal CO2 removal as an adjunct to mechanical ventilation in ARDS. [Review]
Morimont P; Batchinsky A; Lambermont B.
Critical Care (London, England). 19:117, 2015 Mar 16.
[Journal Article. Research Support, Non-U.S. Gov't. Review]
UI: 25888428
This article is one of ten reviews selected from the Annual Update in Intensive Care and Emergency Medicine 2015 and co-published as a series in Critical Care. Other articles in the series can be found online at http://ccforum.com/series/annualupdate2015. 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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Year of Publication
2015

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Click here for full text options

99.

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; Hamilton P; Young D; Hulme C; Hall P; Shah S; MacKenzie I; Tunnicliffe W; Rowan K; Cuthbertson B; McCabe C; Lamb S; OSCAR collaborators.
Health Technology Assessment (Winchester, England). 19(23):1-177, vii, 2015 Mar.
[Journal Article. Multicenter Study. Randomized Controlled Trial. Research Support, Non-U.S. Gov't]
UI: 25800686
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.
OBJECTIVES: To determine the clinical benefit and cost-effectiveness of HFOV in patients with ARDS compared with standard mechanical ventilation.
DESIGN: A parallel, randomised, unblinded clinical trial.
SETTING: UK intensive care units.
PARTICIPANTS: 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.
INTERVENTIONS: Treatment arm HFOV using a Novalung R100(R) 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 MEASURES: 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.
RESULTS: 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.
CONCLUSIONS: 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.
TRIAL REGISTRATION: Current Controlled Trials ISRCTN10416500.
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1
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Authors Full Name
Lall, Ranjit; Hamilton, Patrick; Young, Duncan; Hulme, Claire; Hall, Peter; Shah, Sanjoy; MacKenzie, Iain; Tunnicliffe, William; Rowan, Kathy; Cuthbertson, Brian; McCabe, Chris; Lamb, Sallie; OSCAR collaborators.
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Year of Publication
2015

100.

[Lung and kidney failure. Pathogenesis, interactions, and therapy]. [Review] [German] Lungen- und Nierenversagen. Pathogenese, Wechselwirkungen und Therapie.
John S; Willam C.
Medizinische Klinik, Intensivmedizin Und Notfallmedizin. 110(6):452-8, 2015 Sep. [Journal Article. Review]
UI: 25676118
BACKGROUND: The lungs and kidneys represent the most often affected organs (acute respiratory distress syndrome, ARDS or kidney failure) in multiple organ failure (MOF) due to shock, trauma, or sepsis with a still unacceptable high mortality for both organ failures.
PATHOGENESIS AND INTERACTIONS: Although the exact pathophysiological mechanisms of MOF are not completely elucidated, it appears that the lungs and kidneys share several pathophysiologic pathways and have the potential to further harm each other (kidney-lung crosstalk). Inflammatory signals in both directions and volume overload with consecutive edema formation in both organs may play a key role in this crosstalk.
TREATMENT: The organ replacement therapies used in both organ failures have the potential to further injure the other organ (ventilator trauma, dialyte trauma). On the other hand, renal replacement therapy can have positive effects on lung injury by restoring volume and acid-base homeostasis. The new development of "low-flow" extracorporeal CO2 removal on renal replacement therapy platforms may further help to decrease ventilator trauma in the future.
Version ID
1
Status
MEDLINE
Authors Full Name
John, S; Willam, C.
Institution
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Year of Publication
2015

101.

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 MJ; Simonetti U; Persico P; Nava S; Ranieri VM.
Critical Care Medicine. 43(1):120-7, 2015 Jan.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 25230375
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: Matched cohort study with historical control.
SETTING: Two academic Italian ICUs.
PATIENTS: Patients treated with noninvasive ventilation for acute hypercapnic respiratory failure due to exacerbation of chronic obstructive pulmonary disease (May 2011 to November 2013).
INTERVENTIONS: 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 ventilation-only 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 ventilation-plus-extracorporeal CO2 removal (hazard ratio, 0.27; 95% CI, 0.07-0.98; p = 0.047). Intubation rate in noninvasive ventilation-plus-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.
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Del Sorbo, Lorenzo; Pisani, Lara; Filippini, Claudia; Fanelli, Vito; Fasano, Luca; Terragni, Pierpaolo; Dell'Amore, Andrea; Urbino, Rosario; Mascia, Luciana; Evangelista, Andrea; Antro, Camillo; D'Amato, Raffaele; Sucre, Maria Jose;

Simonetti, Umberto; Persico, Pietro; Nava, Stefano; Ranieri, V Marco.
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Del Sorbo, Lorenzo. 1Dipartimento di Anestesiologia e Rianimazione, Azienda Ospedaliera Citta della Salute e della Scienza e di Torino, Universita di Torino, Torino, Italy. 2Respiratory and Critical Care Unit, Department of Specialist, Diagnostic and Experimental Medicine (DIMES), Sant'Orsola Malpighi Hospital, Alma Mater University, Bologna, Italy. 3Thoracic Surgery Unit, Sant'Orsola Malpighi Hospital, Alma Mater University, Bologna, Italy. 4Unit of Clinical Epidemiology, Azienda Ospedaliera Citta della Salute e della Scienza e di Torino and CPO Piemonte, Torino, Italy. 5Dipartimento di Emergenza ed Accettazione, Unita di Medicina d'Urgenza, Azienda Ospedaliera Citta della Salute e della Scienza e di Torino, Universita di Torino, Torino, Italy.
Comments
Comment in (CIN) Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Year of Publication
2015

102.

Factors of tidal volume variation during augmented spontaneous ventilation in patients on extracorporeal carbon dioxide removal. A multivariate analysis.
Bein T; Muller T; Graf BM; Philipp A; Zeman F; Schultz MJ; Slutsky AS; Weber-Carstens S.
Minerva Anestesiologica. 81(1):28-32, 2015 Jan.
[Journal Article]
UI: 24878875
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.

Version ID
1
Status
MEDLINE
Authors Full Name
Bein, T; Muller, T; Graf, B M; Philipp, A; Zeman, F; Schultz, M J; Slutsky, A S; Weber-Carstens, S.
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Year of Publication
2015

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

103.

Extracorporeal circulatory approaches to treat acute respiratory distress syndrome. [Review]
Abrams D; Brodie D.
Clinics in Chest Medicine. 35(4):765-79, 2014 Dec.
[Journal Article. Review]
UI: 25453424
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.

Version ID
1
Status
MEDLINE
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Year of Publication
2014

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

104.

Extracorporeal life support in critically ill adults. [Review]
Ventetuolo CE; Muratore CS.
American Journal of Respiratory & Critical Care Medicine. 190(5):497-508, 2014 Sep 01.
[Journal Article. Research Support, N.I.H., Extramural. Research Support, Non-U.S. Gov't. Review]
UI: 25046529
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.
Version ID
1
Status
MEDLINE
Authors Full Name
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Year of Publication
2014

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

105.

Extracorporeal carbon dioxide removal for patients with acute respiratory failure secondary to the acute respiratory distress syndrome: a systematic review. [Review]
Fitzgerald M; Millar J; Blackwood B; Davies A; Brett SJ; McAuley DF; McNamee JJ.
Critical Care (London, England). 18(3):222, 2014 May 15.
[Journal Article. Review. Systematic Review]
UI: 25033302
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 ECCOvR. 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Fitzgerald, Marianne; Millar, Jonathan; Blackwood, Bronagh; Davies, Andrew; Brett, Stephen J; McAuley, Daniel F; McNamee, James J.
Year of Publication
2014

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

106.

Extracorporeal life support devices and strategies for management of acute cardiorespiratory failure in adult patients: a comprehensive review. [Review]
Shekar K; Mullany DV; Thomson B; Ziegenfuss M; Platts DG; Fraser JF.
Critical Care (London, England). 18(3):219, 2014 May 09.
[Journal Article. Review]
UI: 25032748
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Shekar, Kiran; Mullany, Daniel V; Thomson, Bruce; Ziegenfuss, Marc; Platts, David G; Fraser, John F.
Year of Publication
2014

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

107.

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):e197-200, 2014 Dec.
[Case Reports. Journal Article]
UI: 24987155
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 extracorporeal CO2 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.

Version ID
1
Status

MEDLINE
Authors Full Name
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Year of Publication
2014

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

108.

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 WR; Schellongowski P.
ASAIO Journal. 60(3):342-7, 2014 May-Jun.
[Journal Article]
UI: 24722345
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Hermann, Alexander; Staudinger, Thomas; Bojic, Andja; Riss, Katharina; Wohlfarth, Philipp; Robak, Oliver; Sperr, Wolfgang R; Schellongowski, Peter.
Institution
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Year of Publication
2014

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

109.

Use of a pediatric oxygenator integrated in a veno-venous hemofiltration circuit to remove CO2: a case report in a severe burn patient with refractory hypercapnia.
Rousseau AF; Damas P; Renwart L; Amand T; Erpicum M; Morimont P; Dubois B; Massion PB.
Burns. 40(7):e57-60, 2014 Nov.
[Case Reports. Journal Article]
UI: 24685066
Acute respiratory distress syndrome management is currently based on lung protective ventilation. Such strategy may lead to hypercapnic acidosis. We report a case of refractory hypercapnia in a severe burn adult, treated with simplified veno-venous extracorporeal carbon dioxide removal technique. We integrated a pediatric oxygenator in a continuous veno-venous hemofiltration circuit. This technique, used during at least 96h, was feasible, sure and efficient with carbon dioxide removal rate up to 32%.

Version ID
1
Status
MEDLINE
Authors Full Name
Rousseau, Anne-Francoise; Damas, Pierre; Renwart, Ludovic; Amand, Theo; Erpicum, Marie; Morimont, Philippe; Dubois, Bernard; Massion, Paul B.
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Renwart, Ludovic. Department of Plastic Surgery, University Hospital, Liege, Belgium.
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Year of Publication
2014

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

110.

ECMO for adult respiratory failure: current use and evolving applications. [Review]

Agerstrand CL; Bacchetta MD; Brodie D.
ASAIO Journal. 60(3):255-62, 2014 May-Jun.
[Journal Article. Review]
UI: 24625534
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Agerstrand, Cara L; Bacchetta, Matthew D; Brodie, Daniel.
Institution
Agerstrand, Cara L. From the *Department of Medicine, Columbia University College of Physicians and Surgeons, New York-Presbyterian Hospital, New York, New York; and Department of Surgery, Columbia University College of Physicians and Surgeons, New York-Presbyterian Hospital, New York, New York.
Year of Publication
2014

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

111.

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):249-53, 2014 Mar-Apr.
[Case Reports. Journal Article]
UI: 24399068
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Kott, Matthias; Bewig, Burkhard; Zick, Gunther; Schaedler, Dirk; Becher, Tobias; Frerichs, Inez; Weiler, Norbert.
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Year of Publication
2014

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

112.

Paracorporeal lung assist devices as a bridge to recovery or lung transplantation in neonates and young children.
Hoganson DM; Gazit AZ; Boston US; Sweet SC; Grady RM; Huddleston CB; Eghtesady P.
Journal of Thoracic & Cardiovascular Surgery. 147(1):420-6, 2014 Jan.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 24199759
OBJECTIVE: To evaluate paracorporeal lung assist devices to treat neonates and children with decompensated respiratory failure as a bridge to recovery or lung transplantation.
METHODS: 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.
RESULTS: 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.
CONCLUSIONS: 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.

Version ID
1
Status
MEDLINE
Authors Full Name
Hoganson, David M; Gazit, Avihu Z; Boston, Umar S; Sweet, Stuart C; Grady, R Mark; Huddleston, Charles B; Eghtesady, Pirooz.
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Huddleston, Charles B. Division of Pediatric Cardiothoracic Surgery, Department of Surgery, St Louis University, St Louis, Mo.
Eghtesady, Pirooz. Division of Cardiothoracic Surgery, Department of Surgery, St Louis Children's Hospital and Washington University, St Louis, Mo. Electronic address: eghtesadyp@wudosis.wustl.edu.
Comments
Comment in (CIN)
Year of Publication
2014

113.

Miniaturization: the clue to clinical application of the artificial placenta.
Schoberer M; Arens J; Erben A; Ophelders D; Jellema RK; Kramer BW; Bruse JL; Brouwer P; Schmitz-Rode T; Steinseifer U; Orlikowsky T.
Artificial Organs. 38(3):208-14, 2014 Mar.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 24147856
The artificial placenta as a fascinating treatment alternative for neonatal lung failure has been the subject of clinical research for over 50 years. Pumpless systems have been in use since 1986. However, inappropriate dimensioning of commercially available oxygenators has wasted some of the theoretical advantages of this concept. Disproportional shunt fractions can cause congestive heart failure. Blood priming of large oxygenators and circuits dilutes fetal hemoglobin (as the superior oxygen carrier), is potentially infectious, and causes inflammatory reactions. Flow demands of large extracorporeal circuits require cannula sizes that are not appropriate for use in preterm infants. NeonatOx, a tailored low-volume oxygenator

for this purpose, has proven the feasibility of this principle before. We now report the advances in biological performance of a refined version of this specialized oxygenator.

Version ID
1
Status
MEDLINE
Authors Full Name
Schoberer, Mark; Arens, Jutta; Erben, Aileen; Ophelders, Daan; Jellema, Reint K; Kramer, Boris W; Bruse, Jan L; Brouwer, Petra; Schmitz-Rode, Thomas; Steinseifer, Ulrich; Orlikowsky, Thorsten.
Institution
Schoberer, Mark. Neonatology Section of the Department of Paediatric and Adolescent Medicine, University Hospital, RWTH Aachen University, Aachen, Germany.
Year of Publication
2014

114.

Effects of venovenous extracorporeal membrane oxygenation on cerebral oxygenation in hypercapnic ARDS.
Muellenbach RM; Kilgenstein C; Kranke P; Kustermann J; Kredel M; Roewer N; Ernestus RI; Westermaier T.
Perfusion. 29(2):139-41, 2014 Mar.
[Case Reports. Journal Article]
UI: 23887087
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 ($PaCO_2$) is one of the main determinants influencing cerebral blood flow and oxygenation. Since CO_2 removal is highly effective during ECMO, reduction of CO_2 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Muellenbach, R M; Kilgenstein, C; Kranke, P; Kustermann, J; Kredel, M; Roewer, N; Ernestus, R I; Westermaier, T.
Institution
Muellenbach, R M. University of Wurzburg, Wurzburg, Germany.
Year of Publication
2014

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

115.

Respiratory dialysis for avoidance of intubation in acute exacerbation of COPD.
Mani RK; Schmidt W; Lund LW; Herth FJ.
ASAIO Journal. 59(6):675-8, 2013 Nov-Dec.
[Case Reports. Journal Article]
UI: 24172275
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Mani, Raj Kumar; Schmidt, Werner; Lund, Laura W; Herth, Felix J F.
Institution
Mani, Raj Kumar. From the *Pulmonology and Critical Care, Artemis Health Institute, Guragon, India; Pneumology and Respiratory Care Medicine, Thoraxklinik, University of Heidelberg, Heidelberg, Germany; and ++ALung Technologies, Pittsburgh, Pennsylvania.
Year of Publication
2013

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

116.

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.
The Journal of Trauma and Acute Care Surgery. 75(5):907-12, 2013 Nov.
[Comparative Study. Journal Article]
UI: 24158215
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.
METHODS: Data were collected from all adult trauma patients referred to one center for ECMO/iLA treatment owing to severe hypoxemic respiratory failure.
RESULTS: 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 rates were 60% and 80% on ECMO and iLA, respectively. Follow-up of survivors detected no neurologic deterioration.
CONCLUSION: 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 be weighed individually against the risk of hemorrhage. Further research should determine whether ECMO therapy also confers survival benefit.
LEVEL OF EVIDENCE: Therapeutic study, level V.
Version ID
1
Status
MEDLINE
Authors Full Name
Biderman, Philippe; Einav, Sharon; Fainblut, Michael; Stein, Michael; Singer, Pierre; Medalion, Benjamin.
Institution
Biderman, Philippe. From the Department of Cardiothoracic Surgery (P.B., M.F., B.M.), Trauma Unit (M.S.), and Department of General Intensive Care (P.S.), Rabin Medical Center, Tel-Aviv University, Tel-Aviv; and General Intensive Care Unit (S.E.), Shaare Zedek Medical Center, Hebrew University, Jerusalem, Israel.
Year of Publication
2013

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

117.

To ventilate, oscillate, or cannulate?. [Review]
Shekar K; Davies AR; Mullany DV; Tiruvoipati R; Fraser JF.
Journal of Critical Care. 28(5):655-62, 2013 Oct.
[Journal Article. Review]
UI: 23827735

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.

Version ID
1
Status
MEDLINE
Authors Full Name
Shekar, Kiran; Davies, Andrew R; Mullany, Daniel V; Tiruvoipati, Ravindranath; Fraser, John F.
Institution
Shekar, Kiran. Critical Care Research Group, Adult Intensive Care Services, The Prince Charles Hospital, The University of Queensland, Brisbane, Queensland, Australia. Electronic address: kiran_shekar@health.qld.gov.au.
Year of Publication
2013

118.

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 HS.
Critical Care (London, England). 17(3):R110, 2013 Jun 20.
[Journal Article. Observational Study]
UI: 23786965
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.
METHODS: 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.
RESULTS: 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: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Ried, Michael; Bein, Thomas; Philipp, Alois; Muller, Thomas; Graf, Bernhard; Schmid, Christof; Zonies, David; Diez, Claudius; Hofmann, Hans-Stefan.
Year of Publication
2013

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

119.

A novel extracorporeal CO(2) removal system: results of a pilot study of hypercapnic respiratory failure in patients with COPD.
Burki NK; Mani RK; Herth FJF; Schmidt W; Teschler H; Bonin F; Becker H; Randerath WJ; Stieglitz S; Hagmeyer L; Priegnitz C; Pfeifer M; Blaas SH; Putensen C; Theuerkauf N; Quintel M; Moerer O.
Chest. 143(3):678-686, 2013 Mar.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 23460154
BACKGROUND: Hypercapnic respiratory failure in patients with COPD frequently requires mechanical ventilatory support. Extracorporeal CO2 removal (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 CO2 removal 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.
RESULTS: 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; PaCO2 decreased 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.
CONCLUSIONS: This single-catheter, low-flow ECCO2R system provided clinically useful levels of CO2 removal in these patients with COPD. The system appears to be a potentially valuable additional modality for the treatment of hypercapnic respiratory failure.
Version ID
1
Status
MEDLINE
Authors Full Name
Burki, Nausherwan K; Mani, Raj Kumar; Herth, Felix J F; Schmidt, Werner; Teschler, Helmut; Bonin, Frank; Becker, Heinrich; Randerath, Winfried J; Stieglitz, Sven; Hagmeyer, Lars; Priegnitz, Christina; Pfeifer, Michael; Blaas, Stefan H; Putensen, Christian; Theuerkauf, Nils; Quintel, Michael; Moerer, Onnen.
Institution
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Herth, Felix J F. Thoraxklinik am Universitatsklinikum Heidelberg, Heidelberg, Germany.
Schmidt, Werner. Thoraxklinik am Universitatsklinikum Heidelberg, Heidelberg, Germany.
Teschler, Helmut. Ruhrlandklinik, Essen, Germany.
Bonin, Frank. Ruhrlandklinik, Essen, Germany.
Becker, Heinrich. Asklepios Klinik Barmbek, Hamburg, Germany.
Randerath, Winfried J. Institute of Pneumology, Universitat Witten/Herdecke, Krankenhaus Bethanien, Solingen, Germany.
Stieglitz, Sven. Institute of Pneumology, Universitat Witten/Herdecke, Krankenhaus Bethanien, Solingen, Germany.
Hagmeyer, Lars. Institute of Pneumology, Universitat Witten/Herdecke, Krankenhaus Bethanien, Solingen, Germany.
Priegnitz, Christina. Institute of Pneumology, Universitat Witten/Herdecke, Krankenhaus Bethanien, Solingen, Germany.
Pfeifer, Michael. Klinik Donaustauf, Donaustauf, Germany.
Blaas, Stefan H. Klinik Donaustauf, Donaustauf, Germany.
Putensen, Christian. University of Bonn, Bonn, Germany.
Theuerkauf, Nils. University of Bonn, Bonn, Germany.
Quintel, Michael. Georg-August-Universitat Gottingen, Gottingen, Germany.
Moerer, Onnen. Georg-August-Universitat Gottingen, Gottingen, Germany.
Year of Publication
2013

120.

High-frequency oscillation for acute respiratory distress syndrome.
Young D; Lamb SE; Shah S; MacKenzie I; Tunnicliffe W; Lall R; Rowan K; Cuthbertson BH; OSCAR Study Group.
New England Journal of Medicine. 368(9):806-13, 2013 Feb 28.
[Comparative Study. Journal Article. Multicenter Study. Randomized Controlled Trial. Research Support, Non-U.S. Gov't]
UI: 23339638
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.
METHODS: 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 (PaO) to the fraction of inspired oxygen (FiO) 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.
RESULTS: 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 PaO:FiO 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).
CONCLUSIONS: 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.).
Version ID
1
Status
MEDLINE
Authors Full Name
Young, Duncan; Lamb, Sarah E; Shah, Sanjoy; MacKenzie, Iain; Tunnicliffe, William; Lall, Ranjit; Rowan, Kathy; Cuthbertson, Brian H; OSCAR Study Group.
Institution
Young, Duncan. John Radcliffe Hospital and the University of Oxford, Oxford, United Kingdom. duncan.young@nda.ox.ac.uk
Comments
Comment in (CIN) Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Year of Publication
2013

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

121.

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 BM; Wewalka M; Philipp A; Wernecke KD; Lubnow M; Slutsky AS.
Intensive Care Medicine. 39(5):847-56, 2013 May.
[Journal Article. Multicenter Study. Randomized Controlled Trial. Research Support, Non-U.S. Gov't]
UI: 23306584
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.
METHODS: 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.
RESULTS: 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.
CONCLUSIONS: 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).
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, Thomas; Weber-Carstens, Steffen; Goldmann, Anton; Muller, Thomas; Staudinger, Thomas; Brederlau, Jorg; Muellenbach, Ralf; Dembinski, Rolf; Graf, Bernhard M; Wewalka, Marlene; Philipp, Alois; Wernecke, Klaus-Dieter; Lubnow, Matthias; Slutsky, Arthur S.
Institution
Bein, Thomas. Department of Anesthesia and Operative Intensive Care, Regensburg University Hospital, Regensburg, Germany. thomas.bein@klinik.uni-regensburg.de
Comments
Comment in (CIN)
Year of Publication
2013

122.

Transportable extracorporeal lung support for rescue of severe respiratory failure in combat casualties.
Bein T; Zonies D; Philipp A; Zimmermann M; Osborn EC; Allan PF; Nerlich M; Graf BM; Fang R.
The Journal of Trauma and Acute Care Surgery. 73(6):1450-6, 2012 Dec.
[Journal Article]
UI: 23188237
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.
METHODS: 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 "lung failure" 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.
RESULTS: 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: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, Thomas; Zonies, David; Philipp, Alois; Zimmermann, Markus; Osborn, Erik C; Allan, Patrick F; Nerlich, Michael; Graf, Bernhard M; Fang, Raymond.
Institution
Bein, Thomas. Departments of Anaesthesia, University of Regensburg, Regensburg, Germany.
Comments
Erratum in (EIN)
Year of Publication
2012

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

123.

Extracorporeal carbon dioxide removal: the future of lung support lies in the history. [Review]
Kaushik M; Wojewodzka-Zelezniakowicz M; Cruz DN; Ferrer-Nadal A; Teixeira C; Iglesias E; Kim JC; Braschi A; Piccinni P; Ronco C.
Blood Purification. 34(2):94-106, 2012.
[Historical Article. Journal Article. Review]
UI: 23095408
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.

Version ID
1
Status
MEDLINE
Authors Full Name
Kaushik, Manish; Wojewodzka-Zelezniakowicz, Marzena; Cruz, Dinna N; Ferrer-Nadal, A; Teixeira, Catarina; Iglesias, Elena; Kim, Jeong Chul; Braschi, Antonio; Piccinni, Pasquale; Ronco, Claudio.
Institution
Kaushik, Manish. International Renal Research Institute, Vicenza, Italy.
Year of Publication
2012

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

124.

Advances in therapy for acute lung injury. [Review]
von Dossow-Hanfstingl V.
Anesthesiology Clinics. 30(4):629-39, 2012 Dec.
[Journal Article. Review]

UI: 23089499
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.

Version ID
1
Status
MEDLINE
Authors Full Name
von Dossow-Hanfstingl, Vera.
Institution
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Year of Publication
2012

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

125.

Bench to bedside review: Extracorporeal carbon dioxide removal, past present and future. [Review]
Cove ME; MacLaren G; Federspiel WJ; Kellum JA.
Critical Care (London, England). 16(5):232, 2012 Sep 21.
[Journal Article. Research Support, N.I.H., Extramural. Review]
UI: 23014710
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.
Version ID
1
Status
MEDLINE
Authors Full Name

Cove, Matthew E; MacLaren, Graeme; Federspiel, William J; Kellum, John A.
Year of Publication
2012

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

126.

Arterial chimney graft cannulation for interventional lung assist.
Burkle MA; Sodian R; Kaczmarek I; Weig T; Frey L; Irlbeck M; Dolch ME.
Annals of Thoracic Surgery. 94(4):1335-7, 2012 Oct.
[Case Reports. Journal Article]
UI: 23006692
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.

Version ID
1
Status
MEDLINE
Authors Full Name
Burkle, Martin A; Sodian, Ralf; Kaczmarek, Ingo; Weig, Thomas; Frey, Lorenz; Irlbeck, Michael; Dolch, Michael E.
Institution
Burkle, Martin A. Department of Anesthesiology, University Hospital Grosshadern, Ludwig-Maximilians-University, Munich, Germany.
Year of Publication
2012

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

127.

Lung transplantation for bronchiolitis obliterans after allogeneic hematopoietic stem cell transplantation.
Kim YR; Haam SJ; Park YG; Lim BJ; Park YM; Paik HC.
Yonsei Medical Journal. 53(5):1054-7, 2012 Sep.
[Case Reports. Journal Article]
UI: 22869493
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 R 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 R. 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Kim, Yu Ri; Haam, Seok Jin; Park, Yoon Ghil; Lim, Beom Jin; Park, Yoo Mi; Paik, Hyo Chae.
Institution
Kim, Yu Ri. Department of Internal Medicine, Yonsei University College of Medicine, Seoul, Korea.
Year of Publication
2012

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

128.

Avoiding invasive mechanical ventilation by extracorporeal carbon dioxide removal in patients failing noninvasive ventilation.
Kluge S; Braune SA; Engel M; Nierhaus A; Frings D; Ebelt H; Uhrig A; Metschke M; Wegscheider K; Suttorp N; Rousseau S.
Intensive Care Medicine. 38(10):1632-9, 2012 Oct.
[Journal Article. Multicenter Study]
UI: 22836139
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).
METHODS: 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.
RESULTS: Of the 21 patients treated with PECLA, 19 (90 %) did not require intubation. Median PaCO(2) 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 PaCO(2) 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 %). CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Kluge, Stefan; Braune, Stephan A; Engel, Markus; Nierhaus, Axel; Frings, Daniel; Ebelt, Henning; Uhrig, Alexander; Metschke, Maria; Wegscheider, Karl; Suttorp, Norbert; Rousseau, Simone.
Institution
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Year of Publication
2012

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

129.

Report of two cases of ARDS patients treated with pumpless extracorporeal interventional lung assist.
Coscia AP; Cunha HF; Longo AG; Martins EG; Saddy F; Japiassu AM.
Jornal Brasileiro De Pneumologia: Publicacao Oficial Da Sociedade Brasileira De Pneumologia E Tisilogia. 38(3):408-11, 2012 May-Jun.
[Case Reports. Letter]
UI: 22782614
Version ID
1
Status
MEDLINE
Authors Full Name
Coscia, Alexandre Peixoto; Cunha, Haroldo Falcao Ramos da; Longo, Alessandra Gouvea; Martins, Enio Gustavo Schoeder; Saddy, Felipe; Japiassu, Andre Miguel.
Year of Publication
2012

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

130.

[Decubitus prone position in patient with extracorporeal CO2 removal device Novalung(R)]. [Spanish] Decubito prono en paciente portador de dispositivo de extraccion extracorporea de CO(2) Novalung(R).
Frade Mera MJ; Vergara Diez L; Fernandez Gaute N; Montes Gil D.
Enfermeria Intensiva. 23(3):132-41, 2012 Jul-Sep.
[Case Reports. English Abstract. Journal Article]
UI: 22726348
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 AND METHODS: 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.
RESULTS: 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 26 days, MBP 82 +/- 9 mmHg, HR 110 +/- 6l pm during the admission, monitoring PICCO 5 days CI 3.2 +/- 0.8 l/min/m2, ELWI 33 +/- 4 ml, continuous hemofiltration 13.2 days with a median removal 50 cc/h. Norepinephrine dose 0.68 +/- 0.79 mu/kg/min for 15 days. 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 R 13 days, 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 R 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.

Version ID
1
Status
MEDLINE
Authors Full Name
Frade Mera, M J; Vergara Diez, L; Fernandez Gaute, N; Montes Gil, D.
Institution
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Year of Publication
2012

131.

The pumpless extracorporeal lung membrane provides complete respiratory support during complex airway reconstructions without inducing cellular trauma or a coagulatory and inflammatory response.
Sanchez-Lorente D; Iglesias M; Rodriguez A; Jungebluth P; Macchiarini P.
Journal of Thoracic & Cardiovascular Surgery. 144(2):425-30, 2012 Aug.
[Journal Article]
UI: 22578896
OBJECTIVE: Our objective was to investigate the capacity of a pumpless extracorporeal lung membrane (iLA) (Novalung; Novalung GmbH, Hechingen, Germany) to provide adequate respiratory support and the impact on morbidity/mortality during complex airway reconstruction.
METHODS: Only patients unable to be ventilated via conventional intubation were eligible for the study. A larynx mask or orotracheal tubes were placed above the airway defect and the iLA was attached via femoral vessels (arteriovenous), providing extracorporeal gas exchange, apneic hyperoxygenation, and total tubeless airway reconstruction. Haptoglobulin, plasmin-antiplasmin complex, P-selectin activation, and interleukin 6 were measured before, during, and after iLA use and 72 hours postoperatively.
RESULTS: Fifteen consecutive patients (age, 42+/-17 years) underwent elective (n=7) or emergency (n=8) reconstruction of the airway owing to a variety of disorders or defects. The iLA was left in place for 185+/-61 minutes, diverted 1.70+/-0.48 L/min of the cardiac output, and provided an arteriovenous carbon dioxide removal and oxygen transfer of 173+/-94 and 144+/-83 mL/min, respectively. The arterial oxygen tension/inspired oxygen fraction (314+/-31 mm Hg), and arterial carbon dioxide tension (40+/-6 mm Hg) remained stable throughout the entire operations. The following procedures were performed: redo slide tracheoplasties (n=3), redo tracheoesophageal fistula repair (n=1), sleeve lobectomies (n=2), main carina reconstructions (n=7), and anastomotic stenting and myocutaneous coverages (n=2). Three patients required prolonged (9+/-2 days) postoperative iLA support. Two (13%) patients died during the hospital stay. The use of iLA was associated with significant (P<.05) but clinically nonrelevant and yet nonpathologic increases of haptoglobulin (hemolysis), plasmin-antiplasmin complex (coagulation activation), and P-selectin activation (platelet activation). Data normalized within 48 hours postoperatively.
CONCLUSIONS: Data suggest that iLA provides complete intraoperative respiratory support in patients who cannot receive conventional intubation/ventilation without relevant effects on cellular trauma, coagulatory response, and inflammatory response.

Version ID
1
Status
MEDLINE
Authors Full Name
Sanchez-Lorente, David; Iglesias, Manuela; Rodriguez, Alberto; Jungebluth, Philipp; Macchiarini, Paolo.
Institution
Sanchez-Lorente, David. Department of General Thoracic Surgery Hospital Clinic, Universitat de Barcelona, Spain.
Year of Publication
2012

132.

The management of extracorporeal carbon dioxide removal device in a diffuse alveolar haemorrhage.
Lopez-Delgado JC; Sabater-Riera J; Avila-Espinoza RE.
Anaesthesia & Intensive Care. 40(3):567-8, 2012 May.
[Case Reports. Letter]
UI: 22577935
Version ID
1
Status
MEDLINE
Authors Full Name
Lopez-Delgado, J C; Sabater-Riera, J; Avila-Espinoza, R E.
Year of Publication
2012

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

133.

Trends in and perspectives on extracorporeal membrane oxygenation for severe adult respiratory failure. [Review]
Sadahiro T; Oda S; Nakamura M; Hirayama Y; Watanabe E; Tateishi Y; Shinozaki K.

General Thoracic & Cardiovascular Surgery. 60(4):192-201, 2012 Apr.
[Historical Article. Journal Article. Review]
UI: 22451141
Various approaches such as ventilator management involving lung-protective ventilation, corticosteroids, prone positioning, and nitric oxide have failed to maintain sufficient 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 influenza 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Sadahiro, Tomohito; Oda, Shigeto; Nakamura, Masataka; Hirayama, Yo; Watanabe, Eizo; Tateishi, Yoshihisa; Shinozaki, Koichiro.

Institution
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Year of Publication
2012

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

134.

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 SF.
Respiratory Care. 57(7):1178-81, 2012 Jul.
[Case Reports. Journal Article]
UI: 22369998
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 skating again.
Version ID
1
Status
MEDLINE
Authors Full Name
Gorjup, Vojka; Fister, Misa; Noc, Marko; Rajic, Vladan; Ribaric, Suada Filekovic.
Institution
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Year of Publication
2012

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

135.

Role and potentials of low-flow CO(2) removal system in mechanical ventilation.
[Review]
Terragni P; Maiolo G; Ranieri VM.
Current Opinion in Critical Care. 18(1):93-8, 2012 Feb.
[Journal Article. Review]
UI: 22186219

PURPOSE OF REVIEW: An analysis of the technological implementation of extracorporeal CO(2) removal (ECCO(2)R) techniques and of its clinical application. A new classification of ECCO(2)R, 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 ECCO(2)R devices can represent the missing link between the prevention of ventilator-induced lung injury and pH control. ECCO(2)R has attracted increasing interest because of new less-invasive approaches allowing an easier management of ARDS patients. Recent studies have also shown that ECCO(2)R 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.
Version ID
1
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Authors Full Name
Terragni, Pierpaolo; Maiolo, Giorgia; Ranieri, V Marco.
Institution
Terragni, Pierpaolo. Department of Anesthesia and Intensive Care Medicine, S.Giovanni Battista Hospital, University of Turin, Turin, Italy.
Year of Publication
2012

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

136.

Physiologic effect and safety of the pumpless extracorporeal interventional lung assist system in patients with acute respiratory failure--a pilot study.
Cho WH; Lee K; Huh JW; Lim CM; Koh Y; Hong SB.
Artificial Organs. 36(4):434-8, 2012 Apr.
[Clinical Trial. Journal Article]
UI: 22040296
Interventional lung assist (iLA) effectively reduces CO(2) 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, PaCO(2) decreased from 83.9+/-23.4mmHg to 40.7+/-10.2mmHg, and PaO(2) /FiO(2) 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 H(2) O to 28.8+/-9.4cm H(2) O. No serious adverse events were observed during iLA use. iLA showed effective CO(2) 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.

Version ID
1
Status
MEDLINE
Authors Full Name
Cho, Woo Hyun; Lee, Kwangha; Huh, Jin Won; Lim, Chae-Man; Koh, Younsuck; Hong, Sang-Bum.
Institution
Cho, Woo Hyun. Department of Internal Medicine, Pusan National University Yangsan Hospital, Korea.
Year of Publication
2012

137.

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):293-7, 2012 Feb.
[Case Reports. Journal Article]
UI: 21762563
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 (P(aCO(2)) 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Petzoldt, Martin; Braune, Stephan; Bittmann, Iris; Kluge, Stefan.
Institution
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Hamburg-Eppendorf, Hamburg, Germany. m.petzoldt@uke.de
Year of Publication
2012

138.

[Severe acute respiratory distress syndrome complicating type A (H1N1) influenza treated with extracorporeal CO2 removal]. [Polish] 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):98-103, 2011 Apr-Jun.
[Case Reports. English Abstract. Journal Article]
UI: 22011871
BACKGROUND: 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.
CASE REPORT: 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.
DISCUSSION: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Smiechowicz, Jakub; Barteczko, Barbara; Grotowska, Malgorzata; Kaiser, Teresa; Zielinski, Stanislaw; Kubler, Andrzej.
Institution

Smiechowicz, Jakub. Department of Anaesthesiology and Intensive Therapy, Wroclaw Medical University,Wroclaw. jsmiech@gmail.com
Year of Publication
2011

139.

Interventional lung assist enables lung protective mechanical ventilation in acute respiratory distress syndrome.
Nierhaus A; Frings DP; Braune S; Baumann HJ; Schneider C; Wittenburg B; Kluge S.

Minerva Anestesiologica. 77(8):797-801, 2011 08.
[Journal Article]
UI: 21730927
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Nierhaus, A; Frings, D P; Braune, S; Baumann, H-J; Schneider, C; Wittenburg, B; Kluge, S.
Institution
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Year of Publication

2011

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

140.

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. 57(4):336-40, 2011 Jul-Aug.
[Case Reports. Journal Article]
UI: 21555937
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 (ECCO2R), allowed weaning from mechanical ventilation, closure of BPF, and resumption of spontaneous breathing.
Version ID
1
Status
MEDLINE
Authors Full Name
Bombino, Michela; Patroniti, Nicolo; Foti, Giuseppe; Isgro, Stefano; Grasselli, Giacomo; Pesenti, Antonio.
Institution
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Year of Publication
2011

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

141.

Use of extracorporeal membrane lung assist device (Novalung) in H1N1 patients.
Johnson P; Frohlich S; Westbrook A.
Journal of Cardiac Surgery. 26(4):449-52, 2011 Jul.
[Journal Article]
UI: 21554392
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 (Novalung TM, 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.

Version ID
1
Status
MEDLINE
Authors Full Name
Johnson, Philip; Frohlich, Stephen; Westbrook, Andrew.
Institution
Johnson, Philip. Department of Intensive Care Medicine, St James's Hospital, Dublin, Ireland.
Year of Publication
2011

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

142.

Protective and ultra-protective ventilation: using pumpless interventional lung assist (iLA). [Review]
Moerer O; Quintel M.
Minerva Anestesiologica. 77(5):537-44, 2011 May.
[Journal Article. Review]
UI: 21540810
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Moerer, O; Quintel, M.
Institution
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Year of Publication
2011

Link to the Ovid Full Text or citation:

Click here for full text options

143.

[Interventional lung assist membrane ventilator. Successful use despite heparin-induced thrombocytopenia type II]. [German] "Interventional-lung-assist"-Membranventilator. Erfolgreiche Anwendung trotz heparininduzierter Thrombozytopenie II.
Lange J; Knuttgen D; Stoelben E; Bauerfeind U; Wappler F; Sakka SG.
Anaesthesist. 60(3):230-5, 2011 Mar.
[Case Reports. Journal Article]
UI: 21184044
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Lange, J; Knuttgen, D; Stoelben, E; Bauerfeind, U; Wappler, F; Sakka, S G.
Institution
Lange, J. Klinik fur Viszeral-, Gefas- und Transplantationschirurgie, Klinikum der Universitat Witten/Herdecke mit Sitz in Koln, Kliniken der Stadt Koln gGmbH, Krankenhaus Merheim, Koln, Deutschland.
Year of Publication
2011

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

144.

Pumpless extracorporeal lung assist for the treatment of severe, refractory status asthmaticus.
Jung C; Lauten A; Pfeifer R; Bahrmann P; Figulla HR; Ferrari M.
Journal of Asthma. 48(1):111-3, 2011 Feb.
[Case Reports. Journal Article]
UI: 21039186
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Jung, Christian; Lauten, Alexander; Pfeifer, Ruediger; Bahrmann, Philipp; Figulla, Hans R; Ferrari, Markus.
Institution
Jung, Christian. Clinic of Internal Medicine I, Friedrich-Schiller-University, Jena, Germany. christian.jung@med.uni-jena.de
Year of Publication
2011

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

145.

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):7-20, 2011 Jan.
[Journal Article. Meta-Analysis]
UI: 20826508
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.
Version ID
1
Status

MEDLINE
Authors Full Name
Wong, Ivan; Vuylsteke, Alain.
Institution
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Year of Publication
2011

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

146.

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):201-5, 2010 Oct-Dec.
[Case Reports. Journal Article]
UI: 21252837
BACKGROUND: 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.
CASE REPORT: 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.
DISCUSSION AND CONCLUSION: 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.
Version ID
1

Status
MEDLINE
Authors Full Name
Banach, Marta; Soukup, Jens; Bucher, Michael; Andres, Janusz.
Institution
Banach, Marta. Klinik fur Anasthesiologie und Operative Intensivmedizin der Martin-Luther-Universitat, Halle, Ernst-Grube Str. 40, 06120 Halle.
Year of Publication
2010

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

147.

Carbon dioxide dialysis will save the lung.
Pesenti A; Patroniti N; Fumagalli R.
Critical Care Medicine. 38(10 Suppl):S549-54, 2010 Oct.
[Journal Article]
UI: 21164396
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 ventilatory 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 hemodialysis. High carbon dioxide removal efficiency may be achieved by combinations of hemofiltration and metabolizable acid loads.
Version ID
1
Status
MEDLINE
Authors Full Name
Pesenti, Antonio; Patroniti, Nicolo; Fumagalli, Roberto.
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Year of Publication
2010

Link to the Ovid Full Text or citation:
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148.

[Extracorporeal lung assist in severe respiratory failure and ARDS. Current situation

and clinical applications]. [Review] [Spanish] Asistencia respiratoria extracorporea en la insuficiencia respiratoria grave y el SDRA. Situacion actual y aplicaciones clinicas.
Gomez-Caro A; Badia JR; Ausin P.
Archivos de Bronconeumologia. 46(10):531-7, 2010 Oct.
[English Abstract. Journal Article. Review]
UI: 20937437
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.

Version ID
1
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MEDLINE
Authors Full Name
Gomez-Caro, Abel; Badia, Joan Ramon; Ausin, Pilar.
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Year of Publication
2010

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

149.

[ECMO and ARDS-therapy - an update]. [German] Die ECMO in der ARDS-Therapie - Ein Update.
Moller T; Vassiliou T; Rolfes C; Wulf H.
Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 45(9):544-50, 2010 Sep.
[English Abstract. Journal Article]
UI: 20839142
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.

Version ID
1
Status
MEDLINE
Authors Full Name
Moller, Thorsten; Vassiliou, Timon; Rolfes, Caroline; Wulf, Hinnerk.
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Year of Publication
2010

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150.

Double ECMO in severe ARDS: report of an outstanding case and literature review.
Litmathe J; Dapunt O.
Perfusion. 25(6):363-7, 2010 Nov.
[Case Reports. Journal Article]
UI: 20696738
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Litmathe, Jens; Dapunt, Otto.
Institution
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Year of Publication
2010

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

151.

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 VM; Rinaldi M.
Transplantation Proceedings. 42(4):1255-8, 2010 May.
[Journal Article]
UI: 20534274
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.
METHODS: 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).
RESULTS: 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 PaCO(2) 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: 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.

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1
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Authors Full Name
Ricci, D; Boffini, M; Del Sorbo, L; El Qarra, S; Comoglio, C; Ribezzo, M; Bonato, R; Ranieri, V M; Rinaldi, M.
Institution
Ricci, D. Division of Cardiac Surgery, San Giovanni Battista Hospital Molinette, University of Torino, Torino, Italy.
Year of Publication
2010

152.

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):1782-7; discussion 1788, 2010 Jun.
[Journal Article]
UI: 20494028
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.
METHODS: 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.
RESULTS: 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 O(2)) and a very efficient elimination of carbon dioxide (121 mL/min transfer of CO(2)). 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.
CONCLUSIONS: 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.

Version ID
1
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Authors Full Name
Wiebe, Karsten; Poeling, Jochen; Arlt, Matthias; Philipp, Alois; Camboni, Daniele; Hofmann, Stefan; Schmid, Christof.
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Year of Publication
2010

Link to the Ovid Full Text or citation:
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153.

Extracorporeal CO2 removal.
Terragni PP; Birocco A; Faggiano C; Ranieri VM.
Contributions to Nephrology. 165:185-196, 2010.
[Journal Article]
UI: 20427969
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.

Version ID
1
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Authors Full Name
Terragni, Pier Paolo; Birocco, Alberto; Faggiano, Chiara; Ranieri, V Marco.
Year of Publication
2010

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Click here for full text options

154.

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 DN; Ronco C.
Contributions to Nephrology. 165:174-184, 2010.
[Journal Article]
UI: 20427968
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.

Version ID
1
Status
MEDLINE
Authors Full Name
Gramaticopolo, Silvia; Chronopoulos, Alexandra; Piccinni, Pasquale; Nalesso, Federico; Brendolan, Alessandra; Zanella, Monica; Cruz, Dinna N; Ronco, Claudio.
Year of Publication
2010

Link to the Ovid Full Text or citation:
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155.

[Status asthmaticus. Role of extracorporeal lung assist procedures]. [German] Status asthmaticus. Stellenwert extrakorporaler Lungenunterstutzungsverfahren.
Aniset L; Kalenka A.
Anaesthesist. 59(4):327-32, 2010 Apr.
[Case Reports. English Abstract. Journal Article]
UI: 20224950
The successful application of a pumpless extracorporeal lung assist procedure ("interventional lung assist, iLA) in three cases of severe refractory status asthmaticus, which could not be solved with conventional pharmacological and respiratory therapy is reported. After an individual risk-benefit analysis such a therapy can be used to reduce lung injury due to invasive mechanical ventilation. Because of the complexity of this therapy it should only be applied in special medical centers with sufficient experience in dealing with extracorporeal lung assist procedures.
Version ID
1
Status
MEDLINE
Authors Full Name
Aniset, L; Kalenka, A.
Institution
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Year of Publication
2010

156.

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 GA; Pfeifer M; Muller T.
Journal of Critical Care. 25(3):436-44, 2010 Sep.
[Journal Article]
UI: 20074908
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.
METHODS: 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 Pao(2)/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. Paco(2) 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: 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.

Version ID
1
Status
MEDLINE
Authors Full Name
Lubnow, Matthias; Luchner, Andreas; Philipp, Alois; Buchner, Stefan; Jeron, Andreas; Karagiannidis, Christian; Bein, Thomas; Pawlik, Michael; Jungbauer, Carsten; Schmid, Christof; Riegger, Gunter A J; Pfeifer, Michael; Muller, Thomas.
Institution
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Year of Publication
2010

Link to the Ovid Full Text or citation:
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157.

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. 11(1):e8-12, 2010 Jan.
[Case Reports. Journal Article]
UI: 20051789
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: Noninvasive mechanical ventilation and Decapsmart have proven efficacious in managing refractory hypercapnic respiratory failure in a pediatric patient awaiting lung transplantation.
Version ID
1
Status
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Authors Full Name
Moscatelli, Andrea; Ottonello, Giancarlo; Nahum, Laura; Lampugnani, Elisabetta; Puncuh, Franco; Simonini, Alessandro; Tumolo, Miriam; Tuo, Pietro.
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Comments
Comment in (CIN)
Year of Publication
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158.

Ventilatory support for acute respiratory failure: new and ongoing pathophysiological, diagnostic and therapeutic developments. [Review] [51 refs]

Del Sorbo L; Slutsky AS.
Current Opinion in Critical Care. 16(1):1-7, 2010 Feb.
[Journal Article. Review]
UI: 19952735
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. [References: 51]
Version ID
1
Status
MEDLINE
Authors Full Name
Del Sorbo, Lorenzo; Slutsky, Arthur S.
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Year of Publication
2010

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Click here for full text options

159.

Pulmonary/renal interaction. [Review] [48 refs]
Ricci Z; Ronco C.
Current Opinion in Critical Care. 16(1):13-8, 2010 Feb.
[Journal Article. Retracted Publication. Review]
UI: 19935063
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. [References: 48]
Version ID
1
Status
MEDLINE
Authors Full Name
Ricci, Zaccaria; Ronco, Claudio.
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Comments
Retraction in (RIN)
Year of Publication
2010

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

160.

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):696-703, 2009 Sep.
[Journal Article]
UI: 19775261
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 CO(2) 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.
Version ID
1

Status
MEDLINE
Authors Full Name
Arlt, Matthias; Philipp, Alois; Zimmermann, Markus; Voelkel, Sabine; Amann, Matthias; Bein, Thomas; Muller, Thomas; Foltan, Maik; Schmid, Christof; Graf, Bernhard; Hilker, Michael.
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Year of Publication
2009

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

161.

Tidal volume lower than 6 ml/kg enhances lung protection: role of extracorporeal carbon dioxide removal.
Terragni PP; Del Sorbo L; Mascia L; Urbino R; Martin EL; Birocco A; Faggiano C; Quintel M; Gattinoni L; Ranieri VM.
Anesthesiology. 111(4):826-35, 2009 Oct.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 19741487
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 < or = PPLAT < or = 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.
METHODS: 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 < or = PPLAT < or = 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.
RESULTS: 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.
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Terragni, Pier Paolo; Del Sorbo, Lorenzo; Mascia, Luciana; Urbino, Rosario; Martin,

Erica L; Birocco, Alberto; Faggiano, Chiara; Quintel, Michael; Gattinoni, Luciano; Ranieri, V Marco.
Institution
Terragni, Pier Paolo. Dipartimento di Anestesiologia e Medicina degli Stati Critici, Universita di Torino, Ospedale S. Giovanni Battista-Molinette, Corso Dogliotti 14, Turin, Italy.
Comments
Comment in (CIN)
Year of Publication
2009

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

162.

Extracorporeal circulatory systems in the interhospital transfer of critically ill patients: experience of a single institution.
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):110-4, 2009 Mar-Apr.
[Journal Article]
UI: 19318758
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.
RESULTS: 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: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Haneya, Assad; Philipp, Alois; Foltan, Maik; Mueller, Thomas; Camboni, Daniele; Rupprecht, Leopold; Puehler, Thomas; Hirt, Stephan; Hilker, Michael; Kobuch,

Reinhard; Schmid, Christof; Arlt, Matthias.
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Comments
Comment in (CIN)
Year of Publication
2009

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

163.

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):304-6, 2009 May-Jun.
[Case Reports. Journal Article]
UI: 19282751
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Camboni, Daniele; Philipp, Alois; Arlt, Matthias; Pfeiffer, Michael; Hilker, Michael; Schmid, Christof.
Institution
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Year of Publication
2009

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

164.

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 BM; Schlitt HJ.
Critical Care (London, England). 13(1):R10, 2009.
[Comparative Study. Journal Article]
UI: 19183475
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.
METHODS: 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.
RESULTS: Initiation of iLA resulted in a marked removal in arterial carbon dioxide allowing a rapid reduction in tidal volume (<or= 6 ml/kg) and inspiratory plateau pressure. Adverse events occurred in 6 patients (11.9%). The hospital mortality rate was 49%.
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Zimmermann, Markus; Bein, Thomas; Arlt, Matthias; Philipp, Alois; Rupprecht, Leopold; Mueller, Thomas; Lubnow, Matthias; Graf, Bernhard M; Schlitt, Hans J.
Institution
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Comments
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Year of Publication
2009

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Click here for full text options

165.

Extracorporeal gas exchange. [Review] [44 refs]

Pesenti A; Zanella A; Patroniti N.
Current Opinion in Critical Care. 15(1):52-8, 2009 Feb.
[Journal Article. Review]
UI: 19179870
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. [References: 44]
Version ID
1
Status
MEDLINE
Authors Full Name
Pesenti, Antonio; Zanella, Alberto; Patroniti, Nicolo.
Institution
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Year of Publication
2009

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

166.

Pumpless extracorporeal removal of carbon dioxide combined with ventilation using low tidal volume and high positive end-expiratory pressure in a patient with severe acute respiratory distress syndrome.
Bein T; Zimmermann M; Hergeth K; Ramming M; Rupprecht L; Schlitt HJ; Slutsky AS.
Anaesthesia. 64(2):195-8, 2009 Feb.
[Case Reports. Journal Article]
UI: 19143699
The effects of the combination of a 'lowest' lung ventilation with extracorporeal elimination of carbon dioxide by interventional lung assist are described in a patient

presenting with severe acute respiratory distress syndrome due to fulminant pneumonia. Reducing tidal volume to 3 ml.kg(-1) together with interventional lung assist resulted in a decrease in severe hypercapnia without alveolar collapse or hypoxaemia but with a decrease in serum levels of interleukin-6. This approach was applied for 12 days with recovery of the patient, without complications. Extracorporeal removal of carbon dioxide by interventional lung assist may be a useful tool to enable 'ultraprotective' ventilation in severe acute respiratory distress syndrome.
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, T; Zimmermann, M; Hergeth, K; Ramming, M; Rupprecht, L; Schlitt, H J; Slutsky, A S.
Institution
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Year of Publication
2009

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

167.

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 CE; Zimmermann M; Birnbaum D; Schmid C; Riegger GA; Pfeifer M.
European Respiratory Journal. 33(3):551-8, 2009 Mar.
[Journal Article]
UI: 19010979
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 x min(-1) for 15 French (Fr), 1.94+/-0.35 L x min(-1) for 17 Fr, and 2.22 +/-0.45 L x min(-1) for 19 Fr) and on mean arterial pressure. Oxygen transfer capacity averaged 41.7+/-20.8 mL x min(-1), carbon dioxide removal was 148.0+/-63.4 mL x 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 approximately 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.
Version ID
1

Status
MEDLINE
Authors Full Name
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.
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Year of Publication
2009

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

168.

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):1652-5, 2008 Dec.
[Case Reports. Journal Article]
UI: 19043011
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 cmH(2)O (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.
Version ID
1
Status
MEDLINE
Authors Full Name
Hommel, M; Deja, M; von Dossow, V; Diemel, K; Heidenhain, C; Spies, C; Weber-Carstens, S.
Institution
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Comments
Comment in (CIN)
Year of Publication
2008

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

169.

[Techniques of extracorporeal lung support]. [Review] [17 refs] [German] Einsatz extrakorporaler Lungenunterstutzungsverfahren.
Bein T; Weber-Carstens S.
Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 43(11-12):786-91; quiz 793, 2008 Nov.
[English Abstract. Journal Article. Review]
UI: 19016390
For patients with severe acute respiratory distress syndrome techniques of extracorporeal lung support have been established thirty years ago. In the beginning of such a strategy a roller-pump-driven veno-venous extracorporeal membrane oxygenation (ECMO) was used, which was characterized by high complication rate. Meanwhile the development of a miniaturized ECMO using centrifugal pumps might have improved the safety of use. Recently a pumpless arterio-venous interventional lung assist (iLA) was introduced. While ECMO enables a complete extrapulmonary gas exchange, iLA provides effective CO(2)-elimination. In this review, technical basements, results from clinical studies, incidence of complications and algorithms for clinical use of extracorporeal lung support systems are discussed. [References: 17]
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, Thomas; Weber-Carstens, Steffen.
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Year of Publication
2008

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

170.

Clinical experience with a pumpless extracorporeal lung assist device.
Hammell C; Forrest M; Barrett P.
Anaesthesia. 63(11):1241-4, 2008 Nov.
[Case Reports. Evaluation Study. Journal Article]

UI: 18717661
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 (Novalung) 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Hammell, C; Forrest, M; Barrett, P.
Institution
Hammell, C. Warrington Hospital, Warrington, UK.
Year of Publication
2008

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

171.

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):410-7; discussion 417, 2008 Aug.
[Journal Article]
UI: 18640306
BACKGROUND: Pumpless extracorporeal lung assist (PECLA) was developed to support pulmonary function in patients with severe respiratory insufficiency.
METHODS: 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.
RESULTS: 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.
CONCLUSIONS: 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.
Version ID
1

Status
MEDLINE
Authors Full Name
Florchinger, Bernhard; Philipp, Alois; Klose, Alexander; Hilker, Michael; Kobuch, Reinhard; Rupprecht, Leopold; Keyser, Andreas; Puhler, Thomas; Hirt, Stephan; Wiebe, Karsten; Muller, Thomas; Langgartner, Julia; Lehle, Karla; Schmid, Christof.
Institution
Florchinger, Bernhard. Department of Cardiothoracic Surgery, University Hospital, Regensburg, Germany.
Year of Publication
2008

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

172.

Advances in extracorporeal ventilation. [Review] [25 refs]
Meyer A; Struber M; Fischer S.
Anesthesiology Clinics. 26(2):381-91, viii, 2008 Jun.
[Journal Article. Review]
UI: 18456221
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. [References: 25]
Version ID
1
Status
MEDLINE
Authors Full Name
Meyer, Anna; Struber, Martin; Fischer, Stefan.
Institution
Meyer, Anna. Division of Thoracic Surgery and Lung Support, Department of Cardiac, Thoracic, Transplant and Vascular Surgery, Hannover Medical School, Carl-Neuberg-Strasse 1, 30625 Hannover, Germany.
Year of Publication
2008

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

173.

[Extracorporeal lung support procedures (ECMO/iLA)]. [German] Extrakorporale Lungenunterstutzungsverfahren (ECMO/iLA).
Bein T; Muller T; Weber-Carstens S.
Pneumologie. 62(3):137-42, 2008 Mar.
[English Abstract. Journal Article]
UI: 18264892
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, T; Muller, T; Weber-Carstens, S.
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Year of Publication
2008

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

174.

Extrapulmonary ventilation for unresponsive severe acute respiratory distress syndrome after pulmonary resection.
Iglesias M; Martinez E; Badia JR; Macchiarini P.
Annals of Thoracic Surgery. 85(1):237-44; discussion 244, 2008 Jan.
[Journal Article]
UI: 18154817
BACKGROUND: The purpose of this study was to evaluate the feasibility of integrating an artificial, pumpless extracorporeal membrane ventilator (Novalung) to near static mechanical ventilation and its efficacy in patients with severe postresectional acute respiratory distress syndrome (ARDS) unresponsive to optimal conventional treatment.
METHODS: Indications were severe postresectional and unresponsive acute respiratory distress syndrome, hemodynamic stability, and no significant peripheral arterial occlusive disease or heparin-induced thrombocytopenia. Management included placement of the arteriovenous femoral transcutaneous interventional lung-assist membrane ventilator, lung rest at minimal mechanical ventilator settings, and optimization of systemic oxygen consumption and delivery.

RESULTS: Among 239 pulmonary resections performed between 2005 and 2006, 7 patients (2.9%) experienced, 4 +/- 0.8 days after 5 pneumonectomies and 2 lobectomies, a severe (Murray score, 2.9 +/- 0.3) acute respiratory distress syndrome unresponsive to 4 +/- 2 days of conventional therapy. The interventional lung-assist membrane ventilator was left in place 4.3 +/- 2.5 days, and replaced only once for massive clotting. During this time, 29% +/- 0.3% or 1.4 +/- 0.36 L/min of the cardiac output perfused the device, without hemodynamic impairment. Using a sweep gas flow of 10.7 +/- 3.8 L/min, the device allowed an extracorporeal carbon dioxide removal of 255 +/- 31 mL/min, lung(s) rest (tidal volume, 2.7 +/- 0.8 mL/kg; respiratory rate, 6 +/- 2 beats/min; fraction of inspired oxygen, 0.5 +/- 0.1), early (<24 hours) significant improvement of respiratory function, and reduction of plasmatic interleukin-6 levels ($p < 0.001$) and Murray score (1.25 +/- 0.1; $p < 0.003$). All but 1 patient (14%) who died of multiorgan failure were weaned from mechanical ventilation 8 +/- 3 days after removal of the interventional lung-assist membrane ventilator, and all of them were discharged from the hospital.
CONCLUSIONS: The integration of this device to near static mechanical ventilation of the residual native lung(s) is feasible and highly effective in patients with severe and unresponsive acute respiratory distress syndrome after pulmonary resection.
Version ID
1
Status
MEDLINE
Authors Full Name
Iglesias, Manuela; Martinez, Elisabeth; Badia, Joan Ramon; Macchiarini, Paolo.
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Year of Publication
2008

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

175.

Extracorporeal circulatory systems and their role in military medicine: a clinical review. [Review] [19 refs]
Midla GS.
Military Medicine. 172(5):523-6, 2007 May.
[Journal Article. Review]
UI: 17521103
This study was undertaken to clinically review the historical use, current manufacturing trends, and military application of extracorporeal circulatory (ECC) systems to treat pulmonary trauma patients. In the past 50 years, ECC support has evolved into a viable treatment option for pulmonary patients. New developments in ECC systems, such as heparin-bonded circuit designs like the Lifebridge B2T and the Novalung, are giving providers more choices with which to initiate ECC support and transport those injured while supporting the global war on terrorism. If ECC support is adopted by the military, then a training program that includes a review of standard operating procedures, equipment types, pharmaceutical dosing, transport with ground and air assets, and the effects of temperature and elevation changes on the circuits should be instituted. Reviewing all possible treatment choices for pulmonary insults received during this war should give providers additional tools with which to save lives. [References: 19]

Version ID
1
Status
MEDLINE
Authors Full Name
Midla, George S.
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Year of Publication
2007

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

176.

From Baghdad to Germany: use of a new pumpless extracorporeal lung assist system in two severely injured US soldiers.
Zimmermann M; Philipp A; Schmid FX; Dorlac W; Arlt M; Bein T.
ASAIO Journal. 53(3):e4-6, 2007 May-Jun.
[Case Reports. Journal Article]
UI: 17515712
The authors describe a new extracorporeal pumpless interventional lung assist system (iLA) that was implemented in two US soldiers with severe acute respiratory distress syndrome received from enemy action in Iraq, who were at risk for critical hypoxemia/hypercapnia. The system is characterized by a new low-resistance gas exchange membrane that is integrated in an arterial-venous bypass established by cannulation of the femoral artery and vein. Cardiovascular stability is essential to produce sufficiently high blood flow rates over the gas exchange unit. After implantation of the interventional lung assist, oxygenation increased and carbon dioxide elimination improved rapidly. Ventilator settings were able to be adjusted to the decreased pulmonary gas exchange needs, making protective lung strategies possible. Air transport of both patients with the running iLA system was uneventful. The iLA was removed after 15 and 8 days of continuous operation, respectively, and both soldiers were successfully weaned from mechanical ventilation. Interventional, extracorporeal pump-free pulmonary support opens up new possibilities for pulmonary protection due to ease of use, effectiveness, and low costs; however, there is concern of distal limb ischemia. Experiences to date are encouraging, although randomized studies are lacking, and the procedure carries significant risks.
Version ID
1
Status
MEDLINE
Authors Full Name
Zimmermann, Markus; Philipp, Alois; Schmid, Franz-Xaver; Dorlac, Warren; Arlt, Matthias; Bein, Thomas.
Institution
Zimmermann, Markus. Department of Anesthesiology, University of Regensburg, Germany.
Year of Publication
2007

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

177.

Clinical experience with the iLA Membrane Ventilator pumpless extracorporeal lung-assist device. [Review] [52 refs]
Walles T.
Expert Review of Medical Devices. 4(3):297-305, 2007 May.
[Journal Article. Review]
UI: 17488224
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.
[References: 52]
Version ID
1
Status
MEDLINE
Authors Full Name
Walles, Thorsten.
Institution
Walles, Thorsten. Klinik Schillerhohe, Department of Thoracic Surgery, Solitudestrasse 18, 70839 Gerlingen, Germany. twalles@yahoo.com
Year of Publication
2007

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

178.

Extracorporeal carbon dioxide removal using the Novalung in a patient with intracranial bleeding.
Mallick A; Elliot S; McKinlay J; Bodenham A.
Anaesthesia. 62(1):72-4, 2007 Jan.
[Case Reports. Journal Article]
UI: 17156230
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 (Novalung) 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Mallick, A; Elliot, S; McKinlay, J; Bodenham, A.
Institution
Mallick, A. Anaesthesia and Intensive Care, Leeds General Infirmary, Leeds, UK. Abhiram.mallick@leedsth.nhs.uk
Year of Publication
2007

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

179.

An update on interventional lung assist devices and their role in acute respiratory distress syndrome. [Review] [35 refs]
von Mach MA; Kaes J; Omogbehin B; Sagoschen I; Wiechelt J; Kaiser K; Sauer O; Weilemann LS.
Lung. 184(3):169-75, 2006 May-Jun.
[Journal Article. Review]
UI: 16902842
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. [References: 35]
Version ID
1
Status
MEDLINE
Authors Full Name
von Mach, Marc-Alexander; Kaes, Joachim; Omogbehin, Babatunde; Sagoschen, Ingo; Wiechelt, Jascha; Kaiser, Kristina; Sauer, Oliver; Weilemann, Ludwig Sacha.
Institution
von Mach, Marc-Alexander. II. Medical Department, University Hospitals, Langenbeckstr. 1, Mainz 55131, Germany. marcm@giftinfo.uni-mainz.de
Year of Publication
2006

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

180.

Role of extracorporeal lung assist in the treatment of acute respiratory failure. [Review] [47 refs]
Kopp R; Dembinski R; Kuhlen R.
Minerva Anestesiologica. 72(6):587-95, 2006 Jun.
[Journal Article. Review]
UI: 16682933
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. Oxygenators 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 demonstrate a clinical benefit for these experimental devices. [References: 47]
Version ID
1
Status
MEDLINE
Authors Full Name
Kopp, R; Dembinski, R; Kuhlen, R.
Institution
Kopp, R. Department of Surgical Intensive Care Medicine University Hospital Aachen RWTH Aachen University, Aachen, Germany.
Year of Publication
2006

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

181.

A new pumpless extracorporeal interventional lung assist in critical hypoxemia/hypercapnia.
Bein T; Weber F; Philipp A; Prasser C; Pfeifer M; Schmid FX; Butz B; Birnbaum D; Taeger K; Schlitt HJ.

Critical Care Medicine. 34(5):1372-7, 2006 May.
[Journal Article]
UI: 16540950
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: We report retrospectively our experience with a new pumpless extracorporeal interventional lung assist (iLA) establishing an arteriovenous shunt as the driving pressure.
SETTING: University hospital.
PATIENTS: Ninety patients with acute respiratory distress syndrome.
INTERVENTIONS: 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.
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, Thomas; Weber, Frank; Philipp, Alois; Prasser, Christopher; Pfeifer, Michael; Schmid, Franz-Xaver; Butz, Bernhard; Birnbaum, Dietrich; Taeger, Kai; Schlitt, Hans J.
Institution
Bein, Thomas. Department of Anesthesiology, University Hospital of Regensburg, Regensburg, Germany.
Comments
Comment in (CIN) Comment in (CIN)
Year of Publication
2006

182.

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 FX.
British Journal of Anaesthesia. 96(1):63-6, 2006 Jan.
[Evaluation Study. Journal Article]
UI: 16299045
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 (Pa(CO2) 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 (Pa(O2) 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Zimmermann, M; Bein, T; Philipp, A; Ittner, K; Foltan, M; Drescher, J; Weber, F; Schmid, F-X.
Institution
Zimmermann, M. Department of Anesthesiology, University of Regensburg, Germany.
Year of Publication
2006

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

183.

Pumpless extracorporeal lung assist (pECLA) in patients with acute respiratory distress syndrome and severe brain injury.
Bein T; Scherer MN; Philipp A; Weber F; Woertgen C.
Journal of Trauma-Injury Infection & Critical Care. 58(6):1294-7, 2005 Jun.
[Journal Article]
UI: 15995487
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).
METHODS: 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.
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, Thomas; Scherer, Markus N; Philipp, Alois; Weber, Frank; Woertgen, Chris.
Institution
Bein, Thomas. Department of Anesthesia, University of Regensburg Hospital, 93042 Regensburg, Germany. thomas.bein@klinik.uni-regensburg.de
Year of Publication
2005

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

184.

[The present role of interventional lung assist (ILA) in critical care medicine]. [Review] [19 refs] [German] Welchen Stellenwert hat die pumpenlose interventionelle Lungenassistenz (ILA) in der Intensivmedizin?
Brederlau J; Anetseder M; Muellenbach R; Wurmb T; Schwemmer U; Roewer N.
Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 40(2):74-8, 2005 Feb.
[Journal Article. Review]
UI: 15714396
The development of low resistance oxygenators widens the therapeutic options for patients with acute respiratory failure (ARDS). Pumpless arteriovenous interventional lung assist systems (ILA) can be used in a subgroup of patients with ARDS. ILA might be indicated in earlier stages of ARDS following a multimodal treatment approach. [References: 19]
Version ID
1
Status
MEDLINE
Authors Full Name
Brederlau, J; Anetseder, M; Muellenbach, R; Wurmb, T; Schwemmer, U; Roewer, N.
Institution
Brederlau, J. Klinik und Poliklinik fur Anasthesiologie, Zentrum Operative Medizin, Universitatsklinikum Wurzburg, Wurzburg. brederlau_j@klinik.uni-wuerzburg.de
Year of Publication
2005

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

185.

High-frequency oscillatory ventilation and an interventional lung assist device to treat hypoxaemia and hypercapnia.
David M; Heinrichs W.
British Journal of Anaesthesia. 93(4):582-6, 2004 Oct.
[Case Reports. Journal Article]
UI: 15277297
A male patient accidentally aspirated paraffin oil when performing as a fire-eater. Severe acute respiratory distress syndrome (Pa(o(2))/Fi(o(2)) ratio 10.7 kPa) developed within 24 h. Conventional pressure-controlled ventilation (PCV) with high airway pressures and low tidal volumes failed to improve oxygenation. Hypercapnia (Pa(co(2)) 12 kPa) with severe acidosis (pH<7.20) ensued. Treatment with high-frequency oscillatory ventilation (HFOV) and a higher adjusted airway pressure (35 cm H(2)O) improved the Pa(o(2))/Fi(o(2)) ratio within 1 h from 10.7 to 22.9 kPa, but the hypercapnia and acidosis continued. Stepwise reduction of the mean airway pressure (26 cm H(2)O), and oscillating frequencies (3.5 Hz), as well as increasing the oscillating amplitudes (95 cm H(2)O) resulted in an unchanged Pa(co(2)), but oxygenation worsened. The new pumpless extracorporeal interventional lung assist device (ILA, NovaLung, Hechingen, Germany) was therefore used for carbon dioxide elimination to enable a less aggressive ventilation strategy. Pa(co(2)) normalized after initiation of ILA. HFOV with a mean airway pressure of 32 cm H(2)O was maintained, but with a higher oscillatory frequency (9 Hz) and very low oscillatory amplitude (25 cm H(2)O). After 6 days, the patient was transferred to a conventional ventilator, and ILA was discontinued after 13 days without complications.
Version ID
1
Status
MEDLINE
Authors Full Name
David, M; Heinrichs, W.
Institution
David, M. Department of Anaesthesiology, Johannes Gutenberg-University, Mainz, Germany. david@mail.uni-mainz.de
Year of Publication
2004

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

186.

[Pumpless extracorporeal lung assist using arterio-venous shunt in severe ARDS. Experience with 30 cases]. [German] Pumpenfreie extrakorporale Lungenunterstutzung mit arteriovenosem Shunt beim schweren akuten Lungenversagen des Erwachsenen. Bericht uber 30 Einsatze.
Bein T; Prasser C; Philipp A; Muller T; Weber F; Schlitt HJ; Schmid FX; Taeger K; Birnbaum D.
Anaesthesist. 53(9):813-9, 2004 Sep.
[English Abstract. Journal Article]
UI: 15221117

BACKGROUND: Extracorporeal lung assist has been proposed as an invasive measure in patients with acute respiratory distress syndrome (ARDS) when oxygenation is critically impaired. However, this technique generally requires high personnel and technical resources. We report on a new system, which is characterised by a short circuit arterio-venous shunt using arterio-venous pressure gradient as driving force (pumpless extracorporeal lung assist [pECLA]).
PATIENTS AND METHODS: In 30 patients with ARDS due to multitrauma, pneumonia or after surgery (p(a)O(2)/F(I)O(2)-ratio 67+/-23 mmHg) pECLA was established by insertion of cannulae to the femoral artery and vein followed by connection with a membrane gas exchanger. For this system, only "low dose" continuous heparin infusion is required.
RESULTS: Arterial oxygenation was acutely and significantly increased by pECLA (p(a)O(2)/F(I)O(2)=103+/-56 mmHg 2 h after begin) and carbon dioxide removal was markedly enhanced in 25 out of 30 patients (87%) allowing a lung protective ventilation strategy. The mean duration of pECLA therapy was 6.5 days, 15 patients (50%) died due to ARDS or non-ARDS related reasons.
CONCLUSION: pECLA represents a feasable and effective treatment in patients with severe ARDS. Compared with pump-driven systems pECLA is characterised by low costs and reduced personnel requirements. However, mortality remains high in patients suffering from severe ARDS despite newer treatment modalities.
Version ID
1
Status
MEDLINE
Authors Full Name
Bein, T; Prasser, C; Philipp, A; Muller, T; Weber, F; Schlitt, H J; Schmid, F-X; Taeger, K; Birnbaum, D.
Institution
Bein, T. Klinik fur Anasthesiologie, Universitatsklinikum Regensburg.
thomas.bein@klinik.uni-regensburg.de
Year of Publication
2004

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

187.

Extracorporeal carbon dioxide removal to control arterial pH and PACO2 in a heart-beating donor with acute lung injury.
Scott LK; Grier LR; Turnage R; Conrad SA.
Transplantation. 76(11):1630-2, 2003 Dec 15.
[Case Reports. Journal Article]
UI: 14702538
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Scott, L Keith; Grier, Laurie R; Turnage, Richard; Conrad, Steven A.
Institution
Scott, L Keith. Department of Emergency Medicine, Critical Care Section, Louisiana State University Health Sciences Center, Shreveport, Shreveport, LA 71130, USA. lscott2@lsushc.edu
Year of Publication
2003

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

188.

Pumpless extracorporeal lung assist using an arterio-venous shunt. Applications and limitations.
Liebold A; Philipp A; Kaiser M; Merk J; Schmid FX; Birnbaum DE.
Minerva Anestesiologica. 68(5):387-91, 2002 May.
[Clinical Trial. Journal Article]
UI: 12029251
We report the use of a pumpless extracorporeal lung assist (PECLA) in 70 patients with severe pulmonary failure of various causes. The device was used under rescue conditions in patients with preserved cardiac function. By establishing a shunt between femoral artery and vein using the arterio-venous pressure gradient as the driving force for the blood flow through the oxygenator, PECLA proved to be extremely effective in terms of oxygenation and carbon dioxide removal.
Version ID
1
Status
MEDLINE
Authors Full Name
Liebold, A; Philipp, A; Kaiser, M; Merk, J; Schmid, F X; Birnbaum, D E.
Institution
Liebold, A. University of Regensburg, Department of Cardiothoracic Surgery, Department of Internal Medicine, Regensburg, Germany. andreas.liebold@klinik.uni-regensburg.de
Year of Publication
2002

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

189.

Total extracorporeal arteriovenous carbon dioxide removal in acute respiratory failure: a phase I clinical study.
Conrad SA; Zwischenberger JB; Grier LR; Alpard SK; Bidani A.
Intensive Care Medicine. 27(8):1340-51, 2001 Aug.
[Clinical Trial. Clinical Trial, Phase I. Journal Article. Multicenter Study. Research Support, Non-U.S. Gov't]
UI: 11511947
OBJECTIVE: To evaluate the safety and efficacy of pumpless extracorporeal arteriovenous carbon dioxide removal (AVCO2R) in subjects with acute respiratory failure and hypercapnia.
DESIGN: 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.
PATIENTS: Eight patients with acute hypercapnic respiratory failure or hypoxemic respiratory failure managed with permissive hypercapnia.
INTERVENTIONS: 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: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Conrad, S A; Zwischenberger, J B; Grier, L R; Alpard, S K; Bidani, A.
Institution
Conrad, S A. Department of Emergency Medicine, Louisiana State University Health Sciences Center, Shreveport, LA 71130-3932, USA. sconrad@lsuhsc.edu
Year of Publication
2001

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

190.

Pathogenesis and management of respiratory insufficiency following pulmonary

resection. [Review] [160 refs]
Alpard SK; Duarte AG; Bidani A; Zwischenberger JB.
Seminars in Surgical Oncology. 18(2):183-96, 2000 Mar.
[Journal Article. Review]
UI: 10657920
The underlying principle of the surgical treatment of non-small-cell lung cancer (NSCLC) is complete removal of the local/regional disease within the thorax. Pulmonary resection should be as conservative as possible without compromising the adequacy of tumor removal. A multitude of factors influence the incidence and severity of complications following pulmonary resection including the pre-operative physical and psychological status of the patient, the pathologic process requiring resection, the physiologic impact of the procedure, and the addition of pre-operative or postoperative adjuvant therapy. The insidious onset of interstitial changes on chest X-ray (CXR) 1 to 2 days after pulmonary resection forewarns of respiratory distress; however, the pathophysiology of adult respiratory distress syndrome (ARDS) with progression to respiratory failure requiring mechanical ventilation and advanced critical care often unfolds. Management of patients with severe respiratory failure remains primarily supportive. "Good critical care" is the mainstay of therapy: this includes gentle mechanical ventilation to avoid ventilator-induced barotrauma and over-extension of remaining functional alveoli, diuresis, infection identification and management, and nutritional support. New therapeutic strategies that may impact on outcomes in the adult population include pressure-limited ventilation (permissive hypercapnia), inverse ratio ventilation, high-frequency jet ventilation, high-frequency oscillatory ventilation, intratracheal pulmonary ventilation, and prone position ventilation. In addition, alternative therapies such as partial liquid ventilation, inhaled nitric oxide, and extracorporeal techniques including extracorporeal membrane oxygenation (ECMO), extracorporeal carbon dioxide removal (ECCO(2)R), intravascular oxygenation (IVOX), and arteriovenous carbon dioxide removal (AVCO(2)R), provide additional modalities. A component of some or all of these strategies is finding a role in clinical practice.
 [References: 160]
Version ID
1
Status
MEDLINE
Authors Full Name
Alpard, S K; Duarte, A G; Bidani, A; Zwischenberger, J B.
Institution
Alpard, S K. Division of Cardiothoracic Surgery, University of Texas Medical Branch, Galveston, Texas 77555-0528, USA.
Year of Publication
2000

191.

The spatial distribution of pulmonary lesions in severe ARDS. An autopsy study of 35 cases.
Barth PJ; Holtermann W; Muller B.
Pathology, Research & Practice. 194(7):465-71, 1998.
[Case Reports. Journal Article]
UI: 9728363

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.
Version ID
1
Status
MEDLINE
Authors Full Name
Barth, P J; Holtermann, W; Muller, B.
Institution
Barth, P J. Department of Pathology, Philipps-University Marburg/Lahn, Germany.
Year of Publication
1998

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

192.

Is extracorporeal CO2 removal an option in the treatment of adult respiratory distress syndrome?.
Deslauriers J; Awad JA.
Annals of Thoracic Surgery. 64(6):1581-2, 1997 Dec.
[Comment. Editorial]
UI: 9436538
Version ID
1
Status
MEDLINE
Authors Full Name
Deslauriers, J; Awad, J A.
Comments
Comment on (CON)
Year of Publication
1997

Link to the Ovid Full Text or citation:

193.

Reduction in adverse effects of mechanical ventilation in rabbits with acute respiratory failure by treatment with extracorporeal CO2 removal and a large fluid volume of diluted surfactant.
Plotz FB; Mook PH; Jansen NJ; Oetomo SB; Wildevuur CR.
ASAIO Journal. 43(6):916-21, 1997 Nov-Dec.
[Journal Article]
UI: 9386843
The long-term outcome of infants with severe respiratory distress syndrome can be improved by optimizing surfactant therapy and minimizing the risk for pulmonary barovolutrauma and oxygen toxicity. The authors hypothesized that this may be achieved with low frequency ventilation and extracorporeal CO2 removal (LFV-ECCO2R), in combination with intratracheal instillation of a large fluid volume with diluted surfactant. Lung lavaged rabbits were initially ventilated with continuous positive pressure ventilation. The rabbits were randomized to treatment with LFV-ECCO2R and surfactant (experimental group), or surfactant only (control group). In the experimental group, the rabbits were treated with a large volume (16 ml/kg) of diluted surfactant (6.25 mg/ml) at a dose of 100 mg/kg body weight. After surfactant therapy, the FiO2 100% was gradually decreased. During 4 hours, the extracorporeal bloodflow was adjusted to maintain the PaCO2 between 4.0-6.0 kPa. Thereafter, the rabbits were allowed to breathe spontaneously with 2.5 cm H2O continuous positive airway pressure ventilation (CPAP) and 40% oxygen. In the control group, the rabbits received the same surfactant therapy. During the study period, the rabbits remained ventilated with an inspiratory oxygen concentration (FiO2) of 100% for 4 hours. The ventilator flow was adjusted to maintain the PaCO2 between 4.0 and 6.0 kPa. Thereafter, positive-end expiratory pressure was decreased to 2.5 cm H2O and FiO2 was gradually decreased to 40%. In the experimental group, FiO2 was decreased to 40% in a stepwise fashion whereby the PaO2 could be maintained easily within the normal range. Extracorporeal flow rates during perfusion ranged from 20-35 ml/kg/min and were sufficient to keep the PaCO2 and pH within normal limits. After 4 hours, the rabbits could breathe spontaneously with CPAP and 40% oxygen, while normal blood gas values were maintained. All rabbits survived the experiment. In the control group, all rabbits experienced severe hypoxemia, despite FiO2 of 100% oxygen and, during the course of weaning, all rabbits died because of hypoxia. In conclusion, the present study demonstrated that barovolutrauma due to mechanical ventilation, and oxygen toxicity due to high FiO2, can be minimized in an animal model of acute respiratory failure by the combination of LFV-ECCO2R and surfactant therapy.
Version ID
1
Status
MEDLINE
Authors Full Name
Plotz, F B; Mook, P H; Jansen, N J; Oetomo, S B; Wildevuur, C R.
Institution
Plotz, F B. Department of Pediatrics, University Hospital Groningen, The Netherlands.
Year of Publication
1997

Click here for full text options

194.

Randomized clinical trial of pressure-controlled inverse ratio ventilation and extracorporeal CO2 removal for adult respiratory distress syndrome.
Falke KJ.
American Journal of Respiratory & Critical Care Medicine. 156(3 Pt 1):1016-7, 1997 Sep.
[Comment. Letter]
UI: 9310029
Version ID
1
Status
MEDLINE
Authors Full Name
Falke, K J.
Comments
Comment on (CON)
Year of Publication
1997

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

195.

Acute respiratory failure, mechanical ventilation, and ECMO/ECCO2R: quo vadis?.
[Review] [19 refs]
Kolobow T; Cereda M; Sparacino ME; Trawoger R.
International Journal of Artificial Organs. 20(6):301-3, 1997 Jun.
[Editorial. Review]
UI: 9259204
Version ID
1
Status
MEDLINE
Authors Full Name
Kolobow, T; Cereda, M; Sparacino, M E; Trawoger, R.
Year of Publication
1997

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

196.

Interest of a therapeutic optimization strategy in severe ARDS.
Guinard N; Beloucif S; Gatecel C; Mateo J; Payen D.
Chest. 111(4):1000-7, 1997 Apr.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 9106581
STUDY OBJECTIVE: Evaluate the interest of the response to a therapeutic optimization as a predictor of prognosis in ARDS.
DESIGN: Prospective study.
SETTING: ICU of a University Hospital.
PATIENTS: Thirty-six consecutive patients with severe ARDS addressed for extracorporeal carbon dioxide removal (ECCO2R).
INTERVENTIONS: 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 ($p<0.05$).
CONCLUSIONS: 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Guinard, N; Beloucif, S; Gatecel, C; Mateo, J; Payen, D.
Institution
Guinard, N. Department of Anesthesiology and Critical Care Medicine, Hopital Universitaire Lariboisiere, Paris, France.
Comments
Comment in (CIN)
Year of Publication
1997

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

197.

New ventilatory strategies in acute respiratory failure. [Review] [108 refs]
Gowski DT; Miro AM.

Critical Care Nursing Quarterly. 19(3):1-22, 1996 Nov.
[Journal Article. Review]
UI: 8981848
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 include 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. [References: 108]
Version ID
1
Status
MEDLINE
Authors Full Name
Gowski, D T; Miro, A M.
Year of Publication
1996

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

198.

Adjuncts to mechanical ventilation. [Review] [168 refs]
Nahum A; Shapiro R.
Clinics in Chest Medicine. 17(3):491-511, 1996 Sep.
[Journal Article. Review]
UI: 8875009
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, perfluorocarbon-associated gas exchange, and prone positioning as adjuncts to oxygenation. [References: 168]
Version ID
1
Status
MEDLINE
Authors Full Name
Nahum, A; Shapiro, R.
Institution
Nahum, A. Department of Pulmonary and Critical Care Medicine, St. Paul-Ramsey Medical Center, Minnesota, USA.
Year of Publication
1996

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

199.

Effects of volume controlled ventilation with PEEP, pressure regulated volume controlled ventilation and low frequency positive pressure ventilation with extracorporeal carbon dioxide removal on total static lung compliance and oxygenation in pigs with ARDS.
Kesecioglu J; Telci L; Tutuncu AS; Esen F; Denkel T; Erdmann W; Akpir K; Lachmann B.
Advances in Experimental Medicine & Biology. 388:629-36, 1996.
[Comparative Study. Journal Article]
UI: 8798869
Version ID
1
Status
MEDLINE
Authors Full Name
Kesecioglu, J; Telci, L; Tutuncu, A S; Esen, F; Denkel, T; Erdmann, W; Akpir, K; Lachmann, B.
Institution
Kesecioglu, J. Department of Intensive Care, Academic Medical Center, Amsterdam, The Netherlands.
Year of Publication
1996

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

200.

Severity and outcome of ARDS: the present place of extracorporeal lung assist (ECLA). [Review] [11 refs]
Steltzer H; Krafft P; Fridrich P; Hammerle AF.
International Journal of Artificial Organs. 18(10):607-10, 1995 Oct.
[Journal Article. Review]
UI: 8647592
Within the last decade extracorporeal lung assist has been recommended for the treatment of acute respiratory distress syndrome. However, this recommendation was challenged by several recent clinical studies and reviews. The goal of our analysis was therefore to investigate data on outcome and severity of gas exchange disturbance published from patients treated with ECLA. These data were compared to a historical control group consisting of ARDS patients treated conventionally. Computerized (MEDLINE 1967-95) literature search using the keywords ARDS, ECLA, ECMO, ECCO2R and HUMAN was performed. Only clinical studies published as full papers reporting data on both, patients mortality and oxygenation index (PaO2/FiO2) were included. Overall mean mortality reported was 53 +/- 22% in 17 studies (419 patients), with no apparent trend towards a higher survival within the last decade with a mean PaO2/FIO2 (14 papers; 61 +/- 17 mmHg). However, mean mortality rates of ARDS patients requiring ECLA was 52.3% and 44.9% if patients undergoing ECMO were excluded (3 papers). Therefore the mortality of these patients with severe lung injury was in the range of patients treated conventionally. Patient outcome observed in our analysis is in accordance with the mortality rates

from the European ECLA centres published recently (49% in 1993). Therefore, we conclude that the mean mortality rate of patients suffering from severe ARDS treated with ECLA is in the 50% range and does not differ significantly from those of patients treated conventionally, despite significantly poorer pulmonary function. [References: 11]
Version ID
1
Status
MEDLINE
Authors Full Name
Steltzer, H; Krafft, P; Fridrich, P; Hammerle, A F.
Institution
Steltzer, H. Department of Anaesthesiology and Intensive Care Medicine, University of Vienna, Austria.
Year of Publication
1995

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

201.

ECCO2R: an experimental approach to treating ARDS.
Chillcott S; Sheridan PS.
Critical Care Nurse. 15(2):50-6, 1995 Apr.
[Case Reports. Journal Article]
UI: 7774247
Version ID
1
Status
MEDLINE
Authors Full Name
Chillcott, S; Sheridan, P S.
Year of Publication
1995

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

202.

Efficacy of low-frequency positive-pressure ventilation-extracorporeal CO2 removal.
Brunet F; Mira JP; Dhainaut JF; Dall'ava-Santucci J.
American Journal of Respiratory & Critical Care Medicine. 151(4):1269-70, 1995 Apr.

[Comment. Letter]
UI: 7697266
Version ID
1
Status

MEDLINE
Authors Full Name
Brunet, F; Mira, J P; Dhainaut, J F; Dall'ava-Santucci, J.
Comments
Comment on (CON)
Year of Publication
1995

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

203.

Staphylococcal septicemia and adult respiratory distress syndrome in pregnancy treated with extracorporeal carbon dioxide removal.
Greenberg LR; Moore TR.
Obstetrics & Gynecology. 86(4 Pt 2):657-60, 1995 Oct.
[Case Reports. Journal Article]
UI: 7675403
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: Extracorporeal carbon dioxide removal may improve survival in gravidas with adult RDS by decreasing the required airway pressures for ventilation, thus permitting pulmonary recovery.
Version ID
1
Status
MEDLINE
Authors Full Name
Greenberg, L R; Moore, T R.
Institution
Greenberg, L R. Department of Reproductive Medicine, University of California San Diego School of Medicine, USA.
Year of Publication
1995

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

204.

Prevention and therapy of the adult respiratory distress syndrome. [Review] [138

refs]
Temmesfeld-Wollbruck B; Walmrath D; Grimminger F; Seeger W.
Lung. 173(3):139-64, 1995.
[Journal Article. Review]
UI: 7616757
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, alpha 1-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. [References: 138]
Version ID
1
Status
MEDLINE
Authors Full Name
Temmesfeld-Wollbruck, B; Walmrath, D; Grimminger, F; Seeger, W.
Institution
Temmesfeld-Wollbruck, B. Department of Internal Medicine, Justus-Liebig-University, Giessen, Germany.
Year of Publication
1995

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

205.

Low blood flow extracorporeal carbon dioxide removal (ECCO2R): a review of the concept and a case report. [Review] [33 refs]
Habashi NM; Borg UR; Reynolds HN.
Intensive Care Medicine. 21(7):594-7, 1995 Jul.
[Case Reports. Journal Article. Review]
UI: 7593903
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. [References: 33]
Version ID
1
Status
MEDLINE
Authors Full Name
Habashi, N M; Borg, U R; Reynolds, H N.
Institution
Habashi, N M. Department of Critical Care Medicine, R. Adams Cowley Shock Trauma Center, Baltimore, MD 21201-1595, USA.
Year of Publication
1995

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

206.

[Present status of extracorporeal membrane oxygenation for adult respiratory failure]. [Review] [36 refs] [Japanese]
Kobayashi K.
Rinsho Kyobu Geka. 14(3):179-83, 1994 Jun.
[English Abstract. Journal Article. Review]
UI: 9423088
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. [References: 36]
Version ID
1

Status
MEDLINE
Authors Full Name
Kobayashi, K.
Institution
Kobayashi, K. Department of Surgery, School of Medicine, Keio University, Tokyo.
Year of Publication
1994

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

207.

Randomized clinical trial of pressure-controlled inverse ratio ventilation and extracorporeal CO2 removal for adult respiratory distress syndrome.
Morris AH; Wallace CJ; Menlove RL; Clemmer TP; Orme JF Jr; Weaver LK; Dean NC; Thomas F; East TD; Pace NL; Suchyta MR; Beck E; Bombino M; Sittig DF; Bohm S; Hoffmann B; Becks H; Butler S; Pearl J; Rasmusson B.
American Journal of Respiratory & Critical Care Medicine. 149(2 Pt 1):295-305, 1994 Feb.
[Clinical Trial. Comparative Study. Journal Article. Randomized Controlled Trial. Research Support, Non-U.S. Gov't. Research Support, U.S. Gov't, P.H.S.]
UI: 8306022
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 PaO2 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 FIO2 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Morris, A H; Wallace, C J; Menlove, R L; Clemmer, T P; Orme, J F Jr; 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.

Institution
Morris, A H. Department of Medicine, LDS Hospital, Salt Lake City, Utah 84143.
Comments
Erratum in (EIN) Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Comment in (CIN)
Year of Publication
1994

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

208.

Extracorporeal carbon dioxide removal technique improves oxygenation without causing overinflation.
Brunet F; Mira JP; Belghith M; Monchi M; Renaud B; Fierobe L; Hamy I; Dhainaut JF; Dall'ava-Santucci J.
American Journal of Respiratory & Critical Care Medicine. 149(6):1557-62, 1994 Jun.

[Comparative Study. Journal Article]
UI: 8004313
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 PaO2/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.
Version ID
1
Status
MEDLINE
Authors Full Name
Brunet, F; Mira, J P; Belghith, M; Monchi, M; Renaud, B; Fierobe, L; Hamy, I; Dhainaut, J F; Dall'ava-Santucci, J.
Institution
Brunet, F. Intensive Care Unit, Cochin-Port-Royal University Hospital, Paris, France.
Year of Publication

1994

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

209.

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 JP; Lanore JJ; Vaxelaire JF; Dall'ava Santucci J; Dhainaut JF.
Chest. 104(3):889-98, 1993 Sep.
[Journal Article]
UI: 8365306
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Brunet, F; Belghith, M; Mira, J P; Lanore, J J; Vaxelaire, J F; Dall'ava Santucci, J; Dhainaut, J F.
Institution
Brunet, F. Intensive Care Unit, Cochin University Hospital, Paris, France.
Year of Publication
1993

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

210.

Venovenous single lumen cannula extracorporeal lung support in neonates. A five year experience.
Chevalier JY; Couprie C; Larroquet M; Renolleau S; Durandy Y; Costil J.
ASAIO Journal. 39(3):M654-8, 1993 Jul-Sep.
[Journal Article]
UI: 8268619

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 +/- 0.6 1 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Chevalier, J Y; Couprie, C; Larroquet, M; Renolleau, S; Durandy, Y; Costil, J.
Institution
Chevalier, J Y. Neonatal and Pediatric Intensive Care Unit, Hopital d'Enfants Armand Trousseau, Paris, France.
Year of Publication
1993

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

211.

[Low frequency positive-pressure ventilation and extracorporeal CO2 removal. Treatment of acute respiratory distress syndrome in adults]. [French] Ventilation apneique et epuration extracorporelle de CO2. Traitement du syndrome de detresse respiratoire aigue de l'adulte.
Belghith M; Brunet F.
Revue du Praticien. 43(16):2089-92, 1993 Oct 15.
[Journal Article]
UI: 8134790
Version ID
1
Status
MEDLINE
Authors Full Name
Belghith, M; Brunet, F.
Institution
Belghith, M. Service de reanimation medicale de l'hopital Cochin, Paris.
Year of Publication
1993

Link to the Ovid Full Text or citation:

Click here for full text options

212.

Role of extracorporeal circulation in adult respiratory distress syndrome management. [Review] [72 refs]
Gattinoni L; Pesenti A; Bombino M; Pelosi P; Brazzi L.
New Horizons. 1(4):603-12, 1993 Nov.
[Journal Article. Review]
UI: 8087580
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.
[References: 72]
Version ID
1
Status
MEDLINE
Authors Full Name
Gattinoni, L; Pesenti, A; Bombino, M; Pelosi, P; Brazzi, L.
Institution
Gattinoni, L. Istituto di Anestesiologia e Rianimazione, Universita degli Studi di Milano, Italy.
Year of Publication
1993

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

213.

EC CO2R: oxygenator or hemodialyzer? An in vitro study.
Gille JP; Lautier A; Tousseul B.
International Journal of Artificial Organs. 15(4):229-33, 1992 Apr.
[Comparative Study. Journal Article]
UI: 1587645
In respiratory support of patients with acute respiratory distress syndrome (ARDS), the extracorporeal CO2 removal (EC CO2R) technique should be the earliest and easiest procedure so as to have the lowest blood flow rate. Extracorporeal circulation (ECC) can be achieved using an oxygenator for CO2 removal under the dry form (dissolved CO2) or a hemodialyser for CO2 removal under the wet form (bicarbonates). This study investigated different methods allowing an increase in

CO2 transfer, using liquid flow rates up to 0.330 l/min. The experimental set-up employed heated (38 degrees C) aqueous polyelectrolytic solutions mimicking the venous blood (pH 7.20, PCO2 53 mmHg). Four in vitro methods were tested: Series I: a DIDECO D702 oxygenator without blood (= liquid) acidification, Series II: D702 oxygenator with inlet HCl acidification, Series III: a HOSPAL H10-10 hemodialyzer without dialysate alkalinisation, Series IV: H10-10 hemodialyzer with NaOH dialysate alkalinisation. Maximum gas flow in the oxygenator and dialysate rate in hemodialyzer were 5 and 0.55 l/min respectively. For the four series the CO2 transfer (TCO2) (mean +/- S.E. ml/min) and pH out were: [table: see text] The difference between the four series was statistically significant (t-test). Acidification using the oxygenator increased CO2 transfer by 80%, but CO2 elimination was better with hemodialysis.
Version ID
1
Status
MEDLINE
Authors Full Name
Gille, J P; Lautier, A; Tousseul, B.
Institution
Gille, J P. Inserm U 14, CHRU Nancy-Brabois, France.
Year of Publication
1992

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

214.

Progress in veno-venous long-term bypass techniques for the treatment of ARDS. Controlled clinical trial with the heparin-coated bypass circuit.
Knoch M; Kollen B; Dietrich G; Muller E; Mottaghy K; Lennartz H.
International Journal of Artificial Organs. 15(2):103-8, 1992 Feb.
[Clinical Trial. Journal Article. Randomized Controlled Trial]
UI: 1555873
Extracorporeal CO2 removal combined with low-frequency positive pressure ventilation (ECCO2-R LFPPV) is a new therapeutic approach in treatment of ARDS. The main problem during long-term extracorporeal support is anticoagulation and related bleeding problems. We conducted a prospective, randomized and controlled clinical trial in 18 patients to compare the effect of the non-heparin-coated (Scimed = group 1) with the heparin-coated (Carmeda = group 2) extracorporeal circuit on clinical course and complication rate. In group 2 the daily blood loss, the amount of substituted red cells and the i.v. heparin dose were significantly lower than in group 1. Bleeding complications were less and more patients survived in group 2. The disadvantage of the hollow fiber oxygenators in the heparin-coated system was plasma leakage, which was more frequent in patients with pancreatitis and hyperbilirubinemia.
Version ID
1
Status
MEDLINE
Authors Full Name
Knoch, M; Kollen, B; Dietrich, G; Muller, E; Mottaghy, K; Lennartz, H.
Institution
Knoch, M. Department of Anesthesiology and Intensive Care, University, Marburg,

Germany.
Year of Publication
1992

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

215.

Intravascular oxygenation for advanced respiratory failure.
Jurmann MJ; Demertzis S; Schaefers HJ; Wahlers T; Haverich A.
ASAIO Journal. 38(2):120-4, 1992 Apr-Jun.
[Case Reports. Journal Article]
UI: 1421605
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 less than 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Jurmann, M J; Demertzis, S; Schaefers, H J; Wahlers, T; Haverich, A.
Institution
Jurmann, M J. Division of Thoracic and Cardiovascular Surgery, Hannover Medical School, Germany.
Year of Publication
1992

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

216.

[Acute respiratory failure--support of gas exchange using extracorporeal or implanted

oxygenators--present status and future development]. [Review] [96 refs] [German]
Akutes Lungenversagen--Unterstutzung des Gasaustausches mittels extrakorporaler oder implantierter Oxygenatoren--Gegenwartiger Stand und zukunftige Entwicklung.
Muller E; Kolobow T; Knoch M; Holtermann W.
Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 27(5):259-73, 1992 Aug.
[English Abstract. Journal Article. Research Support, Non-U.S. Gov't. Review]
UI: 1391363
In acute respiratory failure gas exchange can be supported or even maintained in an "alternative" way to mechanical ventilation using extracorporeal techniques (extracorporeal membrane oxygenation ECMO, extracorporeal CO2-removal ECCO2R), or intravenacaval oxygenators (IVOX). These techniques, which are currently in use in neonatology, pediatrics, and adult intensive care medicine, or techniques at present in clinical evaluation (IVOX), are reviewed with their indications, contraindications, differences, problems, worldwide results, and possible future applications. [References: 96]
Version ID
1
Status
MEDLINE
Authors Full Name
Muller, E; Kolobow, T; Knoch, M; Holtermann, W.
Institution
Muller, E. Abteilung fur Anasthesie und Intensivtherapie, Philipps-Universitat, Marburg.
Year of Publication
1992

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

217.

Treatment of acute pulmonary failure with extracorporeal support: 100% survival in a pediatric population.
Ryan DP; Doody DP.
Journal of Pediatric Surgery. 27(8):1111-6; discussion 1116-7, 1992 Aug.
[Case Reports. Journal Article]
UI: 1328587
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.(ABSTRACT TRUNCATED AT 250 WORDS)
Version ID
1
Status
MEDLINE
Authors Full Name
Ryan, D P; Doody, D P.
Institution
Ryan, D P. Department of Pediatric Surgery, Massachusetts General Hospital, Boston 02114.
Year of Publication
1992

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

218.

Effects of aprotinin on hemorrhagic complications in ARDS patients during prolonged extracorporeal CO2 removal.
Brunet F; Mira JP; Belghith M; Lanore JJ; Schlumberger S; Toulon P; Dhainaut JF.
Intensive Care Medicine. 18(6):364-7, 1992.
[Case Reports. Journal Article]
UI: 1281849
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 10(6) kIU followed by a continuous infusion of 5 x 10(5) kIU/h) combined with heparin, bleeding vanished until the end of bypass.
Version ID
1
Status
MEDLINE
Authors Full Name
Brunet, F; Mira, J P; Belghith, M; Lanore, J J; Schlumberger, S; Toulon, P; Dhainaut, J F.
Institution
Brunet, F. Medical Intensive Care Unit, Cochin-Port Royal University, Paris, France.
Year of Publication
1992

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

219.

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. 95:125-30; discussion 130-1, 1991.
[Journal Article]
UI: 1927222
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Bindslev, L; Bohm, C; Jolin, A; Hambraeus Jonzon, K; Olsson, P; Ryniak, S.
Institution
Bindslev, L. Department of Anaesthesiology, Karolinska Hospital, Stockholm, Sweden.
Year of Publication
1991

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

220.

Interhospital transfer of a patient undergoing extracorporeal carbon dioxide removal.
Kee SS; Sedgwick J; Bristow A.
British Journal of Anaesthesia. 66(1):141-4, 1991 Jan.
[Case Reports. Journal Article]
UI: 1900013
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.
Version ID
1

Status
MEDLINE
Authors Full Name
Kee, S S; Sedgwick, J; Bristow, A.
Institution
Kee, S S. Department of Anaesthesia, St Bartholomew's Hospital, West Smithfield, London.
Year of Publication
1991

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

221.

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; Gressner AM; Lennartz H.
European Journal of Clinical Chemistry & Clinical Biochemistry. 29(12):805-12, 1991 Dec.
[Journal Article]
UI: 1797106
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 nonresponders 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Kropf, J; Grobe, E; Knoch, M; Lammers, M; Gressner, A M; Lennartz, H.
Institution
Kropf, J. Department for Clinical Chemistry, Philipps University, Marburg/Lahn.
Year of Publication
1991

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

222.

In vivo demonstration of the Haldane effect during extracorporeal gas exchange.
Hoffmann BH; Bohm SH; Morris AH; Simon B; Mottaghy K.
International Journal of Artificial Organs. 14(11):703-6, 1991 Nov.
[Journal Article]
UI: 1757157
During the extracorporeal support (LFPPV-ECCO2R) of 11 patients suffering from severe lung failure (ARDS), we consistently noticed a higher arterial than mixed-venous PCO2 in blood samples drawn at the same time. Two explanations are possible: a) the Haldane effect (HE), b) CO2 from lung tissue metabolism. In order to distinguish changes in PCO2 due to the HE from those due to tissue CO2 production, CO2 content (CCO2) was calculated. The results were compared to animal experiments with hyperoxic apnea, after which arterial and mixed-venous samples were drawn simultaneously. All blood gas samples were analyzed for pH, PCO2, PO2, and O2-saturation, from which CCO2 was calculated. In both groups, PaCO2 was 2.15 mmHg (2.7 mmHg respectively) higher at a lower CaCO2 (-2.87 ml/l, -14.9 ml/l). Oxygen saturation increased by 8.1% in the human group and 17.8% in the animal group. A significant relationship was found between changes in PCO2 and changes in O2-saturation. This is a demonstration of the Haldane effect.
Version ID
1
Status
MEDLINE
Authors Full Name
Hoffmann, B H; Bohm, S H; Morris, A H; Simon, B; Mottaghy, K.
Institution
Hoffmann, B H. Department of Physiology and Anesthesiology, University of Aachen, Germany.
Year of Publication
1991

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

223.

Adult respiratory distress syndrome in the trauma patient. [Review] [48 refs]
Snider MT.
Critical Care Clinics. 6(1):103-10, 1990 Jan.
[Journal Article. Review]
UI: 2404541
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. [References: 48]
Version ID
1
Status
MEDLINE
Authors Full Name
Snider, M T.
Institution
Snider, M T. Department of Anesthesia, Milton S. Hershey Medical Center, Pennsylvania State University, Hershey.
Year of Publication
1990

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

224.

Extracorporeal gas exchange in adult respiratory distress syndrome: associated morbidity and its surgical treatment.
Wagner PK; Knoch M; Sangmeister C; Muller E; Lennartz H; Rothmund M.
British Journal of Surgery. 77(12):1395-8, 1990 Dec.
[Journal Article]
UI: 2276027
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 chance of high-risk patients with severe ARDS.
Version ID
1
Status
MEDLINE
Authors Full Name
Wagner, P K; Knoch, M; Sangmeister, C; Muller, E; Lennartz, H; Rothmund, M.
Institution
Wagner, P K. Department of Surgery, Philipps University Hospital, Marburg, FRG.
Year of Publication
1990

Link to the Ovid Full Text or citation:

Click here for full text options

225.

Clinical evaluation of computer-based respiratory care algorithms.
Sittig DF; Gardner RM; Morris AH; Wallace CJ.
International Journal of Clinical Monitoring & Computing. 7(3):177-85, 1990 Jul.
[Clinical Trial. Journal Article. Randomized Controlled Trial. Research Support, U.S. Gov't, P.H.S.]
UI: 2250128
A collection of computer-based respiratory care algorithms were implemented as a prototype computer-based patient advice system (COMPAS) within the existing HELP hospital information system. Detailed medical logic recommended ventilator adjustments for 5 different modes of ventilation: assist/control (A/C), intermittent mandatory ventilation (IMV), continuous positive airway pressure (CPAP), pressure controlled inverted ratio ventilation (PC-IRV), and extracorporeal carbon dioxide removal (ECCO2R). Suggestions for adjusting the mode of ventilation, fraction of inspired oxygen (FiO2), positive end-expiratory pressure (PEEP), peak inspiratory pressure, and several other therapeutic measures related to the treatment of severe arterial hypoxemia in adult respiratory distress syndrome (ARDS) patients were automatically presented to the clinical staff via bedside computer terminals. COMPAS was clinically evaluated for 624 hours of patient care on the first 5 ARDS patients in a randomized clinical trial. The clinical staff carried out 84% (320/379) of the computerized therapy suggestions. In response to a questionnaire distributed to clinical users of the system, 86% judged the system to be potentially valuable. Through implementation of COMPAS, a computer-based ventilatory therapy advice system, we have laid the groundwork for standardization of ventilator management of arterial hypoxemia in critically ill ARDS patients.
Version ID
1
Status
MEDLINE
Authors Full Name
Sittig, D F; Gardner, R M; Morris, A H; Wallace, C J.
Institution
Sittig, D F. Department of Medical Informatics, University of Utah/LDS Hospital, Salt Lake City.
Year of Publication
1990

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

226.

Extracorporeal CO2 removal in a lung lavage induced respiratory distress syndrome.
Zobel G; Pierer G; Dacar D; Berger J; Novak J.
International Journal of Artificial Organs. 13(7):430-5, 1990 Jul.
[Journal Article]
UI: 2205593
Ten pigs with experimental respiratory distress syndrome were treated by

extracorporeal CO2 removal (ECCO2-R) combined with low frequency positive pressure ventilation (LPPV). After lung damage had been induced by repeated lung lavages a PEEP trial was conducted in order to find the appropriate PEEP for the damaged lungs. This PEEP was then applied during the ECCO2-R/LPPV period. Blood gas values improved significantly on extracorporeal bypass within a short time (pre-bypass paO2: 54.2 +/- 3.7 vs 168.5 +/- 31.6 mmHg after 15 min on bypass, p less than 0.001) and were kept constant during the next 4 hours. Minute ventilation (MV) was reduced from 4.01 +/- 0.31 to 0.74 +/- 0.07 l/min (p less than 0.0001), FiO2 of the ventilator from 1.0 to 0.46 +/- 0.08 (p less than 0.0001) whereas FiO2 of the membrane lung (ML) was not changed significantly (FIO2ML 0.59 +/- 0.07 vs 0.53 +/- 0.06). During controlled mechanical ventilation (CMV), comparable adequate gas exchange was only achieved at a significantly higher mean airway pressure (Paw 14.1 +/- 0.08 vs 21.2 +/- 0.47 cmH20, p less than 0.0001). Hemodynamic variables did not change significantly during bypass time. ECCO2-R/LPPV driven by a simple renal perfusion system allows adequate gas exchange in experimental respiratory failure.
Version ID
1
Status
MEDLINE
Authors Full Name
Zobel, G; Pierer, G; Dacar, D; Berger, J; Novak, J.
Institution
Zobel, G. Department of Pediatrics, University of Graz, Austria.
Year of Publication
1990

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

227.

Non-conventional techniques of ventilatory support. [Review] [137 refs]
Villar J; Winston B; Slutsky AS.
Critical Care Clinics. 6(3):579-603, 1990 Jul.
[Journal Article. Research Support, Non-U.S. Gov't. Review]
UI: 2198997
The non-conventional techniques for ventilatory support represent a new approach to the management of patients with respiratory failure. A large number of studies indicate that these techniques can maintain adequate gas exchange under conditions in which the traditional concepts of gas transport no longer hold. We have reviewed the group of techniques, collectively called high frequency ventilation (HFV), in which the tidal volumes are much less (1 to 5 ml per kg) than those observed during conventional mechanical ventilation. Although HFV has theoretical advantages in some clinical settings, it has been shown to be superior to conventional mechanical ventilation in but a few. HFV appears to provide adequate ventilation while still allowing access to tracheal and laryngeal surgical fields. It has been successful during pneumonectomy, and in the treatment of bronchopleural fistulae. The relevance of tracheal insufflation (TRIO) of oxygen and constant flow ventilation (CFV) to the human clinical setting is uncertain. TRIO may be useful to oxygenate patients who are difficult to intubate, or TRIO could be applied for ventilation of patients involved in mass casualties. Although CFV does not maintain normal levels of PaCO2 in humans, it can provide adequate oxygenation. It might be clinically applicable during thoracic surgery, in which movement of the abdominal and thoracic

contents associated with conventional mechanical ventilation is undesirable. During CFV, the lung is kept motionless with sufficient airway pressures to maintain patency of airways and alveoli. CFV is useful as a tool for studying phenomena affected by breathing. The rationale for the use of an artificial lung during extracorporeal membrane oxygenation (ECMO) or extracorporeal carbon dioxide removal with low positive pressure ventilation (ECCO2R-LFPPV) in the treatment of acute respiratory failure is to provide temporary respiratory function while the pulmonary lesion is being treated or is resolving. The factors that most limit the usefulness of ECMO are not technical but relate to the ability of the lung to recover structurally and functionally after a severe insult. Poor survival figures in the published series of ECMO in adults reflect the gravity of illness prior to treatment. However, results in neonates have been quite encouraging. ECCO2R allows less exposure of blood to the extracorporeal circuit and avoids the reduction in pulmonary blood flow associated with ECMO. Although the reported survival of adults with severe acute respiratory failure treated with ECCO2R is extremely promising, it is important to point out that none of the published reports are controlled, randomized studies.(ABSTRACT TRUNCATED AT 400 WORDS) [References: 137]
Version ID
1
Status
MEDLINE
Authors Full Name
Villar, J; Winston, B; Slutsky, A S.
Institution
Villar, J. Department of Medicine, Mount Sinai Hospital, Toronto, Ontario, Canada.
Year of Publication
1990

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

228.

Extracorporeal CO2-removal with a heparin coated extracorporeal system.
Rossaint R; Slama K; Bauer R; Nienhaus M; Barth H; Weidemann H; Falke KJ.
Intensive Care Medicine. 16(5):344-5, 1990.
[Case Reports. Letter]
UI: 2120307
Version ID
1
Status
MEDLINE
Authors Full Name
Rossaint, R; Slama, K; Bauer, R; Nienhaus, M; Barth, H; Weidemann, H; Falke, K J.
Year of Publication
1990

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

229.

Percutaneous extracorporeal CO2 removal in a patient with bullous emphysema with recurrent bilateral pneumothoraces and respiratory failure.
Pesenti A; Rossi GP; Pelosi P; Brazzi L; Gattinoni L.
Anesthesiology. 72(3):571-3, 1990 Mar.
[Case Reports. Journal Article. Research Support, Non-U.S. Gov't]
UI: 2106807
Version ID
1
Status
MEDLINE
Authors Full Name
Pesenti, A; Rossi, G P; Pelosi, P; Brazzi, L; Gattinoni, L.
Institution
Pesenti, A. Institute of Anesthesia and Intensive Care, University of Milan, Italy.
Year of Publication
1990

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

230.

Low-frequency positive-pressure ventilation with extracorporeal carbon dioxide removal.
Abrams JH; Gilmour IJ; Kriett JM; Bitterman PB; Irmiter RJ; McComb RC; Cerra FB.
Critical Care Medicine. 18(2):218-20, 1990 Feb.
[Case Reports. Journal Article]
UI: 2105181
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Abrams, J H; Gilmour, I J; Kriett, J M; Bitterman, P B; Irmiter, R J; McComb, R C; Cerra, F B.
Institution
Abrams, J H. Department of Surgery, University of Minnesota, Minneapolis.
Year of Publication
1990

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

231.

Computerized management of patient care in a complex, controlled clinical trial in the intensive care unit.
Sittig DF; Gardner RM; Pace NL; Morris AH; Beck E.
Computer Methods & Programs in Biomedicine. 30(2-3):77-84, 1989 Oct-Nov.
[Clinical Trial. Journal Article. Randomized Controlled Trial]
UI: 2684495
Acute respiratory distress syndrome (ARDS) is often not responsive to conventional supportive therapy and the mortality rate may exceed 90%. A new form of supportive care, extracorporeal carbon dioxide removal (ECCO2R), has shown a dramatic increase in survival (48%). A controlled clinical trial of the new ECCO2R therapy versus conventional continuous positive pressure ventilation (CPPV) is being initiated. Detailed care protocols have been developed by 'expert' critical care physicians for the management of patients. Using a blackboard control architecture, the protocols have been implemented on an existing hospital information system and will direct patient care and help manage the controlled clinical trial. Therapeutic instructions are automatically generated by the computer from data input by physicians, nurses, respiratory therapists, and the laboratory. Preliminary results show that the computerized protocol system can direct therapy for acutely ill patients.
Version ID
1
Status
MEDLINE
Authors Full Name
Sittig, D F; Gardner, R M; Pace, N L; Morris, A H; Beck, E.
Institution
Sittig, D F. Department of Medical Informatics, LDS Hospital/University of Utah, Salt Lake City 84143.
Year of Publication
1989

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

232.

[Evolutionary biological aspects of the physiology of extracorporeal CO2 removal]. [Review] [17 refs] [German] Evolutionsbiologische Aspekte zur Physiologie der extrakorporalen CO2-Entfernung.
Nolte S.
Anaesthesist. 38(11):622-5, 1989 Nov.
[English Abstract. Journal Article. Review]
UI: 2517576
Extracorporeal CO2 elimination (ECCO2-R) is a new approach to the treatment of severe respiratory failure. Gas exchange is separated into oxygen uptake by apneic oxygenation through the natural lungs while CO2 is removed extracorporeally with an artificial organ. The physiological conditions of both processes can thus be optimized. In the course of evolution, a similar bimodal gas exchange has developed during the respiratory transition from aquatic gas exchange to pulmonary gas exchange: In air-breathing fish or amphibia oxygenation is accomplished predominantly via the lungs while CO2 is eliminated via gill or skin. Today's air-breathing vertebrates maintain a considerable respiratory acidosis which has to be compensated for by an appropriate bicarbonate level. This is dependent upon gill reduction and skin armor to prevent evaporation leading to a rise in pCO2 from 3-4 to 40 mmHg and a tenfold increase of

serum bicarbonate levels. We believe that the developmental history of respiration justifies the use of a bimodal gas exchange system. It is clinically applied as extracorporeal CO2 removal with membrane lungs (ECCO2-R) or, still under investigation, in a hemodialysis-related procedure (extracorporeal bicarbonate/CO2 removal: ECBicCO2). [References: 17]
Version ID
1
Status
MEDLINE
Authors Full Name
Nolte, S.
Institution
Nolte, S. Universitats-Kinderklinik Freiburg.
Year of Publication
1989

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

233.

Haemolysis during in vitro CO2 removal from human blood using a membrane lung.
McRae KM; Dorrington KL.
Journal of Biomedical Engineering. 11(5):369-74, 1989 Sep.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 2507824
Haemolysis of human blood has been examined in vitro as a function of pH in the range 7.2-8.0. The hydrogen ion concentration of freshly donated blood from 11 donors was manipulated in 42 experiments, entirely by altering the carbon dioxide fraction of air with which the blood was equilibrated using a membrane lung. In contrast to the known alkalaemic haemolysis which occurs in canine blood, we observed no correlation between plasma haemoglobin concentrations and blood pH. We conclude that alkalaemic haemolysis is unlikely to complicate the clinical application of extracorporeal carbon dioxide removal in the management of acute respiratory failure.
Version ID
1
Status
MEDLINE
Authors Full Name
McRae, K M; Dorrington, K L.
Institution
McRae, K M. Medical Engineering Unit, Department of Engineering Science, Oxford, UK.
Year of Publication
1989

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

234.

A randomized comparison of total extracorporeal CO2 removal with conventional mechanical ventilation in experimental hyaline membrane disease.
Dorrington KL; McRae KM; Gardaz JP; Dunnill MS; Sykes MK; Wilkinson AR.
Intensive Care Medicine. 15(3):184-91, 1989.
[Comparative Study. Journal Article. Research Support, Non-U.S. Gov't]
UI: 2500468
Apnoeic oxygenation (AO) combined with extracorporeal CO2 removal (ECCO2R), using venovenous perfusion across a membrane area of 0.1 m2 has been shown to be feasible in six healthy anaesthetized rabbits. In a further twelve rabbits, ECCO2R has been randomly compared with conventional mechanical ventilation (CMV) following saline lavage to induce respiratory failure. Blood gases were maintained for up to 6 h within the same range (PaO2 = 8-20 kPa, PaCO2 = 4-6 kPa) in two groups of six by varying airway pressures and the oxygen fraction delivered either to the membrane lung (ECCO2R group) or to the ventilator (CMV group). The influence of single hourly sustained inflations (SI) on oxygenation was studied. ECCO2R subjects remained stable and survived. CMV subjects deteriorated and had 80% mortality. Hyaline membranes were absent from ECCO2R subjects and present in all CMV subjects. The response to SI suggests that a lung volume recruitment is maintained during AO for up to 1 h but is ineffective during CMV.
Version ID
1
Status
MEDLINE
Authors Full Name
Dorrington, K L; McRae, K M; Gardaz, J P; Dunnill, M S; Sykes, M K; Wilkinson, A R.
Institution
Dorrington, K L. Department of Engineering Science, University of Oxford, UK.
Year of Publication
1989

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

235.

Hemodialysis for extracorporeal bicarbonate/CO2 removal (ECBicCO2R) and apneic oxygenation for respiratory failure in the newborn. Theory and preliminary results in animal experiments.
Nolte SH; Jonitz WJ; Grau J; Roth H; Assenbaum ER.
ASAIO Transactions. 35(1):30-4, 1989 Jan-Mar.
[Journal Article]
UI: 2499349
Extracorporeal techniques for respiratory support in the newborn are feasible, as the growth of neonatal extracorporeal membrane oxygenation (ECMO) has demonstrated. It has been shown, however, that even in severely damaged lungs, sufficient oxygenation and gas exchange can be maintained only by removing CO2 in an extracorporeal circuit, i.e., extracorporeal CO2 removal (ECCO2R). To demonstrate the effectiveness of CO2 removal in a bicarbonate-free hemodialysis procedure, CO2 removal was measured during routine acetate hemodialysis in 22 patients on renal replacement therapy for end-stage renal disease. By comparison of predialyzer and postdialyzer total CO2, an overall CO2 removal of 79.1 +/- 15.1 ml/min was measured in the blood and 77.0 +/- 19.5 ml/min in the dialysate; this was

approximately one third of the entire metabolic CO2 production and probably accounted for the secondary hypoxia during acetate hemodialysis. To use bicarbonate-free hemodialysis for total metabolic CO2 removal, acetate dialysate was modified with lactate, phosphate buffer, and sodium hydroxide to compensate for the bicarbonate loss. In sheep, apneic oxygenation could be achieved with blood flow rates as low as 10-15 ml/kg/min for 4-6 hours. These preliminary data suggest that a hemodialysis procedure for bicarbonate and CO2 elimination (ECBicCO2R) could be an efficient method for CO2 removal requiring much lower blood flow rates than techniques presently in use.
Version ID
1
Status
MEDLINE
Authors Full Name
Nolte, S H; Jonitz, W J; Grau, J; Roth, H; Assenbaum, E R.
Institution
Nolte, S H. Children's Hemodialysis Unit, University of Kinderklinik, Freiburg, West Germany.
Year of Publication
1989

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

236.

Extracorporeal CO2-removal with a heparin coated artificial lung.
Peters J; Radermacher P; Kuntz ME; Rosenbauer KA; Breulmann M; Burrig KF; Hopf HB; Rossaint R; Schulte HD; Olsson P; et al.
Intensive Care Medicine. 14(5):578-84, 1988.
[Journal Article]
UI: 3221012
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.
Version ID
1
Status
MEDLINE
Authors Full Name
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.
Institution
Peters, J. Department of Anesthesiology, University of Dusseldorf, FRG.
Year of Publication

1988

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

237.

A controlled clinical trial of a new 3-step therapy that includes extracorporeal CO2 removal for ARDS.
Morris AH; Menlove RL; Rollins RJ; Wallace CJ; Beck E.
ASAIO Transactions. 34(1):48-53, 1988 Jan-Mar.
[Clinical Trial. Comparative Study. Journal Article. Research Support, Non-U.S. Gov't]
UI: 3132189
Version ID
1
Status
MEDLINE
Authors Full Name
Morris, A H; Menlove, R L; Rollins, R J; Wallace, C J; Beck, E.
Institution
Morris, A H. Department of Medicine, LDS Hospital, Salt Lake City, UT 84143.
Year of Publication
1988

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

238.

Membrane oxygenators: current developments in design and application. [Review] [29 refs]
Gaylor JD.
Journal of Biomedical Engineering. 10(6):541-7, 1988 Nov.
[Journal Article. Review]
UI: 3070171
Cardiopulmonary bypass (CPB) procedures require a blood-gas exchanger (oxygenator) to temporarily replace the respiratory function of the lungs. In the past the majority of CPB procedures have been carried out with bubble oxygenators which effect gas exchange by dispersion of bubbles into the blood. Membrane oxygenators, on the other hand, utilize a hydrophobic gas permeable membrane between the blood and gas phases. Bubble oxygenators are being superseded by membrane types for CPB due to improvements in membrane technology and mass transfer efficiency. These advances are reviewed in this paper and are illustrated by reference to the gas exchange and operating characteristics of a number of clinical oxygenators designed for adult CPB. Membrane oxygenators are also being used for long-term support in the treatment of acute respiratory failure. Operated in a partial bypass circuit, the oxygenator may have to function for several days or weeks. In one particular treatment method, the rate of spontaneous breathing is controlled by the partial or total removal of the metabolic CO2 production by the membrane

oxygenator. For this method, known as extracorporeal CO2 removal (ECCO2R), the oxygenator must be optimized for CO2 transfer at low blood flow rates. The suitability of clinical oxygenators for ECCO2R is discussed in terms of gas exchange and functionality over a prolonged operation. [References: 29]
Version ID
1
Status
MEDLINE
Authors Full Name
Gaylor, J D.
Institution
Gaylor, J D. University of Strathclyde, Bioengineering Unit, Wolfson Centre, Glasgow, UK.
Year of Publication
1988

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

239.

Extracorporeal CO2 removal by hemodialysis in patients with chronic respiratory failure.
Matsunobe S; Isobe J; Mizuno H; Shimizu Y.
ASAIO Transactions. 33(3):441-5, 1987 Jul-Sep.
[Journal Article]
UI: 3118918
Version ID
1
Status
MEDLINE
Authors Full Name
Matsunobe, S; Isobe, J; Mizuno, H; Shimizu, Y.
Institution
Matsunobe, S. Respiratory Center, Shiga Health Insurance Hospital, Japan.
Year of Publication
1987

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

240.

Prolonged extracorporeal CO2-removal in severe adult respiratory distress syndrome. Neuropathological observations in two cases.
Krajewski S; Seitz RJ; Schober R; Breulmann M; Falke KJ.
Intensive Care Medicine. 13(1):26-9, 1987.
[Case Reports. Journal Article. Research Support, Non-U.S. Gov't]
UI: 3104430
Extracorporeal CO2-removal (EC-CO2-R) using a membrane lung system was

applied for 12 and 20 days respectively in 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Krajewski, S; Seitz, R J; Schober, R; Breulmann, M; Falke, K J.
Year of Publication
1987

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

241.

Ventilatory impact of partial extracorporeal CO2 removal (PECOR) in ARF patients.
Marcolin R; Mascheroni D; Pesenti A; Bombino M; Gattinoni L.
ASAIO Transactions. 32(1):508-10, 1986 Jul-Sep.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 3096360
Version ID
1
Status
MEDLINE
Authors Full Name
Marcolin, R; Mascheroni, D; Pesenti, A; Bombino, M; Gattinoni, L.
Year of Publication
1986

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

242.

Low-frequency positive-pressure ventilation with extracorporeal CO2 removal in severe acute respiratory failure.
Gattinoni L; Pesenti A; Mascheroni D; Marcolin R; Fumagalli R; Rossi F; Iapichino G; Romagnoli G; Uziel L; Agostoni A; et al.
JAMA. 256(7):881-6, 1986 Aug 15.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 3090285
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, greater than 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.
Version ID
1
Status
MEDLINE
Authors Full Name
Gattinoni, L; Pesenti, A; Mascheroni, D; Marcolin, R; Fumagalli, R; Rossi, F; Iapichino, G; Romagnoli, G; Uziel, L; Agostoni, A.
Year of Publication
1986

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

243.

Management of severe ARDS with low frequency positive pressure ventilation and extracorporeal CO2 removal.
Hickling KG; Downward G; Davis FM; A'Court G.
Anaesthesia & Intensive Care. 14(1):79-83, 1986 Feb.
[Case Reports. Journal Article]
UI: 3082239
Version ID
1
Status
MEDLINE
Authors Full Name
Hickling, K G; Downward, G; Davis, F M; A'Court, G.
Year of Publication
1986

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

244.

Extracorporeal CO2 Removal in severe adult respiratory distress syndrome. [Review]

[68 refs]
Hickling KG.
Anaesthesia & Intensive Care. 14(1):46-53, 1986 Feb.
[Journal Article. Review]
UI: 3082238
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 frequency 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. [References: 68]
Version ID
1
Status
MEDLINE
Authors Full Name
Hickling, K G.
Year of Publication
1986

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

245.

Studies of complement activation in ARDS patients treated by long-term extracorporeal CO2 removal.
Gardinali M; Cicardi M; Frangi D; Bergamaschini L; Gallazzi M; Gattinoni L; Agostoni A.
International Journal of Artificial Organs. 8(3):135-40, 1985 May.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 3928501
To investigate the role of complement activation in the adult respiratory distress syndrome (ARDS) and in the complications of extracorporeal circulation (ECC), several parameters (CH50, C3 split products, C3a, C5a, PMN aggregating activity, carboxypeptidase activity) of the complement profiles of 23 ARDS patients were measured. Twenty patients were treated by long-term extracorporeal support. Before connection to ECC, marked leukocytosis (18,250 +/- 5,950) and significantly high plasma C3a levels (p less than 0.005) were observed. After connection, C3a levels increased further, up to values eight times higher than the basal ones. The WBC count transiently decreased to 41% of prebypass levels after 15 minutes of ECC. At the same time C3 split products appeared and PMN aggregating activity was shown in 52% of the patients. C5a levels remained normal during bypass, even in two samples in which PMN aggregating activity was detected. Later decreases in CH50 titers (p less than 0.001) and carboxypeptidase activity (p less than 0.005) were observed. Complement activation was no longer evident after the 24th hour of bypass. We conclude that there is a low-degree complement activation in ARDS, and ECC is a further strong stimulus for complement activation. This phenomenon appears, however, to be self-limited.

Version ID
1
Status
MEDLINE
Authors Full Name
Gardinali, M; Cicardi, M; Frangi, D; Bergamaschini, L; Gallazzi, M; Gattinoni, L; Agostoni, A.
Year of Publication
1985

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

246.

[Pulmonary function during a 10-day successful extracorporeal CO2 elimination in acute respiratory failure. Case report]. [German] Lungenfunktion wahrend 10-tagiger erfolgreicher extrakorporaler CO2-Elimination bei schwerem akuten Lungenversagen. Fallbricht.
Thies WR; Breulmann M; Lenhsen U; Pesenti A; Kuntz BM; Langer M; Schulte HD; Falke KJ.
Anaesthesist. 34(4):197-202, 1985 Apr.
[Case Reports. English Abstract. Journal Article. Research Support, Non-U.S. Gov't]
UI: 3923858
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.
Version ID
1
Status
MEDLINE
Authors Full Name
Thies, W R; Breulmann, M; Lenhsen, U; Pesenti, A; Kuntz, B M; Langer, M; Schulte, H D; Falke, K J.
Year of Publication
1985

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

247.

Tracheal and alveolar gas composition during low-frequency positive pressure ventilation with extracorporeal CO2-removal (LFPPV-ECCO2R).
Peters J; Radermacher P; Pesenti A; Schulte HD; Falke KJ.
Intensive Care Medicine. 11(4):213-7, 1985.
[Case Reports. Journal Article. Research Support, Non-U.S. Gov't]
UI: 3900167
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 PAO2, P(A-a)O2 and Qva/Qt are to be determined correctly.
Version ID
1
Status
MEDLINE
Authors Full Name
Peters, J; Radermacher, P; Pesenti, A; Schulte, H D; Falke, K J.
Year of Publication
1985

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

248.

The role of total static lung compliance in the management of severe ARDS unresponsive to conventional treatment.
Gattinoni L; Pesenti A; Caspani ML; Pelizzola A; Mascheroni D; Marcolin R; Iapichino G; Langer M; Agostoni A; Kolobow T; et al.
Intensive Care Medicine. 10(3):121-6, 1984.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 6376584
A group of 36 patients with severe adult respiratory distress syndrome (ARDS) meeting previously established blood gas criteria (mortality rate 90%) became candidates for possible extracorporeal respiratory support [low frequency positive pressure ventilation with extracorporeal CO2 removal (LFPPV-ECCO2R)]. Before connecting the patients to bypass we first switched the patients from conventional mechanical ventilation with positive end expiratory pressure (PEEP) to pressure controlled inverted ratio ventilation (PC-IRV), and then when feasible, to spontaneous breathing with continuous positive airways pressure (CPAP). Forty eight hours after the patients had entered the treatment protocol, only 19 out of the 36 patients in fact required LFPPV-ECCO2R, while 5 were still on PC-IRV, and 12 were on CPAP. The overall mortality rate of the entire population was 23%. The only predictive value of success or failure of a particular treatment mode was total static lung compliance

(TSLC). No patients with a TSLC lower than 25 ml (cm H2O)-1 tolerated either PC-IRV or CPAP, while all patients with a TSLC higher than 30 ml (cm H2O)-1 were successfully treated with CPAP. Borderline patients (TSLC between 25 and 30 ml (cm H2O)-1) had to be treated with PC-IRV for more than 48 h, or were then placed on LFPPV-ECCO2R if Paco2 rose prohibitively. We conclude that TSLC is a most useful measurement in deciding on the best management of patients with severe ARDS, unresponsive to conventional treatment.
Version ID
1
Status
MEDLINE
Authors Full Name
Gattinoni, L; Pesenti, A; Caspani, M L; Pelizzola, A; Mascheroni, D; Marcolin, R; Iapichino, G; Langer, M; Agostoni, A; Kolobow, T.
Year of Publication
1984

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

249.

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. 29:227-30, 1983.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 6424303
Version ID
1
Status
MEDLINE
Authors Full Name
Agostoni, A; Cicardi, M; Bergamaschini, L; Gardinali, M; Frangi, D; Gattinoni, L; Pesenti, A.
Year of Publication
1983

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

250.

Complete extracorporeal removal of metabolic carbon dioxide by alkali administration and dialysis in apnea.
Chang BS; Garella S.
International Journal of Artificial Organs. 6(6):295-8, 1983 Nov.
[Comparative Study. Journal Article. Research Support, Non-U.S. Gov't]
UI: 6421753

The high mortality rate of patients afflicted with adult respiratory distress syndrome (ARDS) may be due, in part, to the hemodynamic changes and the barotrauma accompanying mechanical ventilation, especially when high positive pressure and oxygen tension are used. Recent experimental evidence suggests that prognosis may be improved by suspending ventilation: in the apneic condition, oxygenation can be maintained by transalveolar oxygen diffusion, while extracorporeal carbon dioxide removal (ECCO2R), achieved with membrane lungs, assures CO2 homeostasis. This technology, however, requires high blood flow rates, and is available only to very few specially equipped centers. We report results of experiments in dogs using an alternative approach to ECCO2R during apnea. Dissolved CO2 was converted to bicarbonate by the systemic infusion of NaOH at the rate of 0.15 mM/kg/min; the generated bicarbonate was then removed by hemodialysis against a bicarbonate-free dialysate, at a blood flow rate of 200 ml/min. Sodium and fluid balance were maintained by ultrafiltration. Observations in five dogs confirm that systemic pCO2, TCO2, and pH can be maintained well within physiologic ranges, and that prolonged apnea followed by full recovery can be achieved with this methodology. Because of the wide availability of dialysis equipment and expertise, and of lower extracorporeal blood flow requirements, ECCO2R by alkali administration and hemodialysis offers a potentially attractive alternative approach to the use of membrane lungs in the apneic therapy of ARDS.
Version ID
1
Status
MEDLINE
Authors Full Name
Chang, B S; Garella, S.
Year of Publication
1983

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

251.

Extracorporeal carbon dioxide removal in acute respiratory failure.
Gattinoni L; Pesenti A; Pelizzola A; Riva C; Gariboldi G; Pirovano E; Giovanetti AM.
Annales Chirurgiae et Gynaecologiae - Supplementum. 196:77-9, 1982.
[Journal Article]
UI: 6818890
Version ID
1
Status
MEDLINE
Authors Full Name
Gattinoni, L; Pesenti, A; Pelizzola, A; Riva, C; Gariboldi, G; Pirovano, E; Giovanetti, A M.
Year of Publication
1982

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

252.

Techniques of ventilatory therapy in the adult respiratory distress syndrome (ARDS).
Lamy M.
Acta Anaesthesiologica Belgica. 33(4):243-57, 1982.
[Journal Article]
UI: 6762038
Techniques of respiratory support in ARDS are becoming more and more complex. New modes of ventilatory therapy like continuous positive airway pressure (CPAP), appeared during the last years and became popular; other ones are now under investigation, high frequency ventilation and extracorporeal CO2 removal, for instance. A lot of abbreviations are actually commonly used by physicians involved in intensive care as well as by ventilator industries. The purpose of this article is to review these different modes of respiratory assistance in ARDS, as well as their indications. They are grouped into four categories: mechanical ventilation, spontaneous breathing with positive pressure, a "mature" of both, also called intermittent mandatory ventilation (IMV) and finally extracorporeal support. The respective use of these different modes in our Center of Intensive Care at the University of Liege during recent years is analysed. It appears that mechanical ventilation, especially with positive end expiratory pressure (PEEP) keeps a place of choice and that spontaneous breathing with positive pressure (CPAP) represents one of the best improvements of the late years in respiratory intensive care. Last but not least is the absolute necessity to start respiratory assistance with positive pressure as soon as possible, once the diagnosis of ARDS is suspected.
Version ID
1
Status
MEDLINE
Authors Full Name
Lamy, M.
Year of Publication
1982

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

253.

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 ML; Iapichino G; Agostoni A; Damia G; Kolobow T.
Transactions - American Society for Artificial Internal Organs. 27:289-93, 1981.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 6800099
Version ID
1
Status
MEDLINE
Authors Full Name
Gattinoni, L; Pesenti, A; Pelizzola, A; Caspani, M L; Iapichino, G; Agostoni, A; Damia,

G; Kolobow, T.
Year of Publication
1981

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

254.

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. 27:263-6, 1981.
[Journal Article. Research Support, Non-U.S. Gov't]
UI: 6800095
Version ID
1
Status
MEDLINE
Authors Full Name
Pesenti, A; Pelizzola, A; Mascheroni, D; Uziel, L; Pirovano, E; Fox, U; Gattinoni, L; Kolobow, T.
Year of Publication
1981

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

255.

Clinical application of low frequency positive pressure ventilation with extracorporeal CO2 removal (LFPPV-ECCO2R) in treatment of adult respiratory distress syndrome (ARDS).
Gattinoni L; Kolobow T; Agostoni A; Damia G; Pelizzola A; Rossi GP; Langer M; Solca M; Citterio R; Pesenti A; Fox U; Uziel L.
International Journal of Artificial Organs. 2(6):282-3, 1979 Nov.
[Case Reports. Journal Article]
UI: 511369
Version ID
1
Status
MEDLINE
Authors Full Name
Gattinoni, L; Kolobow, T; Agostoni, A; Damia, G; Pelizzola, A; Rossi, G P; Langer, M; Solca, M; Citterio, R; Pesenti, A; Fox, U; Uziel, L.
Year of Publication
1979

256.

Extracorporeal carbon dioxide removal (ECCO2R): a new form of respiratory assistance.
Gattinoni L; Kolobow T; Damia G; Agostoni A; Pesenti A.
International Journal of Artificial Organs. 2(4):183-5, 1979 Jul.
[Journal Article]
UI: 287656
Version ID
1
Status
MEDLINE
Authors Full Name
Gattinoni, L; Kolobow, T; Damia, G; Agostoni, A; Pesenti, A.
Year of Publication
1979

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