

Oral Presentations

Organisation/Outcome/Scoring

001

The Trent Victoria Audit: A Comparison of Delivery Systems for Paediatric Intensive Care

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We present the results of a prospective population-based audit of paediatric intensive care activity in two comparable communities with markedly different delivery systems. In the Trent region of the UK (4.2 million people), children receive intensive care largely without the supervision of a paediatric intensivist in a variety of hospitals, few of which have designated Paediatric Intensive Care Units (PICUs). Critically ill children otherwise receive intensive care in children's wards, special care baby units (SCBUs) or adult intensive care units. In the Australian State of Victoria (4.5 million people), children receive intensive care almost exclusively in one centre - a PICU staffed by full time paediatric intensivists. The two regions are otherwise demographically comparable.

In both groups, data were collected on all children admitted to an intensive care unit between 1/4/94 and 31/3/95 and children who received intensive care (defined by levels of intervention and nurse dependency) in other sites during the same period. Values of each variable at first contact with the ICU, and the highest and lowest values over the first 24 hours were recorded. The principal outcome was survival to discharge from the intensive care unit. Severity of illness was assessed using PIM (Paediatric Index of Mortality) and PRISM. Risk-adjusted mortality was compared using Flora's Z test and logistic regression.

The rate of utilisation of intensive care (>1000 admissions in each region) were similar. There was some variation in case mix between the two groups, but crude mortality rates were similar (7.4% in Trent and 6.6% in Victoria). However severity corrected data and other measures of PICU performance were dramatically better in the centralised delivery system. The substantial excess mortality in the Trent region provides strong evidence for the benefits of centralisation of paediatric intensive care services.

002

EFFICIENCY AND EFFECTIVENESS OF INTENSIVE CARE FOR ACUTE RESPIRATORY FAILURE DURING SEVERE MEDICAL ILLNESS

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There are considerable difficulties in evaluating the efficiency and effectiveness of care in children presenting with respiratory failure during acute medical illness. Optimal outcomes for such episodes include survival and the shortest length of stay (LOS) in intensive care with negligible risk of readmission. We have tried to determine whether or not the time course of acute severe medical illness with respiratory failure is predictable.

Study I (n=1000): A retrospective study of intubated and mechanically ventilated children (>28 days, <17 years) with acute severe medical illness.

Measures: Diagnosis, intensive care LOS in calendar days, and survival.

Results: The underlying diagnosis fell within one of three broad categories: respiratory disease (n=521, mortality 19.2%), central nervous system (CNS) disease (n=342, mortality 38.7%), and systemic inflammation or multisystem (SIMS) disease (n=137, mortality 47.5%). The LOS in survivors was: respiratory - median (interquartile range) 8(4-16) days, CNS 4(3-8) days, SIMS 5(3-8) days. Sixteen diagnosis-related-groups (DRGs) were identified (8 respiratory, 5 CNS, 3 SIMS disease) and each have been characterised by mortality and LOS.

Study II (n=300): A prospective study of patients supported by the hypothesis that LOS for the above DRGs was predictable (compared with Study I data). In certain instances attributable causes for variances in LOS were identified: e.g. disease severity, timing of drug therapy, and associated disease. With daily paediatric risk of mortality scoring within each DRG, four profiles of instability were identified.

Discussion: The time course of acute severe medical illness with respiratory failure is predictable and variance may be attributable to specific care or diagnostic factors. We are now developing a means of linking DRG-specific clinical care pathways with an integrated computerised decision support and education facility at the bedside.

003

Determinants of effectiveness and resource utilization in pediatric intensive care.

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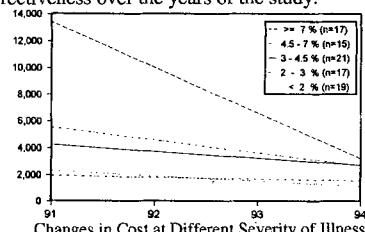
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The objective of this open, prospective study was to assess the relation between basic patient characteristics as well as effectiveness of treatment on the one hand and resource utilization in pediatric intensive care on the other. As universal, non-monetary indicators of resource utilization we used the Therapeutic Intervention Score System (TISS) and length-of-stay (LOS), from which indicators for total resource utilization per admission (TISSTOT) and average daily resource utilization (TISS-MEAN = TISSTOT/LOS) were obtained. Overall 593 admissions, totalling 3130 days, were included. Mortality was 8.4%; non-survivors accounted for 14.1% of overall resource utilization. In non-survivors, both total resource utilization per admission and average daily resource utilization were higher, whereas LOS was not different from survivors'. Severity of illness, surgical status, the presence of substantial chronic comorbidity, emergency admission and transfer from another hospital constituted the major predictive determinants of TISSTOT ($r^2=0.19$) and TISSMEAN ($r^2=0.45$) in multiple regression analysis ($p<0.0001$). Hence these indicators are appropriate non-monetary measures of resource utilization, a considerable proportion of which are determined by a concise set of basic clinical characteristics. Subsequently we analysed the relation between effectiveness of care and resource utilization by assessing severity of illness corrected mortality in low, medium and high resource users, respectively. These 3 categories were delineated by percentiles of resource utilization (<P20, P20-P80, >P80). Despite on average long LOS and high resource utilization in the high risk group, a relatively low standardized mortality was found, probably warranting prolonged intensive treatment in this patient category.

004

DECREASE IN PEDIATRIC CRITICAL CARE COSTS FOR THE MANAGEMENT OF LOWER AIRWAY DISEASE. Jose Irazuzta, Jianliang Zhang, Sukumar Pandit, Forest Arnold, Dept of Pediatrics, Robert C. Byrd HSC of WVU, Charleston, WV.

Objective: To investigate whether a Pediatric Critical Care Team of a recently restructured PICU has an evolution of medical practice that decreases costs. **Material and Methods:** Previously healthy patients admitted for lower airway disease to the PICU between 1991 to 1994 were grouped by year. Age, severity of illness (SI), PICU and hospital length-of-stay (hours), prorated hospital bill, year of admission and patient-specific PICU originated costs (POC) were retrieved. Patient-specific POC was obtained by using the cost-to-charge ratios for each participating department. The costs for radiology, laboratory and electrocardiology were added and expressed as cost for diagnostic tests. **Results:** Eighty-nine patients fulfilled the admission criteria. There was a decrease of POC through the four year period ($p<0.05$ $r^2=0.04$). Two factors were associated with an increase in POC: an increase in the SI ($p<0.0001$ $r^2=0.35$) and the presence of intubation ($p=0.001$). The decrease through the years remained present even when excluding intubated patients and adjusting for SI (N 79, coef for year = -368, $p=0.038$). The decline in costs for diagnostic tests was the most prominent of all areas ($p=0.0004$, $r^2=0.15$); this was 58% of the initial cost. The decrease in POC were paralleled with the ones in hospital length-of-stay and the prorated hospital bill. **Conclusion:** The costs for the management of these previously healthy patients affected with lower airway disease decreased over the study period. A unit organization with a coordinated team care approach, led by dedicated pediatric intensivists, increases in effectiveness over the years of the study.



005

Collaborative Study in Mortality Risk Factors. Saporiti A., Althabe M., Albano A., Allende D., Bordin C., Goldshmidt S., Mendilaharzu J., Olazarri F., Oviedo M., Peltzer J., Shnitzler E., Silbergber J., Tamush H., Trentadue J., Vassallo J.

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SUMMARY: Objective: The primary purposes of intensive care are to provide treatments to patients with life-threatening physiological dysfunction or to monitor and observe patients perceived to be at significant risk of dying. This collaborative study was performed to describe our patients and their outcome. In order to improve our results we tried to identify high risk groups. **Patients and Methods:** 13 PICUs entered the study. The data included all the admissions with >12 hs. during a 60 days period between the 1st June and the 30th September 1993. The records included: age, sex, weight, mechanical ventilation (MV), post-operative condition (P.Op), malnutrition, diagnosis, length of stay, PRISM score and outcome. Student test, Mann-Whitney or Wilcoxon were performed for univariate analysis. Fisher Exact test or Chi square for dicotomic variables. Risk group analysis was performed by logistic regression, odds ratio and 95% confidence interval. **Results:** 650 patients entered the study. Mean age was 47.6 months (DS #60) and median 18 months. We found significant statistical differences in calculated vs observed mortality rate comparing malnourished with euthrofic patients; Mechanical ventilated (MV) with non MV patients. No differences in length of stay or diagnoses were found.

Variable	Expected Mortality.	Observed Mortality	p	Odds ratio	IC 95%
Malnourished	16.6 %	47.8 %	< 0.0001	4.86	2.18-10.8
MV	27.0 %	46.8 %	< 0.0001	7.39	3.47-15.7
Resp. Infection.	5.07 %	26.4 %	0.265	0.98	0.95-1.01

Conclusions: Malnourished patients and those who need MV have higher risk of mortality in our population than it's expected by PRISM score prediction.

006

A MODIFIED PRISM SCORE IN A SOUTH AFRICAN PAEDIATRIC INTENSIVE CARE UNIT POPULATION.

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Background The use of PRISM or other scoring systems in the ICU is of great importance for evaluating the efficacy and efficiency of a particular ICU. The PRISM score was developed and validated in the USA and Europe but has recently been shown to be inaccurate in a South American population, a South African population as well as several European studies. Part of the poor performance of the PRISM score is as a result of differences in the case mix between the reference population and other paediatric ICUs. Since scoring systems should generally be used only in populations similar to the reference population from which the prediction model was developed, a modification of the PRISM score is necessary to improve its discriminatory ability in a wide range of patient groups. **Aim** To improve the predictive power of the PRISM score in a South African paediatric ICU population. **Patients & Methods** We analysed PRISM, demographic and clinical data collected prospectively from 1528 consecutive paediatric ICU admissions. The prediction of actual mortality by PRISM was evaluated by standard statistical methodology (goodness-of-fit test and receiver operating characteristic (ROC) analysis). The components of the PRISM logistic regression equation (PRISM score, operative status and age) and the 14 physiological variables making up the PRISM score in addition to new variables analysed (nutritional index, the need for inotropes and institution of mechanical ventilation) were subjected to discriminant analysis to determine their association with outcome. **Results** The goodness-of-fit test showed a significant failure of PRISM to accurately predict mortality over a wide range of expected mortality ($\chi^2[8] = 195$, $p = 0$). PRISM underpredicted mortality at lower PRISM scores, but overpredicted mortality in patients with high PRISMS. Similarly ROC analysis indicated a poor predictive power ($A_Z = 0.73 \pm 0.01$), with an area under the curve significantly less than that for the PRISM reference population ($p = 0$). PRISM showed equally poor discriminatory function at all age groups and diagnostic categories. With the addition of an index of nutritional status (proportional weight-for-age), and indicators of early respiratory and cardiovascular failure to the logistic regression formula, and a recalibration of the acute physiological score component, the ROC can be improved to 0.83 ± 0.02 , with a good fit described by the goodness-of-fit test ($\chi^2[8] = 3$, $p = 0.89$). **Discussion** The PRISM score is not accurate in our patient population has been recalibrated in view of the poor discriminatory function that we have shown. Part of the inaccuracy derives from the different demographic characteristics of our ICU population and a different pattern of diseases. In addition to assessments of acute physiological aberrations, an assessment of nutritional status and early respiratory and cardiovascular failure significantly improve the discriminatory ability of the PRISM score. These parameters have been devised with a view to improving the accuracy of PRISM in our population, while not decreasing its accuracy in ICUs similar to the reference population.

007

Effect of the UN Sanctions on the Morbidity rate among the Iraqi small children (below 3 years old of age) in Bagdad.

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Meningitis is essentially a childhood disease (1). The risk of infection are increased by poverty and overcrowding (7). The impaired immunity may be an important pathogenic factor underlying the susceptibility to infections in undernourished subjects (5). In general, malnutrition is a man made disease and it begins quite in the womb and ends in the grave (1).

1918 small children, below 3 years of age were admitted to the pediatric Hospital in Washash with meningitis over 4 cold months in 1994, in contrast to only 176 child admitted with meningitis over the same period in 1989.

All of the children who admitted in 1994 were frankly undernourished, 45% of them were infected with Enterobacteriae, because they were exposed to faulty Hygiene and lack of Asepsis.

These facts showed precisely that our small children had suffered at most from the UN Sanctions against Iraq, because of food, milk and drug shortage, since 4 years which had resulted a severe undernutrition among them, which impaired their immune status.

008

COMMUNICATING BAD NEWS IN THE PICU: WHEN A CHILD DIES

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In interviewing parents regarding how physicians have communicated bad news, the response I have received is that it has not infrequently been done without appropriate care, understanding and compassion. Personal experience and the lessons learned from parents, chaplains and others who deal extensively with these situations have provided me with an approach that has been supportive, compassionate, and caring. An especially difficult communication situation for the intensivist occurs when the parents have to be informed of the death of their child. For the parent, death is the hardest loss of all - the ultimate unalterable loss. Circumstances surrounding the death are an important consideration (e.g., a fatal crash caused by a drunken driver, a prolonged illness, a suicide, AIDS). Each produces a different grief reaction. The physician needs to inform parents of their child's death sympathetically coming right out with the news and leaving details until later. Allow pauses and time for the parents to express sorrow and grief. The best communication may be thoughtful silence and a tender touch. There is disbelief that this happened. It is necessary to repeat oneself. Acknowledgment of the parent's "feeling terrible" and the physician's acknowledgment of how terrible he/she feels that the life of the child could not be saved is an important first step in the parent's dealing with this tragic loss.

With prolonged resuscitation, it is helpful to have a member of the ICU team talk to the parents while the resuscitative efforts are ongoing so that the parents are not left unsupported at this time. A progress report should be delivered in a caring, lucid, and sensitive manner, indicating that every effort is being made to save the life of their desperately injured child.

After a child has died, it is helpful to the family if the physician maintains some contact with them. This should take the form of follow-up telephone calls at approximately 6, 12, and 24 months. This can help to screen for depression in the parents. In giving bad news to the family and making every effort to support them through this tragic time, it is necessary to remind oneself that the intensivist has personal needs for dealing with grief and will also require support to pass through this stage.

009

Quantification of quality of life before and after pediatric intensive care.

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In a prospective cohort study we assessed and compared the health-related quality of life (QOL) in children before and 1 year after admission to intensive care. All children aged ≥ 1 year admitted to a tertiary PICU were included. Health status was assessed with the Health Utility Index (HUI), a 7 domain generic health status measure, suitable for children. HUI domains include sensation, mobility, emotion, cognition, self-care, pain and fertility. HUI based health status was described as the number of affected domains, the frequencies of deficits within each domain, and the changes in domain specific health, respectively. The global QOL for each patient was aggregated to a single summary score between 0 for death and 1 for perfect health using the appropriate health index. Uncompromized health was found in 69/227 on admission and in 76/227 patients after 1 year. Hence, a substantial proportion of patients had deficits in one or more domains: on admission the range with deficits found varied from 13.7% in sensation to 59.5% in mobility; after 1 year the range with deficits varied from 20.3% in pain to 50.2% in mobility. Despite the high proportion with impairments before admission, level changes in health domains were substantially less frequent. Mean \pm sd (median) aggregated QOL was 0.78 ± 0.23 (0.92) on admission and 0.76 ± 0.24 (0.90) after 1 year. In conclusion, assessment of health status and changes therein in children is feasible, both in a descriptive and a valued manner. Despite the high proportion with health deficits before PICU admission, mean and median QOL showed no change after 1 year. This indicates that, as opposed to the situation in adults after ICU admission, generally health status in children was well preserved.

010**WHY CHILDREN SHOULD BE ADMITTED TO A PEDIATRIC ICU**

Professor Frank Shann

Direct evidence that child mortality is lower in specialist pediatric ICUs comes from 3 studies. A study in Oregon (CCM 1981;19:150-9) found that mortality adjusted for severity of illness was 102% of expected in 3 pediatric units and 139% of expected in 71 general units ($p < 0.05$). A study in Holland (CCM 1995;23:238-45) found that mortality in high risk patients was 85% of expected in 6 tertiary pediatric units, and 143% of expected in 4 nontertiary units ($p < 0.05$). A third unpublished study, has found that children in Victoria (who almost all receive intensive care in a pediatric ICU) have a much lower standardised mortality rate than children in the Trent region of the UK (where many children receive intensive care in adult ICUs).

There is indirect evidence that ICUs looking after many children are likely, on average, to perform better than ICUs looking after few children: numerous studies in many specialities have found that units looking after many cases of a particular disease have better results than units with few cases. See Luft HS, "Hospital Volume, Physician Volume, and Patient Outcomes", HAPP, 1990; and Farley D, Medical Care 1992;30:77-94.

Compared to general ICUs, medical and nursing staff in pediatric ICUs are likely to be better at looking after children, and PICU RMOs have greater skills in pediatric intubation, ventilation, IV drip insertion and drug doses. PICUs are more likely to have appropriate equipment to manage children - especially for uncommon but life-threatening situations. ICUs in pediatric hospitals are more likely to have physicians and surgeons with pediatric expertise available for consultation at all times.

The American Academy of Pediatrics, the Society of Critical Care Medicine, the British Paediatric Association and the Australian NH&MRC have all said that children should receive intensive care in specialist pediatric units. The weight of authoritative opinion, and direct and indirect evidence is strongly in favour of looking after children in dedicated pediatric ICUs.

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Neuroscience

011

MODIFIED GLASGOW COMA SCORE FOR CHILDREN: RELIABILITY OF A GRIMACE SCORE

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RATIONALE: The James adaptation of the Glasgow Coma Score (JGCS) was designed for children under five years and assesses eye(E), verbal(V) and motor(M) responses corrected for the child's developmental state. We have been using the JGCS for 2 years. We have found good inter-observer agreement for the eye and motor scores but poor agreement for the verbal score suggesting different interpretations of the verbal signs between observers. We therefore developed a grimace score to complement the verbal score. We carried out a prospective study to assess whether inter-observer reliability was improved with the new grimace(G) score.

METHODS: Two JGCS observations were made, within 20 minutes, by two observers, blinded to the prior observations. The inter-observer variation was the difference between the two observations (E1-E2, V1-V2, G1-G2 and M1-M2).

RESULTS: 55 sets of observations were made in 41 children (2 days to 16 years old, 22 males) The table shows the percentage agreement between observers with the same JGCS and those within 1, 2 or 3 points.

	E1-E2	V1-V2	G1-G2	M1-M2
SAME	65.4%	38.5%	40%	52.7%
1 to -1	86.5%	46.2%	90%	87.3%
2 to -2	94.2%	76.9%	90%	90.9%
3 to -3	100%	92.3%	100%	100%
n	52	14	20	55

Over 85% of the eye, grimace and motor scores were within 1 point of agreement, compared to less than 50% for the verbal score.

CONCLUSION: Although the grimace score has not been validated for outcome, we believe that the improved inter-observer agreement may make it a useful addition to the JGCS.

012

CEREBRAL FUNCTION MONITORING IN PAEDIATRIC INTENSIVE CARE

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Continuous monitoring of cerebral activity is carried out in our unit on all admissions at risk of cerebral dysfunction. A number of monitors are commercially available and we report our experience with the CFAM2 which provides in addition to amplitude integrated EEG analysis, continuous raw EEG display and frequency distribution. Bilateral recordings are commenced as soon as possible and continued while clinically indicated. Forty one children ranging in ages from 4 weeks to 16 years were monitored for periods from 3 hours to 10 days. Diagnoses included traumatic brain injury (11), sepsis/meningitis/encephalitis (11), status epilepticus (8) and miscellaneous others (11). Results are tabulated below.

Outcome	Died	Deficit	Normal
Patients	13	12	16
<i>Status epilepticus</i>	10	4	1 *
<i>Beta activity</i>	1	8	15 *
<i>Background voltage <10 μV</i>	10	3	1 *
2 or more of above	12	2	1 *

(* χ^2 p < 0.001)

Asymmetry developed in 4 children, all of whom died. Positive predictors of good outcome included a mean background activity of >10 μV, the presence of faster frequencies (usually β) in response to sedative drugs and the absence of seizures. All monitoring is performed by the PICU staff and increasing expertise in interpretation has resulted in earlier therapeutic and diagnostic interventions.

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013

CO₂-REACTIVITY OF CEREBRAL BLOOD FLOW IN PERINATAL ASPHYXIA

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The aim of our study was to evaluate the significance of the CO₂-reactivity of cerebral blood flow (CBF) in perinatal asphyxia.

Patients: 14 ventilated neonates with severe perinatal asphyxia (gestational age 34 - 42 weeks) were enrolled into this prospective study.

Methods: CBF and CO₂-reactivity were measured by the noninvasive intravenous ¹³³Xenon method. The study was performed 18 to 123 h after birth. Two measurements were taken with a minimal PaCO₂-difference (Δ PaCO₂) of 4 mmHg. Outcome was evaluated one year after birth.

Results: Mean Δ PaCO₂ between the two measurements was 10.9 mmHg. Mean CBF₁ (at lower PaCO₂) was 24.4 (SD ±27.1), mean CBF₂ (at higher PaCO₂) 28.6 (SD ±29.6) ml/100g/min, and mean CO₂-reactivity 1.28 %/mmHg Δ PaCO₂. CO₂-reactivity correlated with lowest pH ($r = 0.6$, $p = 0.02$) but not with absolute CBF values. Δ PaCO₂, hemoglobin, hematocrit, mode of ventilation and age at measurement showed no significant correlation with CO₂-reactivity. Two patients died, one of neonatal sepsis, the other because of heart failure; neurological outcome was good in 11 patients, one had severe cerebral palsy. The patient with severe neurological deficit showed higher CBF values (125.7/115.2 ml/100g/ min.) than the 11 patients with good outcome (mean CBF₁ 17.5 SD ±8.1; CBF₂ 19.9 SD ±9.1 ml/100g/ min.).

CO₂-reactivity and lowest pH

pH	CO ₂ -reactivity
6.75	-10.0
6.80	0.5
6.85	0.8
6.90	1.5
6.95	2.0
7.00	3.0
7.05	3.5
7.10	4.0
7.15	4.5
7.20	5.0
6.75	0.0
6.85	0.0
6.95	0.0
7.05	0.0
7.15	0.0

Discussion: In asphyxia decrease of pH is due to reduced tissue oxygenation and indicates the severity of metabolic derangements. CO₂-reactivity in newborns with perinatal asphyxia correlates with the lowest pH and therefore may reflect severity of asphyxia.

014

HISTAMINE IS AN IMPORTANT MEDIATOR OF HYPOXIC-ISCHEMIC BRAIN EDEMA FORMATION IN NEWBORN PIGS

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It was previously found that histamine, a vasoactive mediator, accumulated in brain compartments (Kovács *et al.* 1995 *Neurosci Lett* 195:25), and anti-histamines prevented brain edema formation (Dux *et al.* 1987 *Neuroscience* 22:317) in asphyxiated newborn pigs. In the present study we investigated the effect of *intracarotid* histamine injection on the blood-brain barrier (BBB) permeability. Left internal carotid artery of 30 newborn pigs (4-8 h; 1,180-1,530 g; ketamine anesthesia, 10 mg x kg⁻¹) was catheterized through the external branch and different doses of histamine (0, 10⁻⁶, 5x10⁻⁶, 10⁻⁵, 5x10⁻⁵, 10⁻⁴ M, respectively, in 6 groups of animals; n=5 in each) diluted in 1.0 ml isotonic saline was injected into the vessel through 1 min. BBB permeability was determined for a small (sodium fluorescein, SF, 376 Da) and a large (Evans blue/albumin, EBA, 67 kDa) tracer (2%, 5 mLxkg⁻¹, 30 min circulation time for both dyes) concomitantly in frontal, parietal and occipital cortex, hippocampus, and periventricular white matter both on left and right sides 1 h after the challenge. Then, *intravascular* dyes were removed by perfusion and BBB permeability for both tracers was quantified by fluorescence spectrophotometry (wavelengths for excitation and emission were 440 nm and 525 nm for SF; and 620 nm and 680 nm for EBA, respectively). Histamine injection, in doses higher than 10⁻⁶ M, significantly ($P < 0.05$; Kruskal-Wallis one way ANOVA on ranks followed by Dunn's test) increased BBB permeability for both tracers in each brain region. Changes in left hemisphere were more intense ($P < 0.05$) than those in right one after the doses of 5x10⁻⁶ and 10⁻⁵ M in each region. 10⁻⁴ M histamine administration induced similar edema in both sides. Increased *intracarotid* histamine levels resulted in a dose-dependent vasogenic brain edema formation. Histamine might have a pathogenetic role in neonatal hypoxic-ischemic cerebral injuries.

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015

INAPPROPRIATE ATRIAL NATRIURETIC FACTOR SECRETION IN CHILDREN WITH SEVERE BRAIN INJURY
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The sodium/water homeostasis is commonly impaired after acute cerebral damage. Recently, ANF have been isolated in brain tissue and would be implicated in such disorders. ANF plasmatic levels were analyzed in 50 children with acute neurological damage. They were evaluated through Glasgow Coma Scale modified (GCS) and classified in three groups according to age: ≤12 months; 13-48 months; and >48 months. Hemodynamic assessment were evaluated by basic monitorization and cardiovascular PSI scale component. ANF, renin and aldosterone levels were measured with RIA. Results were compared with a control group of 48 healthy children.

In control group, ANF levels were significantly higher in children younger than 12 months and levels decreased as age increased ($p<0.01$). However, this finding were not found in patients group. At each age ANF were greater in children with brain injury group than in control group ($p<0.001$), less children younger than 12 months. Renin and aldosterone levels were increased in patients group ($p<0.01$). We did not find differences in ANF, renin and aldosterone between group according to GCS, which median was 6. PSI cardiovascular score was 0/25 in 68% of the patients, maximum 7/25. No differences were found in ANF levels between patient with score 0 and those with some hemodynamic instability sign, neither hemodinamyc parameters and hormomonal levels were related. Mechanical ventilation, with or without PEEP, did not influence in hormonal levels.

In conclusion, an ANF levels increasing in patient with acute neurological damage were found without relationship with hemodynamic state, whose implications on water/sodium homeostasis must be determinated. The finding that ANF levels are similar in both healthy and patients infants may induce to consider the intracranial hypertension will be possibility that the intracranial hypertension would be able to explain the results.

016

NITRIC OXIDE SYNTHASE INHIBITION ATTENUATES CEREBRAL HYPEREMIA AND UTILIZATION OF GLUCOSE AFTER CARDIAC ARREST IN PIGLETS.

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Introduction: The cerebral hyperemic blood flow response seen after cardiac arrest and CPR may play a major role in brain dysfunction by disrupting the blood-brain barrier. L-NAME (LN) a nitric oxide synthase inhibitor, may decrease this hyperemic response and also mediate excitotoxicity to lessen brain damage after cardiac arrest (CA). **Methods:** Three groups of pentobarbital anesthetized piglets were studied. Vascular pressures, regional blood flow (spheres), and arterial blood gases, glucose and lactate were measured at baseline, 10 min after placebo (group 1, n=8) or after 3 mg/kg L-N (group 2 & 3, n=8 in each), during CPR after 8 min of CA, and again 10 and 60 min after resuscitation. L-Arginine (LA), 90 mg/kg iv then 3 mg/kg/min infusion was given just after resuscitation in group 3 to reverse the effects of L-N.

Results: LN decreased the hyperemic response after resuscitation, particularly in the brainstem. This was not associated with any change in CMRO₂. However the CMR glucose and CMR lactate levels were not increased in the LN group compared to placebo. LA reversed these effects of LN.

	Saline	L-Name	LN/L-Arg
CBF (ml/100g/min)	155 ± 39*	91 ± 14	157 ± 34*
CO (ml/min/kg)	121 ± 12*	73 ± 7	129 ± 19*
CMR _{glu} (μMol/min/100g)	350 ± 97*	83 ± 33	439 ± 217*
CMR _{lac} (μMol/min/100g)	124 ± 40*	36 ± 63	131 ± 112*
CMRO ₂ (ml/min/100g)	2.47 ± .58	1.80 ± .11	2.19 ± .18

* p < 0.05 from L-N group by 2-way ANOVA.

Conclusion: Nitric oxide synthase inhibition did not negatively affect brain blood flow during CPR. By decreasing brain hyperemia after CA, LN may be protective by averting vascular endothelial damage. The decreased CMR glucose and CMR lactate postresuscitation represents either a decreased uptake or increased release of glucose and lactate. This could be due to an alteration in barrier transport of glucose and lactate by LN or a change in glucose utilization possibly secondary to enhanced conversion of lactate to glucose in the brain.

017

FLUID RESUSCITATION IN SEVERE HEAD INJURY: RINGER'S LACTATE VERSUS HYPERTONIC SALINE

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We evaluated the effects of fluid resuscitation with Ringer's lactate compared to hypertonic saline in severely head-injured children over a 3-day period.

Material and methods: 32 children with GCS<8 were randomly assigned to receive either Ringer's lactate (group A) or hypertonic saline (group B). Routine care was standardized. Mean arterial pressure (MAP) and intracranial pressure (ICP) were monitored continuously and documented at every intervention, at least hourly. The means of every four-hour period were calculated and serum sodium levels were measured at the same time. ICP≥15mmHg was treated by a predefined sequence of interventions, and complications were documented.

Results: There was no difference with respect to age, male:female ratio, initial GCS score, survival and duration of hospital stay. Group B showed a trend of shorter time of mechanical ventilation (9.5±6.0vs.6.9±2.2days; p=0.1), and a significantly shorter stay in the ICU (11.6±6.1vs.8.0±2.4 days; p=0.04). Group A patients received less sodium (8.0±4.5 vs.11.5±5.0 mmol/kg/d, p=0.05) and more fluid on day 1 (2850±1480vs.2180±770ml/m², p=0.05) had a higher incidence of ≥2 complications (6vs.1, p=0.05) and ARDS (4vs.0, p=0.05). In both groups there was an inverse correlation between serum sodium and ICP (A: r= - 0.14, p=.02; B: r= - 0.3; p <0.001).

Conclusion: Treatment of severe head injury with hypertonic saline is superior to Ringer's lactate as shown by shorter stay in the ICU , lower intracerebral pressure with less interventions, and fewer complications.

018

COLOR DUPLEX DOPPLER IN THE DIAGNOSIS OF BRAIN DEATH

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BACKGROUND: Study the use of color duplex-doppler in the diagnosis of brain death and related with the different methods most frequently employed.

MATERIAL AND METHODS: We have studied 9 children with clinical criteria and EEG compatible with brain death. In all of them EEG, isotopic studies, intracranial and transfontanelar doppler with insonation of cerebral media left and right arteries (2 MHz electronic sectorial probe, 3 MHz convex electronic probe or 7 MHz sectorial electronic probe), and internal left and right carotid arteries doppler were realized (Ultramark 9 HDI, ATL). We have studied the presence or absence of flow (with measurement of flow speed when possible), curve morphology and resistance index in each one of the insonated arteries. The isotopic study of cerebral flow was done with HMPAO.

RESULTS: The age range was between newborn and 10 years; 3 males and 6 females. The diagnosis were: Cranial trauma four cases, and one case of the following diagnosis: Hanging, acute cerebral hemorrhage, fetal acute suffering and septic shock. All of them had criteria for brain death and the EEG didn't show any signs of electric activity in 2 subsequent determinations, with 12 hours interval. In every case the resistance indexes of the insonated arteries were > 1, and in four cases in which more than one duplex-doppler was done, high systolic peaks, absence of dyastole and decreased speed flow were found. The isotopic study revealed absence of flow in 8 cases. In one of the cases presence of flow in basal ganglia was demonstrated; in this case, the color duplex-doppler also showed flow in the basal ganglia despite a high resistance index.

CONCLUSIONS: There exists a perfect concordance between the color duplex-doppler and isotopic studies in our cases.

019

OUTCOME AFTER ACUTE BRAIN INJURY

Professor Frank Shann

In coma caused by traumatic brain injury, an indication of the likely outcome is provided by the best motor response to pain in the first 1 hours after the insult. In a study in our PICU, the proportion of children who died or had a severe disability was 100% in 35 who had no response to pain, 40% in 47 with an extensor response, 14% in 64 with a flexor response, and 1% in 61 who localized in response to pain.

The long term outcome of traumatic brain injury appears to be worse in children <4 years old. Other risk factors in traumatic brain injury are absent basal cisterns, midline shift or subdural haemorrhage on CT scan (or loss of grey-white differentiation in nontraumatic injury); or an intracranial pressure >30 mmHg despite hyperventilation, mannitol and barbiturate infusion.

Apart from brain death, there are two findings implying such a poor prognosis that consideration should be given to stopping treatment: first, after traumatic injury, the absence of any motor response to painful stimulus in the cranial nerve distribution (providing drug effects and a post-ictal state have been excluded); and second, in acute brain injury from trauma, infection, hypoxia, or ischaemia, the bilateral absence of short-latency somatosensory evoked potentials (providing brain stem haemorrhage, subdural and extradural effusions, and decompressive craniectomy have been excluded).

In children over 2 months of age, recovery from prolonged coma or a vegetative state is exceedingly rare when more than 12 months have elapsed after traumatic brain injury, and when more than 3 months have elapsed after nontraumatic injury.

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Sepsis

020

GASTRIC TONOMETRY AND CARDIAC FUNCTION IN CHILDREN WITH MENINGOCOCCAL DISEASE

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Introduction The pathophysiology underlying cardiovascular collapse in meningococcal septicemia is uncertain.

Aims and Methods Children admitted to PICU with a diagnosis of Meningococcal infection were studied with echocardiography (fractional shortening, FS), gastric tonometry (pHi) and blood lactate determination. Results 19 of 24 children admitted to the ICU with severe meningococcal sepsis were studied on admission. Of these, 7 had a Glasgow Meningococcal Prognostic Score (GMPS) of less than 8, and 12 children were more severely ill with a score of 8 or more. The three children that died all had a GMPS ≥ 8.

Admission values (median and range)

	Lactate (mmol/L)	pHi	FS (%)
Overall	2 (0.8 - 12) N = 17	7.32 (7.03 - 7.43) N = 13	36 (21 - 49) N = 19
GMPS < 8	2 (0.8 - 3.8) N = 5	7.35 (7.33 - 7.43) N = 5 *	36 (26 - 40) N = 7
GMPS ≥ 8	2.1 (0.8 - 12) N = 12	7.27 (7.03 - 7.43) N = 8 *	35 (21 - 49) N = 12
Nonsurvivors	3.5, 8, 12 (individual values)	7.06, 7.22	29, 26, 31

* p < 0.05 by MannWhitney Test

The FS is given by FS = 100 * (LVEDd - LVESd) / LVEDd

Conclusions There is no difference in lactate or FS between the groups stratified by GMPS. The pHi was lower in the more severely ill group. Nonsurvivors tended to have more extreme values of all variables on admission.

021

HYPOKALAEMIA IN MENINGOCOCCAL DISEASE

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Background: Disturbances in potassium metabolism causing hyperkalaemia are commonly seen in conditions causing metabolic acidosis and renal dysfunction. This may lead to severe cardiac dysfunction and may contribute to the disturbance in cardiac output seen in septic shock. However, in our experience of children with acute meningococcal disease (MD), rather than hyperkalaemia, we have most commonly observed hypokalaemia requiring aggressive potassium replacement in the presence of metabolic acidosis and oliguria.

Aim: In order to study this more formally, we have carried out a retrospective review of the incidence, severity and duration of hypokalaemia in relation to acid base status in the acute phase of MD.

Patients & methods: Serum potassium and acid-base status measurements in the first 48 hours of presentation were analysed in 100 critically ill children suffering from MD and referred to the PICU.

Results: Hypokalaemia (≤ 3.5 mmol/l) was observed in 39 (39 %) patients on presentation. The median (range) serum potassium on presentation was 3.7 (2.1 - 6.1) mmol/l. The median (range) base deficit (BD) in these 39 patients was -7.7 (0.8 to -14.3) mmol/l. 27 of these 34 patients (79 %) had evidence of metabolic acidosis ($BD < -2.0$ mmol/l). Hypokalaemia was observed in 87 (87 %) patients in the first 48 hours despite aggressive treatment with parenteral potassium replacements. The median (range) lowest serum potassium in the first 48 hours was 3.0 (2.1 - 6.1) mmol/l. The median (range) base deficit (BD) in these 87 patients was -4.7 (8 to -22.4) mmol/l. 54 of these 87 patients (62 %) had evidence of metabolic acidosis. The median (range) duration of hypokalaemia in the first 48 hours was 13 (0 - 48) hours.

Conclusions: In MD, hypokalaemia needing replacement is present in 39 % of patients on admission and in 87 % of patients at some point during the first 48 hours, frequently in the presence of metabolic acidosis. Aggressive correction of hypokalaemia in the acute phase may lead to a decrease in the morbidity and mortality of severe MD. The distribution of potassium in MD needs further study.

022

Plasma Nitric Oxide and Severity of Meningococcal Sepsis.

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Overproduction of nitric oxide (NO) via an inducible isoform of NO synthase (iNOS) produces profound vasodilatation in adult septic shock. High nitrate levels have been reported in hypotensive children with sepsis syndrome¹. Cardiovascular collapse is a prominent feature of severe meningococcal disease (MCD). However, systemic vascular resistance (SVR) was slightly higher in a group of non-survivors² and the role of NO in MCD remains unclear.

Children with a presumptive diagnosis of MCD were enrolled. Parental consent was obtained. Blood was drawn on admission and 12hrly thereafter. Plasma was separated immediately and stored at -80°C. The final concentrations reported represent the product of nitrite and nitrate (NOx). NOx was measured spectrophotometrically using the Greiss reaction.

21 children were studied (median age (range); 27m (5-203)). The diagnosis of MCD was confirmed in 18 children, 12 of whom had a Glasgow Meningococcal Score (GMS) of ≥8. In this group with severe MCD there were 3 deaths. Peak NOx was significantly higher (54(27-78)vs 96(50-363)nmol/ml, median) and systolic blood pressure was significantly lower in children with severe MCD than mild MCD ($p<0.05$, Wilcoxon rank test). There was a significant correlation between peak NOx and GMS (Spearman's rank correlation $r=0.6$ ($p=0.01$)) and PRISM ($r=0.6$ ($p=0.01$)). NOx production from admission onwards was also higher in the severe MCD group ($p=0.002$, Kruskal-Wallis).

We have demonstrated that plasma NOx levels are elevated in children with MCD, correlate directly with the severity of disease and are inversely related to systolic blood pressure. Similar to hypotensive septic syndrome, MCD appears to be associated with an up-regulation of the L-arginine-NO pathway.. Non-survivors with MCD have higher SVRs and may be relatively hypovolaemic. In our group of severe MCD there was a significantly lower systolic pressure and increased NO formation. Excess iNOS expression at different stages in MCD may contribute to the pathology of the disease. The identification of agents which can boost and/or inhibit NO release may therefore represent different treatment strategies for MCD.

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023

MANAGEMENT OF SEPTIC SHOCK AND PURPURA FULMINANS USING A PROTEIN C CONCENTRATE

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Septic shock is associated with a poor outcome despite advances in management. A major cause of morbidity and mortality is the associated coagulopathy which causes purpura fulminans, gangrene and leads to multi-system failure. Reduction in circulating levels of naturally occurring anticoagulants such as Protein C (PC) has been shown to be correlated with severity and outcome in sepsis. Supplementation of PC in a baboon model of sepsis was shown to reduce fatality, and significantly improve coagulopathy and organ function.

PATIENTS: We describe the use of a PC concentrate in 5 children. 3 had meningococcal septicaemia, and 2 had other gram-negative sepsis. All had shock, purpura fulminans and documented PC deficiency.

RESULTS: All children had reduced PC levels on presentation (mean 15.6iu, range 1.3-30.7iu, normal 70-120iu). Treatment with PC, 10-50 iu/kg/6-8 hourly, was initiated within 36 hours of presentation, and continued for a mean of 5 days (range 2-9 days). Normalisation of PC level was achieved on this regimen, and dosage adjusted according to levels, until sustained normalisation or death. All children demonstrated improvement in coagulopathy as indicated by clotting times, fibrinogen and FDP levels.

2 children died and 2 required amputation. 1 child with cerebral thrombosis demonstrated improvement in neurological function. In the children who died, PC therapy was commenced more than 24 hours following presentation. The children who required amputation had PC therapy commenced within 6 hours of admission to the PICU. These children had rapid improvement of cardiovascular, coagulation and other organ function, despite a predicted mortality of >90%. However, reversal of established gangrene was impossible.

CONCLUSION: Correction of the deficiency of PC due to sepsis may improve outcome if started early in the course of disease. A randomised, controlled trial is required to assess the benefit of PC supplementation in children with purpura fulminans due to septic shock.

024

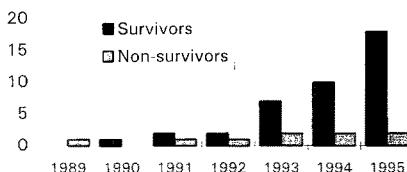
REDUCTION IN MORTALITY FROM MENINGOCOCCAL SEPSIS

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OBJECTIVE & DESIGN Prospective analysis of age, administration of penicillin, severity of illness scores, inotropic therapy, source of admission, morbidity and mortality of each case of meningococcal sepsis admitted to the PICU.

SUBJECTS Forty-nine consecutive infants and children were studied. 24 were transferred from district general hospitals and 25 were directly admitted to the PICU via the Accident & Emergency Department or the Wards in the RBHSC (Regional Referral Hospital).

RESULTS We found that there was an annual increase in the number of children admitted to the Paediatric Intensive Care Unit but that the mortality rate decreased. Of 49 admissions, 9 died (18% overall mortality) and 2 required limb amputation. There were no differences between survivors and non-survivors in respect to age, GP administration of antibiotics, PRISM scores, WBC count, platelet count, or DIC. Mortality occurred in 2 children (8%) directly admitted to the RBHSC and in 7 children (29%) referred from other hospitals.



DISCUSSION Mortality from meningococcal sepsis has decreased in the past year from 33% to 10% in children with similar PRISM and Meningococcaemia Severity Scores. This may reflect early and aggressive treatment with fluid and inotropes.

025

VARIATION IN THE TNF- α GENE PROMOTER REGION MAY BE ASSOCIATED WITH DEATH FROM MENINGOCOCCAL DISEASE

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Tumour Necrosis Factor α (TNF- α) plays a central role in the pathophysiology of meningococcal disease (MD) and other forms of sepsis. Levels of TNF- α are directly correlated with severity in MD. Increased secretion of TNF- α is likely to be a normal host response to infection. However, excessive levels of production may be associated with fulminant disease.

Control of TNF- α secretion is believed to be regulated by variable genetic elements within the major histocompatibility complex (MHC), where the TNF- α gene resides. A polymorphism that may directly influence the regulation of the TNF- α gene is located in its promoter region. There are 2 allelic forms (TNF1 and TNF2). Possession of the TNF2 allele is associated with higher constitutive and inducible levels of TNF- α than possession of the TNF1 allele. A recent study of Gambian children with malaria showed an increased prevalence of TNF2 homozygotes in children with cerebral malaria, when compared with children with malarial anaemia or controls.

AIMS, PATIENTS and METHODS: To investigate whether possession of the TNF2 allele is associated with increased severity in MD, we compared the frequency of TNF1 and TNF2 alleles, by PCR from genomic DNA, in 65 children with MD of varying severity as assessed by PRISM score.

RESULTS: There were significantly more deaths in children heterozygous for the TNF2 allele (8 of 15 deaths compared with 12 of 50 survivors, $p=0.05$, Relative risk 2.56, 95% CI 1.07 - 6.25), than in children without the TNF2 allele. There was no increase in severity in children homozygous for the TNF2 allele, but the numbers were small (3/65).

CONCLUSION: Possession of the TNF2 allele may predispose to a worse outcome in children with MD. This is the first study which confirms that host factors which may influence level of secretion of TNF- α may be implicated in severity of MD.

026

GRANULOCYTE-COLONY STIMULATING FACTOR IN THE EARLY DIAGNOSIS OF SEPSIS

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Background: Early diagnosis of sepsis is impeded by unspecific clinical and laboratory findings. Although bacteria rapidly activate neutrophile granulocytes, leucocyte counts are of limited diagnostic value. Granulocyte-colony stimulating factor (G-CSF) plays an important role in neutrophile activation. We tested the diagnostic properties of G-CSF determinations in septic episodes at intention to treat.

Methods: Prospective inception cohort study in a neonatal and pediatric intensive care unit in a tertiary pediatric teaching hospital. 146 episodes of suspected sepsis were included. Each episode was stratified for severity of illness and likelihood of bacterial infection (documented, likely, localised, unlikely). Severity was assessed as SIRS/sepsis, severe SIRS/sepsis, shock or multiple organ failure. 20 critically ill patients without SIRS and 58 patients with absent bacterial infection but systemic inflammatory response syndrome (SIRS) of comparable severity of illness served as controls.

Results: In 104 of 224 episodes patients progressed to severe illness (severe SIRS/sepsis n= 51, shock n= 40, multiple organ failure n=13). In the remainder episodes resolved after moderate illness. Bacterial infection was documented in 63 and was likely in 29 episodes. G-CSF levels above 750 pg/ml (normal \leq 30 pg/ml) identified patients with likely or documented bacterial infection and with severe illness with a sensitivity of 83.6% (95% CI 73.96-93.4%) and specificity of 90.9% (95% CI 85.5-96.3%). With G-CSF > 750 pg/ml likelihood ratio for systemic bacterial infection and severe illness was 9.2 (95% CI 5.0-16.8). Positive predictive value was 85%, negative predictive value 88%. G-CSF values >1500 pg/ml practically proved sepsis (likelihood ratio 19.4, 95% CI 7.3-51.6). At intention to treat diagnostic potential of G-CSF measurements exceeded that of interleukin-6, leucocyte studies and C-reactive protein.

Conclusions: In critically ill neonates and children G-CSF determinations identify patients with bacterial sepsis and severe illness more precisely than other laboratory parameters.

027

DENGUE SHOCK SYNDROME IN A PAEDIATRIC INTENSIVE CARE UNIT

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Dengue Hemorrhagic Fever, which is a major public health problem in Southeast Asia and the Western Pacific region, is a contagious disease, caused by Dengue viruses, characterized by specific clinical manifestation like sudden onset of high fever along with hemorrhagic evidence with a tendency towards shock and ultimately to death. The main pathophysiology of Dengue Hemorrhagic Fever are vasculopathy, thrombopathy, coagulopathy and humoral and cellular immunologic changes which caused leakage of plasma and abnormal homeostasis, leading to hypovolemic shock and/or haemorrhages.

There are four grades of severity in the clinical manifestation of the disease, from mild to the most severe. The severe form of Dengue Hemorrhagic Fever which is called Dengue Shock Syndrome with or without bleeding usually needs special management in the Intensive Care Unit.

From January until December 1995, there were 563 cases of Dengue Hemorrhagic Fever in "Harapan Kita" Children's and Maternity Hospital, Jakarta, among which 140 cases (24.86 %) were treated in Paediatric Intensive Care Unit (PICU). Problems of interest were haemodynamic, respiratory, neurologic, multiple organ failure, nosocomial infection etc. There were 25 (17 %) deaths due to one or more problems mentioned above. Our present PICU management along with the result will be fully discussed.

Pulmonary

028

EARLY VERSUS LATE DEXAMETHASONE TREATMENT IN PREMATURE INFANTS WITH HIGH RISK FOR CHRONIC LUNG DISEASE

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In this controlled, prospective study 30 ventilated premature infants with a birth weight ≤ 1250 g were randomized to receive treatment with dexamethasone (DEX) either on day 7 of life or on day 14 of life. DEX was given over 16 days tapering from 0.5 mg/kg/day to 0.1 mg/kg/day.

The infants treated with DEX on day 7 of life could be weaned earlier from the ventilator - in median after 14 days (range 10 - 34) versus 24 days (range 8 - 44) in the late treatment group ($p = 0.01$). The need for supplemental oxygen was shorter in the early treatment group - in median 24 days (range 10 - 50) versus 40 days (range 10 - 70) ($p = 0.2$, ns). The incidence of chronic lung disease was lower in the early treatment group - 6 of 14 infants (42.9%) versus 10 of 16 patients (62.5%) (ns).

To evaluate the long-term efficacy of early DEX treatment we performed a respiratory function test in the age of 3 - 6 months using an infant whole body-plethysmograph. The intrathoracic gas volume (ITGV), the airway resistance (R_{aw}) and the airway conductance (G_{aw}) were measured and no significant differences could be detected between the groups.

The frequency of adverse effects due to DEX therapy was found to be without significant differences between the early and the late treatment group.

We conclude that early DEX treatment had short-term improvements in pulmonary outcome in our study population, long-term efficacy however, remained unproven.

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029

OXIDATIVE STRESS AND ANTIOXIDANTS IN CHRONIC LUNG DISEASE OF PREMATURITY

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Several factors contribute to the development of chronic lung disease (CLD) in premature infants including structural immaturity of the lung, mechanical ventilation, and oxidative stress. Reactive oxygen species are formed during normal cellular metabolism but they are generated in higher concentrations during inflammation or inhalation of high oxygen concentrations.

To study the relationship between increased oxidative stress, antioxidants and the development of CLD we examined 102 ventilated premature infants with birth weights below 1500g. 32 infants developed severe chronic lung disease of prematurity (CLD), defined by radiological signs of CLD and an increased oxygen requirement at a postconceptional age of 36 weeks, and 29 infants had moderate CLD with an increased oxygen requirement on day 28 but not at an age of 36 weeks. Ventilator settings (FiO₂, peak inspiratory and mean airway pressure) and the incidence of early-onset-sepsis were significantly higher in the severe CLD group than in infants with moderate CLD or without CLD ($n=41$) during the first week of life. Plasma concentrations of the two antioxidant substances bilirubin and uric acid (UA) were comparable in all groups during the first days of life. However, on day seven bilirubin and UA were significantly decreased in the plasma of infants with severe and moderate CLD compared to the non CLD group ($p<0.001$). There was no difference between both CLD groups.

In serially obtained tracheal aspirate fluids (TAF) malondialdehyde (MDA) was measured by HPLC as an indicator of lipid peroxidation reflecting oxygen injury of the lung. UA was found in higher concentrations in TAF than bilirubin. UA has been proven to be a potent antioxidant, capable to react especially with hydroxyl radicals and hydrochlorous acid, which play an important role in the induction of lipid peroxidation. Infants with severe CLD had significantly higher MDA/UA ratios in TAF from day 5 to 14 compared to the non-CLD group ($p<0.01$). MDA/UA ratios in TAF of infants with moderate CLD were significantly higher from day 7 on but still lower than in the severe CLD group. In addition, the ratio oxidized / reduced glutathione was significantly increased in TAF of infants with CLD compared to infants without CLD between day 5 and 14.

The data support the hypothesis that an imbalance of oxidative stress and antioxidant defense contributes to the onset of CLD at the end of the first week of life.

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030

ROCURONIUM USE IN CRITICALLY ILL CHILDREN

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Introduction. Rocuronium bromide (Roc), a neuromuscular blocking agent with an onset time close to that of succinylcholine^{1,2}, has been studied in American Society of Anesthesiologists' Physical Status (ASA) I or II pediatric patients under non-critical elective conditions. There is a paucity of studies looking at the pharmacodynamics of Roc under emergent conditions, involving pediatric patients who are ASA III or IV, without the use of adjuvant inhaled anesthetics³.

Methods. With approval of our Committee on Clinical Investigations (IRB), Roc 1.2 mg/kg was administered to 15 ASA III/IV pediatric intensive care patients (age 40 days to 23 months; M:F=8:7) on intravenous sedation. The time to reach 25% and 10% of baseline tetanic stimulus response was recorded using a Relaxograph NMT-100 nerve stimulator/recorder (Datex, Helsinki). Depth of clinical relaxation at the 25% level was recorded.

Results. The time from rapid bolus to 25% was 25.4 ± 12.6 sec with a range of 10-50 sec; and to 10% was 30.1 ± 17.6 sec, with a range of 10-69 sec. At the 25% level, excellent clinical relaxation was seen.

Conclusion. In critically ill children, use of Roc at 1.2 mg/kg produces rapid onset of neuromuscular blockade and excellent clinical relaxation, such that Roc should be considered for rapid sequence intubation.

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031

COMPUTED TOMOGRAPHY OF THE CHEST IN MECHANICALLY VENTILATED CHILDREN

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Computed tomography of the chest (CT) in mechanically ventilated adults can detect intrathoracic pathology not appreciated on chest radiographs (CXR) and influence intensive care management. No such data exists for ventilated children.

AIMS: 1) To assess if CT provides additional information over CXR regarding extent and nature of intrathoracic disease in ventilated children. 2) To determine whether such information alters clinical management.

INCLUSION CRITERIA : 10 ventilated children with CXR changes inconsistent with their respiratory status underwent CT if either a) PaO₂:FiO₂ ratio <30 and/or mean Paw>15 cm H₂O or b) there was an unexplained increase in ventilatory requirement.

METHODS : High resolution CT was performed in 3 patients and spiral CT in 7 patients. To ensure minimal transport related morbidity, patients were transferred to the CT scanner by a specialised mobile intensive care team.

RESULTS: In 2/10 patients CT demonstrated greater extent of disease than appreciated on CXR but did not significantly alter clinical management. In 7/10 patients CT provided additional information regarding the nature of disease present. In 2/7 children this involved a further diagnosis and in 5/7 children the exclusion of a suspected pathology.

New information led to a positive therapeutic intervention in 2 children, prevented inappropriate manoeuvres in 3, and had no significant effect on acute management in 2 children.

CONCLUSIONS: Initial data suggests that in a selected group of mechanically ventilated children chest CT can add to the sensitivity and specificity of intrathoracic diagnosis provided by the chest radiograph and directly influence acute management.
Case selection criteria and choice of the most appropriate protocol requires further study.

032

PRESSURE CONTROL VENTILATION INCREASES DYNAMIC COMPLIANCE AND DECREASES PEAK INSPIRATORY PRESSURE IN INFANTS AND CHILDREN *Ira M. Cheifetz, MD; Jon N. Meliones, MD; Barbara G. Wilson, RRT; Frank H. Kern, MD; William J. Greeley, MD. Duke University Medical Center, Division of Pediatric Critical Care Medicine, Box 3046, Durham, NC 27710 USA*

Introduction: Pressure control ventilation (PCV) utilizes a decelerating flow pattern which may improve gas distribution and lead to alveolar recruitment. In contrast, volume control ventilation (VCV) employs a constant flow. In children, the effects of PCV as compared to VCV are unclear. The purpose of this study was to determine how these two modes compare in terms of dynamic compliance (C_{dyn}), peak inspiratory pressure (PIP), and mean airway pressure (Paw) at equivalent minute ventilation.

Methods: Sixteen infants and pediatric patients ranging in age from 1 day to 13 years were studied. Diagnoses included ARDS (6), postoperative cardiac surgery (7), head trauma (1), and restrictive lung disease (2). Patients were randomized to PCV (9) or VCV (7). Initial measurements of gas exchange (ABG's) and respiratory mechanics (Ventrak, Novametrics Medical Systems) were obtained after a 20 minute stabilization period. Respiratory mechanics included PIP, PEEP, Paw, delivered tidal volume, and C_{dyn} (Δvolume/Δpressure). The patients were then crossed over to the alternate mode of ventilation holding delivered tidal volume, PEEP, inspiratory time, minute ventilation, and FiO_2 constant. Data were collected after 20 minutes. In each mode the absence of intrinsic PEEP was confirmed. To assure that the measurements were not affected by changes in clinical status, the patients were returned to the initial mode of ventilation and measurements repeated (Final). Patients were ventilated with a Siemens 900C or SV300.

Results: Data were analyzed using 2-way analysis of variance with repeated measures. (mean ± sem; * = p<0.05 vs. VCV)

	VCV	PCV	Initial	Final
C_{dyn}	3.5±0.7	4.3±0.8 *	3.7±0.6	3.9±0.7
PIP	32±1.0	30±1.0 *	31±1.0	31±1.0
Paw	9.2±0.6	10.9±0.7 *	9.7±0.7	10.0±0.8
PaO ₂	97±14	92±10	87±9	97±14

Discussion: At the same minute ventilation, the decelerating flow pattern of PCV resulted in a 23% increase in C_{dyn} and an 18% increase in Paw while decreasing PIP by 6%. The lack of a significant change in oxygenation may be a result of the limited time in each ventilator mode as well as the inclusion of patients with both normal and abnormal lungs. There was no significant difference in initial and final measurements indicating patient stability.

The beneficial effects of increasing C_{dyn} and Paw while decreasing PIP indicate that PCV may be a preferable mode of ventilation in patients with lung injury. Further randomized studies examining the effect of PCV on respiratory outcome measures in pediatrics are indicated.

033

NASAL HIGH FREQUENCY OSCILLATION AND NASAL CONTINUOUS POSITIVE AIRWAY PRESSURE FOR RESPIRATORY INSUFFICIENCY IN NEWBORN INFANTS

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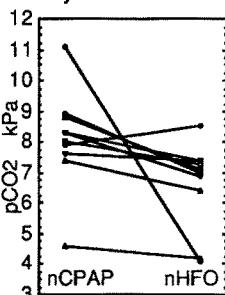
OBJECTIVE: to evaluate the effect of nasal high frequency oscillation (nHFO) during nasal continuous positive airway pressure (nCPAP) in newborn infants with moderate respiratory insufficiency we performed a non controlled observational study.

PATIENTS AND METHODS:

10 patients (gestational age 25-37 weeks, birth weight 570-3100 gram, age 4 hrs - 21 days) were treated with nHFO. We used an Infant Star ventilator, initial setting mean airway pressure 4-8 cm H2O and amplitude ΔP 35-45 mm H2O. A tube with an inner diameter 2.5-3.0 mm was placed nasally at a depth of 3 cm. Indications for nHFO were clinical signs of respiratory distress, increasing oxygen need and/or CO₂ retention during prior nCPAP.

RESULTS: In 9 patients we observed a decline in pCO₂ within 2,5 hours (Wilcoxon, p=0,013; figure). There was no effect on oxygen need, heart rate or blood pressure.

CONCLUSION: nHFO reduces pCO₂ in selected newborn infants with moderate respiratory insufficiency. A randomized study should be done to determine the exact value of nHFO.



034

CONTINUOUS NEGATIVE EXTRATHORACIC PRESSURE (CNEP) FOR POSTOPERATIVE MANAGEMENT OF CONGENITAL DIAPHRAGMATIC HERNIA (CDH).

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Prolonged positive pressure ventilation following repair of CDH is associated with a high prevalence of iatrogenic lung injury. In our unit during 1981-1990 3/4 late deaths after repair of CDH were due to chronic lung disease.

Since 1990 babies requiring assisted ventilation for more than 7 days following surgery were transferred to a CNEP chamber to limit lung injury. CNEP of -6cm of H₂O was combined with positive pressure ventilation via an endotracheal tube during the transition phase. Immediate reduction of peak inspiratory and positive end pressures were possible and following extubation respiratory support was maintained by CNEP with appropriate inspired oxygen.

Overall outcome:

	1981-1990 n=68	1990-1995 n=40
Deaths before surgery (%)	11 (16.2)	3 (7.5)
Postoperative Deaths (%)	12/57 (21)	1/37 (2.7)*
Postoperative Survival (%)	45/57 (78.9)	36/37 (97.3)
Overall Survival (%)	45/68 (66.2)	36/40 (90.0)

Ventilatory support after Surgery:

Ventilation	1981-1990 n=57		1990-1995 n=37	
	< 7 days	> 7 days	< 7 days	> 7 days
Died (%)	8 (14)	4 (7)	0	1* (2.7)
Survived (%)	35 (61)	10 (17.5)	20 (54)	16 (43)
CNEP	0	0	0	11/16

* Referred for ECMO

During 1990-1995 11/16 who were ventilated for more than 7 days received CNEP and there were no deaths and no chronic lung disease in that group.

CNEP assisted ventilation may be an important management option for babies who require prolonged respiratory support to avoid the adverse effects of chronic positive pressure ventilation.

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035

Perfluorocarbon Associated Gas Exchange (PAGE) - Middle European Experience in Human Babies

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Introduction So far 2 modes of liquid ventilation (LV) have been used in experimental animals and, exceptionally, in humans: 1. total liquid ventilation (TLV)-functional residual capacity (FRC) is filled by perfluorocarbons (PFC), and slow tidal volume (Tv) breathing is performed by PFC. 2. partial liquid ventilation (PAGE) - only FRC is filled by PFC. Gas Tv is delivered by conventional mechanical ventilation (CMV), high frequency jet ventilation (HFJV) or high frequency oscillation (HFO). The aim of our study is to present our limited experience with PAGE in newborns and infants.

Methods PAGE was used in two groups of infants: 1. in 2 infants with brain death before disconnection from CMV, because recipients for organ transplantation were not available. These infants have relatively normal lungs (FiO_2 less than 0.4). Infants stayed on PAGE for 1 hour, during that period no ventilator manipulations were made. After PAGE, infant were switched to CMV for next 6 hours. 2. very critically diseased infants with ARDS (RDS) - 2 on ECMO more than 5 days, 1 before cannulation for ECMO, 4 on HFO because of intractable respiratory failure. Preoxygenated RM 101 (Mitenti, Italy) was used in the doses up to 40 ml/kg intratracheally. Blood gases and parameters of pulmonary mechanics were followed (dynamic compliance - C_{dyn} , airway resistance - Raw, Bicore monitor). PAGE was combined with NO inhalation (5-80 p.p.m. in 2 infants). In both groups ad hoc an approval from a local ethical commission and informed parental consent were obtained.

Results In the first group with relatively normal lung parameters of oxygenation drops after PFC instillation intratracheally and stayed depressed for 4-6 hours. Slight pCO₂ retention occurred in both cases during PAGE. C_{dyn} increased almost double during PAGE period, Raw drops transitorily after PFC instillation but in 10 minutes they were identical like in prePAGE period. Parameters of oxygenation (PaO₂/FiO₂) after 4-6 hours after PAGE improved and were better than in prePAGE period. After that time infants were disconnected and died. In the second group no improvement of oxygenation was seen in one ECMO baby, in spite of transient improvement of C_{dyn} . In the second ECMO baby, oxygenation improved and flow of pump could be decreased by more than 20%. None of these babies, however, survived, improvement was only transient in spite of repeated doses of PFC. In these babies serious problems were to maintain the adequate FRC by liquid, because of severe air leak. In 5 babies on HFO/HFJV with severe ARDS/RDS the improvement of oxygenation were seen in all the cases immediately after PFC instillation for the period of 4-6 hours. After that period, PFC dose had to be repeated. Two babies of this group survived.

Conclusion. PAGE is going steadily from labs to clinical practice. It is simple, could be performed anywhere, cheaper than TLV. However, because Liquivent Perflubron (Aliance Pharmaceutical) is not available in Europe, RM 101 of 82 (Mitenti, Italy) is the only solution, which could be currently used here. Before the widespread use of PAGE in clinics, liquid network among most NICUs and PICUs must be built up, the criteria for PAGE must be defined and ethical-legal problems resolved as well. After resolution of these particular problems PAGE can be life saving procedure for very special part of critically ill newborns and infants.

036

THE USE OF BI-LEVEL POSITIVE AIRWAY PRESSURE (BIPAP) IN END-STAGE CYSTIC FIBROSIS PATIENTS AWAITING LUNG TRANSPLANTATION.

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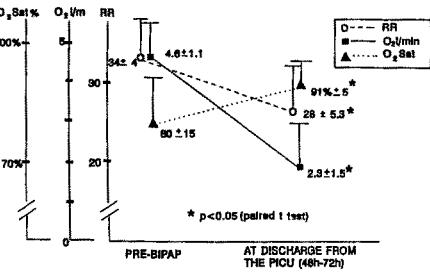
Introduction: Cystic fibrosis (CF) patients awaiting lung transplantation present a therapeutic dilemma when severe respiratory decompensation occurs. Endotracheal intubation and mechanical ventilation is known to have no long term benefits and is associated with high morbidity and mortality. Noninvasive respiratory support appears to be a beneficial alternative.

Methods: We instituted BIPAP (Respironics, Inc., Murrayville, PA) in 9 end-stage CF patients who were admitted to the Pediatric ICU with severe respiratory decompensation. All patients were awaiting lung transplantation. After a control period, BIPAP was applied via a tight fitting nasal or facial mask, using the spontaneous breathing mode. Expiratory pressures were set at 4-8 cm H₂O. Inspiratory pressures were started at 8 cm H₂O and increased in 2 cm H₂O increments until the patient's respiratory comfort was achieved and substantiated by non-invasive monitoring. Patients were instructed to use BIPAP during night sleep and whenever subjectively required. Data are reported as mean \pm S.D.

Results: All 9 patients utilized nocturnal BIPAP for 6-10 hours/day during a follow-up period of 2-19 months. Compared to their pre-BIPAP status, the patients' oxygen requirement and respiratory rate both decreased significantly ($p < 0.05$), and their arterial oxygen saturation increased significantly ($p < 0.05$) with the use of BIPAP [see figure]. All patients tolerated BIPAP without any reported discomfort. 3 patients ultimately underwent successful lung transplantation after having utilized nocturnal BIPAP for 4, 6, and 16 months.

Conclusion: BIPAP therapy improves the respiratory status of decompensating end-stage CF patients. It is well tolerated for long term use at home, and provides an extended period of respiratory comfort and stability for CF patients awaiting lung transplantation.

¹Piper AJ, et al: Chest 1992; 102(3):846-850.



Acute lung injury/Airway

037

ACUTE RESPIRATORY DISTRESS SYNDROME(ARDS): RESULTS OF A SURVEY IN GERMAN PAEDIATRIC INTENSIVE CARE UNITS

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Background Acute respiratory distress syndrome (ARDS) is a therapeutic challenge in pediatric intensive care in view of the high mortality. In 1992 about 50 German paediatric hospitals founded a working group aiming on collaborative clinical research in this field.

Aims and methods The aim of both a prospective and retrospective survey conducted in German pediatric intensive care units in 1993 was to accumulate data on the epidemiology, risk factors, natural history and treatment strategies in a large group of pediatric ARDS patients who were treated in the three year period from 1991 to 1993. All patients had acute bilateral alveolar infiltration of noncardiogenic origin and a $\text{PaO}_2/\text{FiO}_2$ ratio < 150 mmHg. The influence of sex, underlying disease and single organ failure was analyzed using the Fischer's exact test, the influence of additional organ failure on mortality was tested with the Cochran-Mantel-Haenszel statistics.

Results 112 patients were reported giving an incidence of 7 cases per 1000 admissions to pediatric ICUs. Median age was 24 month. In 43% of the cases, ARDS was associated with a pulmonary, in 39% with a systemic underlying disease. In 20% immunocompetence was impaired. Mortality was 46% and not dependent on age, sex and triggering event. The number of associated organ failures, however, strongly influenced mortality. Mortality in immuno-compromised patients was 81%.

The Analysis of treatment modalities employed in the patients revealed a lack of uniform therapeutic strategies. On the other hand, the patients were exposed to interventions not yet supported by controlled trials.

Conclusions The observation of the lack of uniform treatment strategies led to the elaboration of recommendations on ventilator therapy and patient monitoring within the working group. The data gathered in this survey provide the basis for the design of prospective multicenter studies urgently needed to evaluate innovative treatment modalities in pediatric ARDS.

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038

ARDS TRIGGERED BY RSV INFECTION IN INFANTS

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Recurrent apnea and respiratory failure due to severe lower respiratory tract disorders such as bronchiolitis or pneumonia are the most common reasons for mechanical ventilation during respiratory syncytial virus (RSV) infection. Acute respiratory distress syndrome (ARDS) has been described as a complication of severe RSV infection.¹ In contrast to the low mortality rates associated with RSV infection (<5%), mortality rates in the range of 40-70% have been reported in pediatric patients with ARDS. However, studies on ARDS are usually lumped in respect to causation and the disease course of RSV induced ARDS has not been previously studied.

We examined the lung function abnormalities of 37 infants with RSV induced respiratory failure requiring assisted ventilation. Measurements included respiratory mechanics, maximal expiratory flow-volume curves and lung volumes. ARDS was defined clinically using the criteria which were recently proposed by the American-European Consensus Conference on ARDS²: acute disease onset, $\text{PaO}_2/\text{FiO}_2$ ratio ≤ 200 mm Hg, bilateral infiltrates on chest radiograph and absence of clinical evidence of left atrial hypertension. We calculated the Murray lung injury scores modified for use in pediatric patients³ from total respiratory system compliance, radiographic findings, ventilator settings and blood gas results. We identified 10 infants with severe restrictive lung disease that fulfilled the clinical criteria for classification as ARDS. All had lung injury scores above 2.5 which is the recommended cut-off for a diagnosis of ARDS. Twenty-seven infants had obstructive disease consistent with a clinical diagnosis of bronchiolitis. The ARDS patients were significantly younger, had a longer time of assisted ventilation ($p < 0.05$) and a greater proportion of infants with preexisting illnesses ($p = 0.023$, Odds ratio = 6.67) when compared to the patients with obstructive disease. With the exception of one immunodeficient patient, none of these infants died. Given the low mortality despite a clinical picture of severe lung injury, there is evidence that RSV induced respiratory failure may represent a relatively benign cause of ARDS in pediatric patients.

¹ Bachmann DCG, et al. J. Intensive Care Med 1994; 20: 61-63

² Bernard GR et al. Am J Respir Crit Care Med 1994; 149:818-824

³ Stretton M, et al. Am Rev Respir Dis 1992; 143: A248

039

Acute Hypoxic Respiratory Failure in Paediatric Intensive Care.

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An audit of patients with severe acute hypoxic respiratory failure (AHRF) receiving high-frequency oscillatory ventilation (HFOV) in our unit (n=32, mortality 75%) revealed that sub-groups with severe underlying disease (n=14, mortality 100%) and those with multiple organ failure (≥ 2 systems failing, n=7 mortality 100%) accounted for all the deaths beyond the neonatal period. We therefore hypothesized that in a modern paediatric intensive care unit (PICU):

- a) children greater than one month of age with AHRF do not die in the absence of severe, pre-existing disease or multi-organ dysfunction syndrome,
- b) respiratory parameters alone will predict outcome poorly in AHRF.

Method Prospective study of all admissions to our tertiary PICU. Data including the respiratory parameters (oxygenation index [OI], alveolar-arterial oxygen tension gradient [A-aDO₂], $\text{PaO}_2/\text{FiO}_2$ ratio) were collected hourly from the bedside charts throughout admission. Patients were included in the study if AHRF was present at admission either alone or in combination with other organ dysfunction. AHRF was defined as the acute (<48 hour) onset of respiratory dysfunction with a $\text{PaO}_2/\text{FiO}_2$ ratio < 200 for six consecutive hours during the first 24 hours of admission (with no evidence of left atrial hypertension). X-ray review defined a sub-group of patients with Acute Respiratory Distress Syndrome (ARDS) by the presence of bilateral interstitial infiltrates.

Results To date 59 children (ages 1-168 months, weight 1.2-70 kg) have been admitted in AHRF. 18 of these also had ARDS. The overall mortality was 23.7% (14/59), and greater in the ARDS group than the non-ARDS group (10/18, 55.5% Vs, 4/41, 9.7%, p < 0.01). It was not possible to predict survivors from non-survivors on the basis of the severity of the respiratory failure alone. The A-aDO₂ on the day of admission (best in 24 hours) was not significantly different between survivors and non-survivors: (mean, \pm sd) (174 mmHg \pm 108, Vs 304 mmHg \pm 156). All non-survivors were immunodeficient (n=8), previously extremely premature infants (<28/40), (n=3) or suffering from chronic metabolic or gastrointestinal disease (n=3). No previously normal child died.

Conclusion The severity of respiratory failure does not allow prediction of outcome in our patients. We believe that this reflects that modern PICU is so effective at providing respiratory support that pre-existing pathology alone determines prognosis. This suggests that an abnormally regulated host response or abnormal persistence of a pathogen may be required to induce lung injury of sufficient severity that the resulting respiratory failure cannot be supported in a modern PICU.

040

ARDS IN CHILDREN: THE EFFECT OF CHANGING FROM PRONE TO SUPINE

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Introduction: Postural changes (supine to prone) is a therapeutic intervention that could be useful in children with adult respiratory distress syndrome.

Objective: To determine the effects of postural changes in the oxygenation of young children with ARDS.

Methods: A prospective study was performed in eleven subjects aged 6 to 120 months (mean = 33) with the diagnosis of ARDS receiving ventilatory support. (mean PEEP and FiO_2 of 9 and 0.75 respectively). Postural changes was performed every 8-12 hours, during a period of time ranging from 5 to 16 days. Arterial blood gases were determined before and 30-60 min after the postural change. No modification in the mechanical ventilation other than changes in the FiO_2 were performed. The oxygenation was determined by the index $\text{PaO}_2/\text{FiO}_2$ (P/F). To study the differences between the oxygenation mean, before and after the postural changes the Wilcoxon test for paired samples was used.

Results: 184 changes were performed (104 from supine to prone and 80 from prone to supine). A 9% increased P/F ratio was obtained after the change from supine to prone. Although, not all the patients receiving postural changes improved their P/F. Six of them (Group I) showed an improve in the P/F when changed from supine to prone, returning to their base line when positioned from prone to supine. No improvement on the P/F was observed in the remaining 5 subjects (Group II) after postural changes (Table 1). During the maneuver no complications were observed. Two patients had a pneumothorax, not related with the postural change.

Conclusions: Postural changes (supine to prone) is an easy way to improve oxygenation in some children with ARDS.

	Change to prone				Change to supine			
	P/F Supine	P/F Prone	$\Delta P/F$	P	P/F Prone	P/F Supine	$\Delta P/F$	P
All patients	98	107	9%	<0.001	104	100	-4%	ns
6 patients	81	95	18%	<0.001	94	83	-12%	<0.05
5 patients	114	120	6%	ns	116	117	-1%	ns

041**SURFACTANT APPLICATION IN CHILDREN WITH ACUTE****RESPIRATORY DISTRESS SYNDROME**

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Background: Surfactant deficiency or functional defective surfactant can often be demonstrated in acute respiratory distress syndrome (ARDS). In ARDS of adults the application of exogenous surfactant has been shown to be beneficial in initial studies, but to date, there exists no experience with respect to effect, timing and dosing in children.

Objectives: Retrospective evaluation of children with ARDS treated with exogenous surfactant in the PICU (1992 through 1995) in a single institution with regard to effect of surfactant as well as dose and timing.

Results: A total of 18 children with ARDS were treated with bovine surfactant (Alveofact®), 17 cases were evaluable in detail. The median age was 2.49 years (range 2 weeks to 11 years). In 9 cases ARDS was associated with pneumonia, in 4 cases with lung hemorrhage; in 4 case isolated ARDS following surgery. The first surfactant application was performed with a median latency of 16 days (range 2.6 to 67.5 days) after first symptoms of ARDS with a median dose of 79 mg/kg (range 18-133 mg/kg). In 17 patients 56 doses of surfactant were applied. During the hour before therapy, the median PaO₂/FiO₂-ratio was 73; the AaDO₂ averaged 571. Within 30 min. after application of exogenous surfactant the PaO₂/FiO₂-ratio increased to 113 with a successive decrease over a period of 8 hours; the AaDO₂ improved to a median of 483. Accordingly, an increase in PaO₂ and oxygen saturation and a decrease in ventilation parameters could be observed (decrease of the oxygenation index (OI) from a median of 30.5 before surfactant treatment and 18.2 within 1 hour after therapy). Six of 17 treated patients survived (7 of the 18, respectively). 13 of the 56 surfactant doses were applied in 2 surviving patients.

Conclusions: The application of exogenous surfactant in children with ARDS caused a significant improvement in oxygenation, which declined over a period of 8-12 hours. The effect could often repeatedly be reproduced, in one case after 11 applications. The increase in oxygenation often allowed the reduction of FiO₂ and/or the inspiratory pressure. No side effects were observed after exogenous surfactant application. In many cases the application of surfactant was too late after first symptoms of disease (median latency 16 days). ARDS mostly due to pneumonia seemed to respond less well to surfactant therapy.

042

ARDS and ECMO; preliminary data from a randomized clinical trial. J Fackler, C Steinhart, D Nichols, D Bohn, M Heulitt, T Green, L Martin, K Newth, M Klein, J Ware.

Many suggest ECMO be considered experimental for ARDS and undertaken only with careful data collection and reporting. A multicenter pediatric RCT is in progress to determine whether 1) ECMO and/or 2) permissive hypercapnia, offer significant advantage for the treatment of ARDS.

Methods: All patients aged 2 wk to 18 yr (without congenital heart disease) are eligible for study. Data collection begins when a patient receives at least 50% oxygen and a PEEP of 6 cm H₂O for 12 hours (stage 1). If the predicted mortality reaches 60% within 7 days (stage 2), eligible patients are asked for written consent for randomization. Patients are excluded from randomization with significant chronic lung disease, immune compromise, cardiac disease; or profound *acute* central nervous system damage. The prime outcome variable is survival. At the studies onset, 400 pts were estimated to be required so that 65 pts were randomized per arm.

Results: 131 patients are enrolled from 9 centers. Data are complete on 85. 66 patients never reached Stage 2 (i.e. 60% mortality). 47 patients improved and 19 died. Of the latter, 13 had randomization exclusion criteria even if Stage 2 was reached. 19 patients reached Stage 2. 11 had exclusions from randomization and all died. Eight patients (4 survivors) were eligible for randomization; consent was obtained in no case. Two patients received ECMO. Overall survival is 60% (51/85). In patients without randomization exclusions, survival is 77% (34/44). Morbidity in survivors (discharge - admission POPC or PCPC score ≥2) was seen in none of the 4 Stage 2 survivors and 15% (7/41) of those who reached only Stage 1.

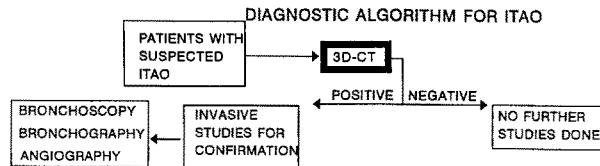
Conclusion: The RCT requires completion.

042A**THREE-DIMENSIONAL IMAGING FOLLOWING CHEST CT (3D-CT) IN THE DIAGNOSIS AND MANAGEMENT OF PEDIATRIC INTRATHORACIC AIRWAY OBSTRUCTION.**

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Introduction: The common noninvasive diagnostic efforts to identify possible obstruction of the intrathoracic airway, are of limited value. Invasive procedures such as bronchoscopy and bronchography may also be noncontributory and entail risks. We evaluated the usefulness of 3D-CT in the diagnosis and management of pediatric patients with suspected intrathoracic airway obstruction (ITAO).

Methods: We used a diagnostic algorithm (see diagram) in patients with suspected ITAO resulting in respiratory distress. Three-dimensional imaging of the tracheobronchial tree was reconstructed, following high speed spiral CT scan, by specific computer software (Advantage Window Computer Work Station, General Electric, Milwaukee, Wisconsin). Non-ionic contrast medium was injected, in some patients, to delineate the intrathoracic large vessels.



Results: Eight patients were studied. In 5 patients the 3D-CT revealed intrathoracic airway abnormalities. These patients underwent further invasive studies which confirmed the following diagnoses: 2 patients had bronchomalacia, 1 had bronchial stenosis due to a dilated pulmonary artery and 2 patients had subglottic stenosis extending to the thoracic cavity. Three patients had no significant disruption in the configuration of the tracheobronchial tree and thus did not require invasive diagnostic procedures.

Conclusion: Computer reconstruction of three dimensional images of the tracheobronchial tree is a safe and reliable diagnostic tool for ITOA.

Cardiopulmonary resuscitation/Emergencies

043

OUTCOME OF IN-HOSPITAL PEDIATRIC CARDIAC ARREST

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The records of hospital in-patients at King Faisal Specialist Hospital and Research Center who received external cardiac massage as part of their cardiopulmonary resuscitation were reviewed. Success of resuscitation was analyzed as (1) short term (restoration of spontaneous circulation), and (2) long term (discharge from hospital). Of 234 such patients, 171 (73.1%) survived the initial resuscitation, and 66 (28.2%) were discharged. Success of outcome was not related to age, location of patient, time of day, or rhythm at arrest, including asystole. Longer resuscitation time was associated with less chance of restoration of spontaneous circulation ($p<0.001$), but not associated with Hospital discharge rate. Results for patients with congenital heart disease were similar to those with other medical or surgical conditions. In this series, 36.7% of ward in-patients survived to discharge, compared to two other series where the results were 9% and 15%. Overall, 39.7% of patients who survived the initial resuscitation were discharged from hospital. Where resuscitation continued for more than 30 minutes, 18.9% of patients had long term survival. Outcome from asystole was no worse than for other cardiac rhythms. We believe that previous reports of poor outcome from asystole in pediatric cardiac arrest should not influence decisions to stop resuscitation for pediatric in-patients prematurely. Successful restoration of spontaneous circulation with long term survival can be achieved after prolonged resuscitation.

044

REVIEW OF 14 ADMISSIONS TO A PAEDIATRIC INTENSIVE CARE UNIT AFTER CARDIOPULMONARY ARREST

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INTRODUCTION: Cardiopulmonary arrest (CPA) in children is usually preceded by a deterioration of cardiac or respiratory function due to sepsis, dehydration and hypovolemia. Early recognition of clinical and laboratory signs followed by immediate intervention are essential for prevention of CPA. The purpose of the present study was to identify factors which contributed to high rates of mortality from CPA in patients admitted to a Paediatric Intensive Care Unit (PICU).

METHODS: A prospective study was done of all non-surgical patients with CPA who were admitted to the PICU, Hospital Baca Ortiz, Quito Ecuador from January to October 1995. Clinical and laboratory variables before and after admission to the PICU, time from hospital admission to PICU admission and the Pediatric Risk of Mortality score (PRISM) were recorded on a questionnaire designed specifically for this study.

RESULTS: Of the 70 non-surgical patients admitted to the PICU, 14 (20%) were admitted after developing CPA on the general pediatric wards. Mean age was 16 ± 19.1 months, with 13 of 14 patients under 20 months of age. Initial diagnoses upon PICU admission included meningitis (n=3), respiratory failure (n=2), congenital heart disease (n=2), severe neurological impairment (n=2), end stage neoplastic disease (n=2), hypovolaemic shock (n=1), peritonitis (n=1) and sepsis (n=1). Mean time from hospital admission to PICU admission was 16 ± 19.2 hours. The mean PRISM score upon hospital admission was 30 ± 13.7 (score > 20 = > 50% mortality). 79% (11/14) of the patients died. One of the three survivors had severe neurologic injury. Prior to PICU admission, patients experienced tachycardia (n=9), hypotension (n=8), neurological deterioration (n=8), respiratory distress (n=7), oliguria (n=5), bradycardia (n=3), metabolic acidosis (n=7), hyponatremia (n=4), hypokalemia (n=2), hypocalcemia (n=2) and severe hypoglycemia (n=2). There were serious delays from the time of development of clinical and laboratory abnormalities to the time of admission to PICU.

CONCLUSION: In the critically ill pediatric patient, rapid recognition of clinical and laboratory signs of deterioration, followed by immediate intervention, are required to prevent end stage shock and CPA. We found serious delays in intervention following development of important premonitory clinical and laboratory abnormalities in patients less than 20 months of age on the general pediatric wards, which likely contributed to the dismal 79% mortality rate. Hospitals throughout Ecuador should institute immediate improvements in clinical supervision, and provide training in paediatric advanced life support (PALS) to decrease excessively high rates of and mortality from CPA.

045

COMPARISON OF ACID BASE OF BLOOD FROM INTRASSEOUS AND CENTRAL VENOUS SITES DURING PROLONGED CARDIOPULMONARY RESUSCITATION AND DRUG INFUSIONS

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Central acidosis is well recognized as a marker of inadequate tissue perfusion and ventilation. However, obtaining central venous blood is difficult and fraught with complications in the child undergoing cardiopulmonary resuscitation. Intravenous blood may be used instead of central venous blood to judge pH and pCO₂ during short durations of cardiopulmonary resuscitation and during hemorrhagic shock. The purpose of this study is to compare the pH and pCO₂ status of intravenous and central venous during prolonged cardiopulmonary resuscitation after fluid and drug infusion. We hypothesized that there would be no difference in pH and pCO₂ values of simultaneously obtained intravenous and central venous blood samples.

Eighteen (18) piglets were mechanically ventilated and instrumented (pulmonary artery, carotid artery and intravenous cannulas). Following hypoxic cardiac arrest, ventilation and chest compression (mechanical thumper, Michigan Instruments) were resumed. During cardiopulmonary resuscitation, at 5, 10 and 15 minutes, animals received normal saline (NS, n=6), adrenaline (Adr, n=6), sodium bicarbonate (NaHCO₃, n=8), via intravenous cannula.

The table outlines mean pH, pCO₂ and r values at times specified. (p < .05 significant)

	Sampling Time	Saline IO/CV (r)	Adrenaline IO/CV (r)	NaHCO ₃ IO/CV (r)
pH	T _{xx} - baseline	7.37/7.34 (.28)	7.46/7.48 (.81)*	7.35/7.36 (.72)*
	T ₀₀ - arrest	7.17/6.99 (.51)	7.25/7.03 (.14)	7.16/7.03 (.42)
	T ₁₀ - post arrest	7.11/7.16 (.68)	7.21/7.28 (.58)	7.51/7.41 (.08)
	T ₁₅ - post arrest	7.09/7.15 (.37)	7.17/7.31 (.63)	7.60/7.50 (.15)
	T ₃₀ - post arrest	7.12/7.10 (.86)	7.16/7.23 (.20)	7.39/7.45 (.27)
pCO₂	T _{xx} - baseline	41.3/50.0 (.36)	34.2/34.6 (.79)	44.6/50.4 (.81)
	T ₀₀ - arrest	66.0/108.0 (.25)	55.3/91.6 (.27)	51.8/108.0 (.17)
	T ₁₀ - post arrest	48.9/56.6 (.58)	38.7/41.4 (.15)	102.0/68.4 (.39)
	T ₁₅ - post arrest	49.5/57.6 (.016)	33.3/34.2 (.51)	94/67.5 (.17)
	T ₃₀ - post arrest	46.1/56.7 (.85)	36.3/38.0 (.55)	112/66 (.50)

There was no correlation of pH and pCO₂ after drug infusion (adrenaline and sodium bicarbonate).

Intravenous blood may not be useful in judging pH and pCO₂ of the central circulation during prolonged cardiopulmonary resuscitation and after drug and saline infusion. Intravenous blood may be affected by sodium bicarbonate infused.

046

INCIDENCE OF FAT AND BONE MARROW EMBOLISM WITH THE USE OF INTRASSEOUS INFUSION DURING CARDIOPULMONARY RESUSCITATION

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Intravenous access is recommended by the American Heart Association and American Academy of Pediatrics as a means of rapid access to the vascular system for childhood emergencies. Bone marrow and fat embolism is a concern and has been reported post intravenous infusion in stable animals but has never been studied in animals subjected to cardiopulmonary resuscitation. We undertook this study to investigate the incidence and magnitude of fat and bone marrow embolism with the use of intravenous infusion during prolonged cardiopulmonary resuscitation and after fluid and drug infusion. We hypothesized that there will be no difference in the magnitude of fat embolism between cardiopulmonary resuscitation only and other experimental conditions.

Thirty-one (31) piglets were anesthetized, mechanically ventilated, and instrumented (carotid artery, pulmonary artery and intravenous cannulas). The animals then underwent hypoxic cardiac arrest followed by chest compressions with the mechanical thumper (Michigan Instruments) and mechanical ventilation for a minimum of 45 minutes. The animals were divided in groups: A (n=5) which had no intravenous, group B (n=6) had intravenous with no infusion, and groups C (n=6), D (n=6), E (n=8) had intravenous with infusion of adrenaline, normal saline and sodium bicarbonate. At cessation of cardiopulmonary resuscitation, representative lung samples were collected from upper and lower lobes of each lung, embedded in OCT and frozen immediately. Lung specimens were stained using Oil Red-O dye and observed for fat globules and bone marrow elements. The amount of emboli present was rated as a percentage in relationship to lung tissue, by a pathologist blinded to the experimental groups. Buffy coat specimens were collected before and at cessation of cardiopulmonary resuscitation, stained with Oil Red-O dye and observed for fat globules. Percentage of fat present were compared using analysis of variance.

Fat globules were seen in the prebronchial blood vessels and in intravascular areas throughout all lung fields. There was no difference in appearance or distribution of fat globules between groups. Quantity varied in the different groups (A) 45%, (B) 44%, (C) 30% (D) 23%, (E) 25%, but were not statistically significant ($p = .097$). Fat globules in the buffy coat were few and inconsistent with lung findings.

Fat and bone marrow emboli were present in all experimental conditions. The use of the intravenous cannula does not increase the magnitude of embolization during cardiopulmonary resuscitation. The decision to use the intravenous route should not be influenced by the risk of embolization.

047**CHARACTERISTICS OF THE CHANGES IN HAEMODYNAMICS AND BREATHING FUNCTION IN CHILDREN WITH SEVERE BLUNT ABDOMINAL TRAUMA.**

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Among 566 children with blunt abdominal trauma, treated in EMI Pirogov during the last five years, 79 children had serious disturbances of the basic vital functions, connected with the trauma, and most often with massive haemorrhage, for this reason being an object of reanimation and intensive care.

In the group of children who survived - 37, predominated the trauma of only one abdominal organ (mainly the spleen, rarely the kidneys, the intestine) and only 15 children had injuries of more than one abdominal organ. In the same group, in 15 children the abdominal trauma was combined with chest or head trauma or bone fractures.

In the group of children who died - 12, a profound combined trauma was present.

The haemodynamic parameters in all children showed a characteristically significant tachycardia along with normal or even high blood pressure, while hypotonia was present in only 6.4% of the children on the first trauma day.

Despite the fact that only 13.4% of the children had direct chest injury as well, the gas exchange was considerably disturbed - 89% of the children were hypoxicemic during the first, and 100% during the third trauma day - in 25% significant - below 8.0 kPa (60 mmHg). Together with the markable decrease in haemoglobin levels, this determines the pronounced disturbance in oxygen transport.

During the first trauma day all the children were acidotic, and a metabolic alkalosis was present during the following days.

Twelve of the children with severe combined trauma died within several hours, with the symptoms of irreversible haemorrhagic shock, or in the next 2-3 days, developing multiple organ failure.

In conclusion, the intensive therapy of children with severe abdominal and combined trauma, should take in consideration the special haemodynamical trauma answer in children, and requires dynamic monitoring of the most influenced homeostatic parameters - blood gases, acid-base metabolism, haemostasis.

048**CARBOHYDRATE INTOXICATION IN CHILDREN.**

GERBAKA B; HAKME C; AKATCHERIAN C.

Hotel-Dieu de France - Beyrouth - LEBANON.

Toxics are frequently involved in domestic accidents during childhood; among non medical products ingestion, carbohydrate poisoning is a serious injury often made possible by inadequate stocking.

Over 10 years, 43 children aged 10 years and less were examined in the emergency department of Hotel-Dieu de France Hospital for carbohydrate ingestion.

62,8% are boys; age goes from 13 months to 6 years (mean = 2,5years). Kerosene is found in 35,8% of cases; all were admitted (mean = 2,8 days).

79,1% were symptomatic on first examination but 93% of all children presented signs of gastric (58%) or respiratory (69,8%) irritation sometime during their history; 37,2% had neurological signs and 41,9% presented some fever. Leucocytosis is found in 65% of cases; 25,6% of the children received antibiotics.

Chest X Ray was abnormal in 48,8% of cases: mainly parahilar infiltrates were found.

All children survived; 76,7% with a normal course (1,9 days of hospital stay) whereas those who presented complications (severe pneumonia, coma) stayed in the hospital for 6 days (mean) with short course of assisted ventilation for two of them; long term follow up was not possible.

We found Nick's criteria for hospital admission to be of value:

- symptomatic children with normal X Ray } 6 to 8 hours monitoring
- asymptomatic children with X Ray abnormality }
- symptomatic children with X Ray abnormality: Hospital admission
- asymptomatic children with normal X Ray : no admission.

These criteria would have helped to avoid admission in 8 children and would have allowed a short 12 hours stay for 6 more.

We found chest X Ray to be mandatory in carbohydrate ingestion; other tests were not helpful, aside arterial blood gases measurement in case of respiratory involvement; we now also advocate more restriction in antibiotic use.

Prevention remains efficient and should be stressed on.

049**ADRENAL INSUFFICIENCY:A LIFE THREATENING DISEASE**

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Introduction: Endocrine emergencies, other than diabetic ketoacidosis, are uncommon causes of Pediatric Intensive Care Unit (PICU) admissions. We report our experience of children diagnosed of adrenal insufficiency (AI) admitted in the PICU, during the last four years.

Subjects: Five cases of AI requiring 7 intensive care unit admissions are presented. Four females and 1 male, with ages ranging from 11 days to 7 years. None of them had a previous systemic or endocrine diseases that could suggest AI. The initial clinical manifestations were: dehydration (5), vomits (3), abdominal pain (2), seizures (2), lethargy (2) and hyperpigmentation in the muco-genital area in a newborn male and ambiguous genitalia in a newborn female. The reason for their admission in the PICU were: shock in two subjects; three because of hyperkalemia and hyponatremia (K/Na: 5.6/123; 9/126; 7.1/134 mEq/L); and two with severe hyponatremia (Na: 117; 113 mEq/L).

Laboratory findings: severe hyponatremia (5), increased concentration of urinary sodium and chloride (4); metabolic acidosis (4); hyperkalemia (3); increased levels of urea (3) and hypoglycemia (2). In all of them, the electrolytes abnormalities did not normalize with replacement and only normalized after the administration of hydrocortisone. The AI was due to: autoimmune disease in two subjects, congenital adrenal hypoplasia, congenital adrenal hyperplasia secondary to 21 alpha hydroxylase deficiency and in one no etiology was found, at the present time.

Comments: AI is an uncommon disease in the pediatric age. An early diagnosis is crucial, as if the treatment is delayed could lead to patients death. In subjects with arterial hypotension and electrolytes abnormalities refractory to the usual treatment, they should be treated with corticosteroids, if no etiology is found. Although, previously samples must be obtained to make the diagnosis.

(): denotes the number of cases.

Transplantation/Digestive tract

050

FULMINANT LIVER FAILURE [FLF] IN CHILDREN: REPORT OF 63 CASES EVALUATED FOR ORTHOTOPIC LIVER TRANSPLANTATION

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We report our results with orthotopic liver transplantation [OLT] in children with FLF.

Patients: Between Dec 1987 and January 1996, 63 children (mean : 5.5 yr) with FLF were evaluated for OLT. The main causes were viral hepatitis (30.1 %) and toxin-induced FLF (14.2%). In 21 children (33.3%), the cause of FLF remained undetermined. Children were considered as candidates for OLT only if hepatic encephalopathy was associated with a decrease in the level of factor V to below 25 %.

Results: 12 children had no indications for OLT : all recovered. OLT was contraindicated in 7: all died. In 3 of these 7 children, contraindications included irreversible brain damage at the time of admission. 44 children were considered as candidates, 3 died awaiting a graft, 1 recovered spontaneously, 40 underwent OLT. Among them, 25 survived (62.5 %) but 2 had serious neurologic sequelae. Mortality rates in children with toxin-induced FLF, virus-induced FLF, and undetermined causes were respectively 66 %, 22 % and 30 %.

Conclusion: Emergency OLT is an effective treatment for children with FLF. However the prognosis is still serious especially in patients with toxin induced fulminant liver failure.

051

COMPARATIVE MORBIDITY AND MORTALITY FOR PEDIATRIC PATIENTS UNDERGOING REPEAT LIVER TRANSPLANTATION

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Introduction: A number of children undergo primary graft failure after liver transplantation. It is unknown if there is any increased morbidity or mortality following retransplantation. This study seeks to explore these issues.

Methods: A pediatric intensive care/liver transplant database is in formation. Records of all liver transplant patients are reviewed and abstracted. This data is then computerized to allow analysis. This data provides the source for this study. Statistical analysis was performed via Student's t-test where appropriate.

Results: Of the 350 patients who have thus far received at our center orthotopic liver transplants, the records of 112 who underwent 140 transplants form the basis for this review. Twenty-three patients underwent multiple transplants, 19 required one additional, three required 3 organs, and one patient survived after a fourth organ transplant. There was no significant difference in age at first transplant between those who received multiple organs and those who did not (40 vs. 44 months, p=NS). The anesthesia time for the procedure did not significantly increase for subsequent transplants (8.3 vs. 7.3 hours), nor did time in the intensive care unit (16.6 vs. 22.2 days), nor did time on the ventilator (8.4 vs. 15.3 days). Subsequent transplants did not predispose to having more bleeding in the intensive care unit for usage of packed red blood cells or platelets was not significantly altered (299 vs 306 ml and 127 vs 207 ml respectively). Patients who required retransplantation did receive more fresh frozen plasma (FFP)during their first transplant than in the subsequent ones (275 vs 81 cc, p < 0.05). However FFP use was not significantly different than patients who did not require retransplant. Patients who underwent retransplant had a markedly increased mortality (47%) than the overall mortality for liver transplants at our center (20%).

Conclusion: Children who require another liver transplant have a markedly increased mortality. Bleeding and prolonged ICU stay is not significantly different between the first and subsequent transplants.

052

ORTHOTOPIC LIVER TRANSPLANTATION [OLT] FOR SEVERE LIVER FAILURE [SLF] IN INFANTS YOUNGER THAN 1 YEAR OF AGE.

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Severe liver failure [SLF] is a rare but severe condition in infants. We report our experience.

Patients: SLF was defined as liver insufficiency with hepatic encephalopathy and a decrease in the level of factor V to below 25 %. Between 1984 and 1996, 29 infants (mean : 4 mo) were admitted for SLF (neonates excluded). Main causes were metabolic disorders (41.3%) (tyrosinemia n=5, hemochromatosis n=2, Reye's syndrome n=2, other n=3), virus-induced FLF (20.6%) and hematologic diseases (13.7%). In 4 cases, the causes remained undetermined.

Results: OLT was contraindicated in 12 cases because of multiple organ failure (n=10), or underlying disease. All of them died within 6 days after admission. 7 patients had no indications for OLT, all but one are alive. (1 of them was transplanted later for tyrosinemia and 1 died lately (virus induced-SLF). Among the 10 infants who underwent emergency OLT, 6 are alive and 4 died because of primary non function of the graft.

Conclusion: SLF in infants admitted before their first birthday is a severe condition with an overall mortality rate reaching 60%. Inherited metabolic disorders are the first cause of SLF at this age. Contraindications for OLT are frequent because of underlying disease or multiple organ failure.

053

FULMINANT HEPATIC FAILURE AND ORTHOTOPIC LIVER TRANSPLANTATION.Dr.Sasbón,J.Centeno,M;Entín,E;Acerenza,M;Ciocca,M;Góñi,J;Bianco,G;Weller,G;Imventarza,O. Unidad de Cuidados Intensivos.Hospital de Pediatría "Dr.J.P. Garrahan"1245.Buenos Aires.Argentina.

Introduction: Fulminant Hepatic Failure (FHF) is a clinical syndrome, defined by the development of hepatic encephalopathy within 8 weeks from onset of illness in a previously healthy person. By far, the most common cause of pediatric FHF in all series, is acute viral hepatitis. We report our experiences with the pediatric FHF and orthotopic liver transplantation (OLT) as alternative of treatment.

Patients: 30 children with FHF diagnosis were admitted at the PICU from 1/1/1993 to 1/12/1995. Symptomatic treatment was given to all children and all were put on list for OLT following the King's College criterion (Prothrombin time, age, etiologies, bilirubin, and encephalopathy state).

Results: Etiologic causes corresponded to the 30 childrens were: 23, HAV (76%); 6, NoA NoB (20%); 1, autoimmune (4%). The age was mean: 4 years (Range: 16 month-10 years). Seventeen patients were transplanted, 13 children were discarded because: no donors: 5; withdraw of the list: 3, because sepsis in 2 and bleeding of CNS 1; and no admission at list: 5 because genetic syndrome 1, massive intestinal necrosis 1, mitral valvulopathy 1 and sepsis 2. 25 patients (86%) had at least one complication during the post operative period. The most frequent was the acute renal insufficiency (ARI) and 4 patients required continuous hemofiltration. The global mortality rate was 75%. The mortality of patients without OLT was 100% and the mortality of patients with OLT was 41%, 4 patients died because sepsis, (2 candidiasis) and the others 3 because MOF. The actuarial survival at 1 year is 54% and the follow up of 8 months.

Conclusions: The FHF is a very severe and frequent disease at PICU. Supportive treatment only is associated with a very poor prognosis and high mortality rate. The most frequent etiology in our country is the HAV. The OLT is applicable in this cases and is a valid alternative of treatment (mortality in our series 41%). The ARI is the most frequent complication during the post operative period. In Argentina, due the high prevalence of HAV, prevention must be considered the main and only way to avoid this catastrophic illness.

054**GASTRIC INTRAMUCOSAL PH IN CRITICALLY ILL CHILDREN LIKE HEMODYNAMIC MONITORING**

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OBJECTIVE: To assess the efficacy of gastric intramucosal pH (pHi) for evaluation of tissue perfusion and prediction of hemodynamic complications in critically ill children.

PATIENTS AND METHODS: Thirty critically ill children (16 boys and 14 girls) whose age ranged from 3 month and 12 years old were studied. A tonometry catheter was placed in the stomach of all patients at their admission in Pediatric ICU. Intramucosal pH measures were made at the admission and each 6-12 hours during the study: a total of 202 determinations were made. The catheter was removed after extubation and/or checking of hemodynamic stability of the patient. The intramucosal pH was derived from application of the Henderson-Hasselbach formula using the pCO₂ value from the tonometer and the arterial bicarbonate. Values of pHi between 7.30 and 7.45 were considered normal. The relationship between pHi and severity of patient measured through PRISM, presence of major (cardiorespiratory arrest, shock) and minor (hypotension, hypovolemia or arrhythmias) hemodynamic complications, mortality and stay in the PICU, was analysed.

RESULTS: The admission value of pHi was 7.48 ± 0.15 (range 7.04-7.68). Five patients (16%) had an admission pHi < 7.30. No relationship was found between an admission pHi < 7.30 and a higher incidence of hemodynamic complications. Sixteen patients (53%) showed some values of pHi < 7.30 during their evolution. Patients with pHi < 7.30 had a higher number of hemodynamic complications than the rest ($p < 0.0001$). Every cardiorespiratory arrest (CRA) and shock cases were related to a pHi < 7.30. Patients with major complications (CRA and shock) had a pHi lower ($p = 0.03$), as well as a higher number of measurements of low pHi ($p = 0.003$) than patients with minor hemodynamic complications. The value of pHi lower than 7.30 presented a 90% of sensibility and 98% of specificity with regard to hemodynamic complications. There was no relationship between pHi < 7.30 and PRISM score and stay in PICU. Patients with pHi < 7.20 presented a PRISM higher than the rest of patients ($p < 0.05$).

CONCLUSIONS: The pHi value may be an early sign of presence of hemodynamic complications in the critically ill child.

055**PROGNOSTIC VALUE OF THE GASTRIC INTRAMUCOSAL pH IN MORTALITY AND MULTIORGAN FAILURE IN CRITICALLY ILL CHILDREN**

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Objectives: 1-To determine the prognostic value of the gastric intramucosal pHi in mortality and multiple organ dysfunction (SDMO) in critically ill children. 2-To compare this value, with the Pediatrics Risk Index Mortality Score (PRIMS).

Methods: A prospective study was performed with 51 critically ill children, aged from 1 month to 16 years. The admitting diagnosis was: 26 post-surgery (13 neurosurgery, 9 spinal fusion and 4 thoracic or abdominal surgery), 7 sepsis, 6 polytraumatism, 5 adult respiratory distress syndrome and 8 with miscellaneous. All the subjects were monitored on PICU admission and treated for their underlying condition. Gastric intramucosal pH was measured following the tonometric method, on admission and every 4-8 hours depending on the patients state. The severity of the clinical condition was evaluated using the PRIMS, on admission (PRIMS-1) and during the first 24 hours, when the clinical condition deteriorate, the worse score was utilized for the statistical analysis (PRIMS-2). To perform the statistical analysis the subjects were divided in two groups, one with the pHi < 7.30 and the other with pHi > 7.30. A univariate analysis (Student's t and Wilcoxon two tailed test, chi-square) and multivariate analysis were used.

Results: 12 out of the 51 subjects dyed. Of 14 children developing multiorgan failure (MOF) 9 expired. 50% of the patients admitted to the PICU with sepsis, ARDS and miscellaneous had a pHi < 7.30. In contrast, with 27% of post-surgical and none of the post-traumatism. The mortality rate, in children with a pHi < 7.30 was 47% (CI 95%; 26.16; 69.04) and 11.76% (CI 95%; 4.67; 26.62) in children with pHi > 7.30 ($p = 0.011$). MOF was observed in 41.18% of children with pHi < 7.30 v.s. 20.6% with pHi > 7.30. No relationship was observed between the pHi and the score of PRIMS-1 and 2.

Performing an unconditional logistic regression analysis, two independent variables have mortality predictive value: the pHi and the PRISM-2. (Table 1).

Conclusions: The pHi value is a better predictive value for mortality than the PRIMS score in critically ill children. A trend toward a MOF is observed in children with pHi < 7.30.

VARIABLE	Odds ratio	CI (95%)	χ^2	p
pHi	2.50	1.23; 5.05	6.54	0.01021
PRIMS 2	1.09	1.01; 1.17	5.68	0.01631

Chi-square of model $\chi^2 = 0.00039$. Hormer-Lemeshow test, $\chi^2 = 6.11$; p = 0.41054

056**GASTRIC INTRAMURAL PH AS A PREDICTOR OF SUCCESS IN WEANING PEDIATRIC PATIENTS FROM MECHANICAL VENTILATION. IBIZA E, ABENGOCHEA A, MODESTO V, ABENGOCHEA B*, ARAGO J, SANCHIS R, VARAS R, GARCIA E.**

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We tested the hypothesis that Gastric intramural pH (pHi) can be used as an early sign of failure in weaning pediatric patients because the blood flow from nonvital areas is diverted to meet the increased demands of respiratory muscles.

METHODS: 24 children (mean age (4.2±0.3) years ± SD) who were thought by their physicians to be weanable from Mechanical ventilation (M.V.). These patients were ventilated on Servo 900C ventilators, receiving ranitidine, and had intestinal tonometer (tonometrics, inc.) 60 minutes before obtaining a sample.. All children were placed on pressure support (PS) at levels judged to overcome the resistance of the endotracheal tube and ventilatory circuit (2 cm H₂O). A sample of arterial blood and a sample of tonometer were obtained during VM and weaning (PS). pHi, hemodynamic and respiratory data were recorded during VM and weaning. We did not interfere with the primary caretaker's decisions regarding extubation. Patients were considered to be successfully weaned if they were able to sustain spontaneous ventilation for more than 24 hours after extubation. Paired t-test were used to compare the values obtained during mechanical ventilation with those obtained during weaning trials. Unpaired t-test were used to compare values from the group that was successfully weaned (A=15) with those from the group that were not (B=9).

RESULTS: We did not find statistical differences in any of those variables measured during MV for patients who were successfully weaned(group A) and those who were not (group B). Gastric pHi was in group A: 7.35 ± 0.03 (VM) and 7.39 ± 0.02 (weaning); in group B: 7.40 ± 0.04 (VM) and 7.41 ± 0.02 (weaning).

DISCUSSION: Although we did not find differences in gastric pHi during VM, the group A had a lower value than group B because of the number of cardiac patients (70%) and transfusion therapy, in this group. In group B 75% of patients showed a problem in upper airway (subglottic edema, and enlarged tonsils). We found it after extubation.

CONCLUSION: 1) Gastric pHi is a good predictor of risk in critically ill patients but maybe because of the small size of the sample, in our study is not of practical value as a predictor of failure in weaning pediatric patients from VM. 2) This test is not a predictor of problems in upper airway, important etiology of failure weaning in children.

057**EFFECT OF HYPOThERMIA ON RECTAL MUCOSAL PERfusion IN INFANTS UNDERGOING CARDIOPULMONARY BYPASS**

Booker PD, Prosser DP, Franks R

After Ethics Committee approval, written, informed consent was obtained from the parents of 20 infants aged 1.4-45 wk requiring cardiopulmonary bypass (CPB). Patients with aortic coarctation were excluded from study.

Method: Following induction of anaesthesia, a laser Doppler probe (Moorsoft Instruments Ltd) was inserted 7cm into the patient's rectum, the probe's special design ensuring that the optical prism lay against the mucosa. Continuous monitoring of rectal mucosal perfusion ("flux") was continued throughout the operation. After 10 min CPB at 35°C, "steady state" readings of nasopharyngeal temperature, mean femoral arterial pressure (MAP) and flux were recorded over a further 5 min before CPB-induced core cooling to 14-24°C. Steady state was defined as a 5 min period with no change in core temperatures or MAP. Other 5 min steady state recordings were taken immediately prior to low flow, immediately prior to rewarming and after rewarming to 35°C, before initiation of any vasoactive drugs. The CPB flow rate was kept at 100 ml·kg⁻¹ min⁻¹, the PCV at 25±3%, the $P_{a}CO_2$ at 5.3±0.5 kPa and the $P_{a}O_2$ at 20±5 kPa.

Results: Initial warm and rearm MAP (both 46 mmHg) were significantly lower ($p=0.008$) than during the 2 cold CPB periods (63 & 64 mmHg). The mean cold flux before (152) and after (159) low flow were both significantly lower ($p=0.001$) than the mean initial warm CPB flux (211). The mean rearm CPB flux (127) was significantly lower than all other flux values ($p=0.001$). There were no significant correlations between MAP and flux except at the first warm CPB period ($r=0.33$, $p=0.04$).

Conclusions: Although hypothermia significantly reduces rectal mucosal perfusion, rewarming produces an even greater reduction in gut perfusion which, considering that mucosal oxygen consumption is highest during this time, may prove crucial in the postoperative development of MOF. Therapy aimed at improving gut perfusion during CPB should be directed at the rewarming period in particular.

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058

**ACUTE CLINICAL FORMS OF ENTERITIS NECROTICANS
(PIGBEL SYNDROME)**

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ABSTRACT

This work is aimed at establishing a clinical procedure for the diagnosis of Enteritis necroticans (EN), even at the communal level, and to define criteria for diagnosis able to distinguish between acute forms.

SUBJECTS AND METHOD : 100 cases admitted at the Institute for Protection of Children's Health (IPCH), having characteristic symptoms, were examined clinically, by roentgenography of the abdominal cavity, with the analysis of the blood (total protein, electrolytes, hematocrite) and cultures of intestinal fluid and faeces. Through surgical operations, the pathological lesions were observed and recorded.

RESULTS: Common epidemiological features: the average age is 6-8 years old (3-15); male/female : 1.85; In 70% of the cases, the disease occurred after a meal rich in protides. The acute toxic form accounted for 15% : severe shock appearing early, with very severe dehydration associated with profoundly decreased blood protein concentration and lowered natriemia as well. The lesions of the small intestine were expanded, all of them were necrotic. In the surgical form (20%), the predominant feature was an obstruction - peritonitis syndrome, the peritoneal fluid showed a characteristic inflammatory reaction. For the rest of cases 65% were the internal form, the shock syndrome was less severe, the abdominal distention was light and disappears gradually, the inflammatory reaction of the peritoneal fluid was not so characteristic.

CONCLUSION: The EN can be diagnosed at the communal level of care units. The changes in the peritoneal fluid are factors contributing to the accurate diagnosis and classification. Approximately half of the cases of EN can be treated at the district hospital. A specific management of shock due to the Pigbel syndrome is also well established.

Nitric oxide

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SAFETY OF INHALED NITRIC OXIDE IN PEDIATRIC PATIENTS.

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Introduction: Inhaled nitric oxide (INO) is a selective pulmonary vasodilator that is rapidly inactivated compared to intravenous vasodilators. These qualities make INO an attractive agent for the treatment of pulmonary hypertension (PHTN). The efficacy of INO has been studied in persistent fetal circulation, acute respiratory distress syndrome (ARDS), and congenital heart disease (CHD). Potential adverse effects of INO include: nitrogen dioxide (NO_2) toxicity, methemoglobinemia, and platelet dysfunction. Our objective was to evaluate the safety of INO in pediatric patients (pts).

Methods: Pediatric pts with PHTN from ARDS or CHD were studied under an established, approved protocol conforming to FDA guidelines for an investigational new drug. Informed consent was obtained for each child prior to treatment. INO was sequentially titrated from 10 parts per million (ppm) to 20, 40, 60, and 80 ppm at ten minute intervals. Parameters monitored before and during therapy included nitric oxide (NO) and NO_2 concentrations (conc.), mean arterial blood pressure (MAP), and percent methemoglobin (MHG). NO and NO_2 levels were continuously monitored using an in-line Dräger electrochemical detection device. MAP was continuously measured with an indwelling arterial catheter. MHG was measured by co-oximetry. A MHG level $\geq 5\%$ or NO_2 conc. $\geq 5\text{ ppm}$ were considered adverse effects by study criteria. Pretreatment MAP was compared to MAP at 40 and 80 ppm INO using paired t-tests. A p value < 0.05 was considered statistically significant.

Results: Thirty-two mechanically ventilated children with PHTN (16 with ARDS, 16 with CHD) were studied. Five pts. were treated following cardiopulmonary bypass. Mean age was 38.1 months (range 1 day - 201 months). Pretreatment MAP was 66.3 mmHg (range 35-98 mmHg); MAP at 40 ppm INO was 65.7 mmHg (range 36-105 mmHg; $p=0.48$); MAP at 80 ppm INO was 70 mmHg (range 46-102 mmHg (N=29); $p=0.5$). Two asymptomatic pts. had MHG levels $\geq 5\%$ while receiving continuous INO therapy at 80 ppm (1 neonate, MHG 6%; 3 year old, MHG 5.7%). No other patients had MHG levels $\geq 5\%$. Twenty-five children received continuous INO therapy with a mean duration of 105 hours (range of 6.2-661.5 hours). Clinical bleeding problems were not observed in any pts. treated with INO. NO_2 levels did not exceed 5 ppm.

Conclusion: Clinically significant adverse effects from INO were not observed, although two asymptomatic pts. had MHG levels $\geq 5\%$. No treatment for elevated MHG levels was required other than decreasing the INO conc. Methemoglobinemia is potentially a greater risk for the neonatal population because they have decreased methemoglobin reductase activity. In the acute setting, INO appears to be a safe form of therapy for pediatric pts. with PHTN from ARDS or CHD in conc. up to 80 ppm. Further investigation is needed to determine if there are any long term effects from INO therapy in pediatric pts.

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Variation of the inhaled nitric oxide concentration with the use of a continuous flow ventilator.

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Objective: To investigate the homogeneity of nitric oxide (NO) concentration in a delivery system with a continuous flow ventilator. **Design:** Bench study. **Setting:** Biomedical laboratory. **Interventions:** A nitrogen/nitric oxide (N_2/NO) gas mixture was injected at three different sites in the patient circuit: just before and just behind the humidifier, and 20 centimetres before the Y-connector. Ventilator flow (12, 15, 20 L/min), ventilator rate (40 to 110, increments of 10) and compliance of the testlung (0.36; 0.5; 1.0 ml/cm H_2O) were changed. Carbon dioxide (CO_2) instead of N_2/NO was injected at the same points in the circuit. **Measurements and main results:** A) Though the flow ratio of the N_2/NO and the ventilator gas were kept constant, the NO concentration ([NO]) raised with increasing ventilator rates. The increase in [NO] was up to 40% when the N_2/NO injection site was close to the Y-connector of the ventilator circuit. Minimal changes in [NO] were noticed when the N_2/NO was mixed to the ventilator gas before the humidifier. B) Analysis of the ventilator flow pattern showed variations at different places in the ventilator circuit. The magnitude of the flow change depended on the measurement site. The closer to the expiratory valve the highest the flow change was. The duration of the flow change was inversely proportional to the adjusted ventilator flow. C) Real time measurements of the CO_2 concentration ([CO_2]) showed variations during the respiratory cycle. These [CO_2] variations were higher when the CO_2 gas was blended closer to the Y-connector. **Conclusions:** The ventilator flow variations in relation to the fixed side flow of the N_2/NO gasmixture result in changes of the inhaled [NO] during the respiratory cycle. The NO concentration during inspiration is always higher than during expiration. This could not be detected with the available monitoring system. To ensure a constant [NO] by blending a N_2/NO gas balance in a continuous flow ventilator, the site of injection should be as close as possible to the inspiratory outlet.

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EXTRACORPOREAL CIRCULATION INCREASES NITRIC OXIDE (NO) INDUCED METHEMOGLOBINEMIA

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Methemoglobin (Met-Hb) levels were routinely measured in two prospective clinical studies on NO inhalation in 25 pediatric patients with pulmonary hypertension following heart surgery with extracorporeal circulation and in 19 pediatric and neonatal ARDS patients. The observed differences between the groups prompted an in vitro study. Red blood cells (RBC) of 20 patients sampled before and after surgery with and without extracorporeal circulation (ECC), respectively, were incubated with 32 ppm NO for 100 min. Met-Hb, ATP, and NADH/ NADPH concentrations were compared.

During therapeutic exposure NO increased Met-Hb from 0.2 ± 0.1 to $1.2 \pm 0.7\%$ in cardiac surgery patients and from 0.2 ± 0.1 to $0.5 \pm 0.4\%$ in ARDS patients ($p < 0.01$). RBC's having undergone ECC were more susceptible to Met-Hb formation ($p < 0.001$) whereas intracellular coenzymes did not differ neither between the groups (table) nor before and after NO exposure.

Table: Results of in vitro exposure to NO

	RBC in surgery with ECC		RBC in surgery without ECC	
	preoperative	postoperative	preoperative	postoperative
Met-Hb (%)	3.7 ± 1.9	7.4 ± 2.4	3.6 ± 1.6	3.6 ± 1.9
ATP (10^{-3} mol/l)	2.7 ± 1.2	2.7 ± 1.1	1.8 ± 0.4	1.7 ± 0.4
NADH/NADPH (10^{-5} mol/l)	1.0 ± 1.7	1.0 ± 1.9		

ECC predisposes to increased methemoglobinemia upon exposure to NO both in vivo and in vitro. Our data suggest a reduced activity of Met-Hb reducing enzymes rather than diminished availability of energetic substrates.

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NECROTIZING TRACHEOBRONCHITIS: A SEVERE COMPLICATION OF NITRIC OXIDE?

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Nitric oxide, a potent and selective pulmonary vasodilator, has recently been successfully used to treat pulmonary hypertension of variable etiology in infants and children. Side-effects and complications in infants are so far not well known. We describe here two cases in which prolonged (5 and 7 days respectively) high-dose (50 - 80 ppm) nitric oxide was used to treat refractory pulmonary hypertension. One patient was a newborn infant with pulmonary hypertension secondary to a large left-sided diaphragmatic hernia. Nitric oxide was begun under conventional ventilation (Babylog 8000) at 7 hours of life with a slight initial improvement in oxygenation. He was then placed on oscillation with the same nitric oxide concentration due to worsening respiratory failure. He died on 5th day of life. Monitored nitric dioxide concentration never exceeded 4 ppm. The other patient was a 3 months old infant with severe pulmonary hypertension due to a complete atrioventricular septal defect. He required high-dose nitric oxide to come off cardiopulmonary bypass after surgical repair of his heart defect. He slowly improved over the week following surgery but developed suddenly respiratory failure due to massive pulmonary hemorrhage and died. Surprisingly, a particular autopsy finding in both infants was a massive acute necrotizing tracheobronchitis.

We conclude that nitric oxide is an excellent and sometimes life-saving treatment of pulmonary hypertension in infants. Tracheobronchitis has not yet been reported as a possible complication of nitric oxide administration. We suggest that caution needs to be taken with prolonged high-dose administration and this possible complication to be looked for at autopsy.

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INHALED NITRIC OXIDE IMPROVES RV WORK LOAD BUT DOES NOT CHANGE INTRINSIC RV CONTRACTILITY IN AN ARDS MODEL WITH PERMISSIVE HYPERCAPNIA **Ira M. Cheifetz, MD**: Damian M. Craig, MS; Frank H. Kern, MD; Peter K. Smith, MD; Jon N. Meliones, MD. Duke University, Departments of Pediatrics and Surgery, Box 3046, Durham, NC 27710 USA

Introduction: Permissive hypercapnia (PH) is a beneficial strategy for patients with acute respiratory distress syndrome (ARDS) to minimize barotrauma by decreasing the peak inspiratory pressure (PIP). Hypercapnia and hypoxia cause pulmonary vasoconstriction, pulmonary artery (PA) hypertension, and, thus, an increased afterload to the right ventricle. This increased afterload may result in increased right ventricular (RV) work load and subsequent RV dysfunction. One therapeutic approach is the use of inhaled nitric oxide (iNO), a selective PA vasodilator. The objectives of this study were to test the hypothesis that in a swine model of ARDS with PH, iNO would improve RV work load and not change intrinsic RV contractility.

Methods: In 11 swine (25-35 kg), ARDS was induced by surfactant depletion. Hypercapnia was achieved by decreasing the PIP while increasing the PEEP to maintain a constant mean airway pressure. iNO was administered in concentrations of 2, 5, and 10 ppm in a random order. Pulmonary blood flow (Qpa) was determined by an ultrasonic flow probe. RV total power (TP) and stroke work (SW) were calculated by Fourier transformation of the PA pressure (Ppa) and Qpa data. Preload recruitable stroke work (PRSW), a preload and afterload independent measure of ventricular contractility, was determined by a shell-subtraction method and vena caval occlusion.¹

Results: Data are represented as mean \pm sem and compared by two-way analysis of variance with repeated measures. (* $p < 0.05$ vs. 0 ppm)

	0 ppm	2 ppm	5 ppm	10 ppm
PRSW (ergs*1000)/ml	24.6 \pm 1.6	25.2 \pm 2.4	23.3 \pm 1.8	22.9 \pm 2.5
TP (mW)	92 \pm 11	74 \pm 6 *	75 \pm 8 *	66 \pm 6 *
SW (ergs*1000)	439 \pm 45	336 \pm 28 *	377 \pm 39 *	331 \pm 31 *
Ppa (mmHg)	31.3 \pm 1.5	25.5 \pm 1.2 *	24.9 \pm 1.0 *	24.1 \pm 1.1 *
PIP (cm H ₂ O)	29.2 \pm 1.1	28.7 \pm 1.4	28.9 \pm 1.4	28.8 \pm 1.3
PaO ₂ /FiO ₂ (torr)	146 \pm 19	307 \pm 43 *	306 \pm 40 *	317 \pm 35 *
PaCO ₂ (torr)	64.5 \pm 1.8	63.3 \pm 1.2	64.2 \pm 1.4	62.0 \pm 1.3

Conclusions: iNO decreased the afterload to the right ventricle as shown by a decrease in Ppa. RV work load (TP and SW) correspondingly decreased indicating less of a stress on the ventricle. These beneficial hemodynamic effects occurred without any change in intrinsic RV contractility (PRSW). Thus, the beneficial effects of iNO are related to alterations in RV afterload and not RV systolic function. Inhaled nitric oxide may be beneficial in varying conditions where RV dysfunction is caused by increased RV afterload.

¹Feneley et al. Circ Res 1990;67:1427-1436.

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ACUTE AND LONG-TERM EFFECTS OF INHALATIONAL NITRIC OXIDE IN INFANTS AND CHILDREN WITH SEVERE RESPIRATORY FAILURE
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As in neonates, severe respiratory failure in infants and children can be aggravated by pulmonary hypertension, resulting in further deterioration of oxygenation due to increasing intrapulmonary shunting. We analysed the influence of inhalational nitric oxide (iNO) in treatment, course and outcome of severe ARDS in a pediatric population. Since 1993 20 infants and children (age: 1-107 months) with ARDS and OI > 15 (mean value: 32.5 \pm 11) underwent a trial with iNO (concentration: 3, 10, 30, 60 and 100 ppm) to prevent further respiratory failure. 11 patients had a significant improvement of their oxygenation (rise of PaO₂ > 15 mm Hg) for at least 24 hours (responders); mean best effective NO dose: 24.6 ppm. The non-responders had only a short-term improvement or iNO had no effect. In responders and non-responders there was no significant difference with regard to age, underlying disease, ARDS severity, time on mechanical ventilation, blood gases and ventilator settings before NO-trial, nor was there a different grade of pulmonary hypertension (estimated by echocardiography). The only difference was an higher OI in the group of the non-responders: 40.9 \pm 9.1 vs. 25.6 \pm 6.7, $p < 0.002$. In the group of the 11 responders there was a secondary deterioration of lung function after 1 - 6 days on iNO in 5 children (transient responders): in these patients, as well as in the group of the non-responders, alternative modalities of treatment (HFV and/or ECMO) became necessary. 6 children (30 %) died: 2 transient responders and 4 non-responders.

In infants and children with ARDS due to different underlying diseases iNO can acutely lead to a significant improvement of oxygenation in about 50 % of the cases. The right selection of patients for NO therapy and the influence of iNO on the survival rate of ARDS in childhood has to be evaluated in further studies.

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Partial Liquid Ventilation combined with Inhaled Nitric Oxide in Acute Respiratory Failure with Pulmonary Hypertension in Piglets
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Objective: To evaluate gas exchange, pulmonary mechanics and hemodynamic data during partial liquid ventilation (PLV) combined with inhaled nitric oxide (NO) in acute respiratory failure with pulmonary hypertension.

Design: Prospective, randomized, controlled study.

Setting: University research laboratory.

Subjects: Twelve piglets weighing 9 to 13 kg.

Interventions: Acute respiratory failure with pulmonary hypertension was induced by repeated lung lavages and a continuous infusion of the stable endoperoxane analogue of thromboxane. Thereafter the animals were randomly assigned either for PLV or conventional mechanical ventilation. Initially perfluorocarbon liquid (30ml/kg) was instilled into the endotracheal tube over 5 min followed by 5-10ml/kg/h. All animals were treated with different concentrations of NO (1-10-20 ppm) inhaled in random order.

Measurements and results: Continuous monitoring included ECG, CVP, MPAP, MAP, SaO₂ and SvO₂ measurements. During PLV PaO₂/FiO₂ increased significantly from 62 \pm 3.2 mmHg to 193 \pm 44 mmHg ($p < 0.01$) within 10 min, while PaO₂/FiO₂ remained constant at 61 \pm 3.3 mmHg. Qs/Qt decreased significantly from 48 \pm 4% to 25 \pm 5% ($p < 0.01$) during PLV and did not change during conventional mechanical ventilation. Static pulmonary compliance (Cstat) increased significantly from 0.48 \pm 0.02 to 0.75 \pm 0.03 ml/cmH2O/kg ($p < 0.01$) during PLV and decreased slightly from 0.58 \pm 0.08 to 0.46 \pm 0.04 ml/cmH2O/kg during conventional mechanical ventilation. The infusion of the endoperoxane analogue resulted in a sudden decrease of PaO₂/FiO₂ from 262 \pm 44 to 106 \pm 8.0 mmHg in the PLV group and from 71 \pm 7 to 52 \pm 2.0 mmHg in the control group. Inhaled NO significantly improved oxygenation in both groups (PaO₂/FiO₂: 344 \pm 38 mmHg during PLV and 196 \pm 56 mmHg during conventional mechanical ventilation). During inhalation of NO MPAP decreased significantly from 57 \pm 2 to 35 \pm 2 mmHg ($p < 0.01$) in both groups. There was no significant change in oxygenation and MPAP during inhalation of 1 and 20 ppm NO.

Conclusions: PLV significantly improves oxygenation and pulmonary compliance in acute respiratory failure. The additional application of inhaled NO further improves oxygenation and pulmonary hemodynamics when acute respiratory failure is associated with severe pulmonary hypertension. Inhaled NO is very effective in improving oxygenation and pulmonary blood flow even at low doses.

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Inhaled Nitric Oxide in the Postoperative Management of Children with Fontan-like Operations

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Purpose: After Fontan procedure cardiac output is critically dependent on the pulmonary vascular resistance. Even minor elevations of the pulmonary vascular resistance may significantly decrease cardiac output. Inhaled NO is an effective, selective pulmonary vasodilator in experimental and clinical situations of pulmonary hypertension. The aim of this study is to evaluate the effects of inhaled NO on oxygenation and pulmonary circulation in children after a bidirectional Glenn-anastomosis (n=4) or a Fontan-like operation (n=9).

Material and methods: From June 1993 to January 1996 13 children with a mean age of 7.1 \pm 2.1 (SEM) yrs and a mean body weight of 24.3 \pm 5.8 (SEM) kg were treated with inhaled NO after Glenn- or Fontan-like operations. All but one had complex cardiac malformations with single ventricle. All children were mechanically ventilated with an FiO₂ > 0.75. Inhaled (NO) was applied using a microprocessor based system which additionally allowed measurement of NO/NO_x using the chemiluminescence method. Methemoglobin concentrations were determined 3 times a day. The major indication for postoperative inhalation of NO was a high (>10 mmHg) transpulmonary pressure gradient (TPG=CVP-LAP). Severe myocardial dysfunction of the single ventricle was excluded by echocardiography.

Results: The mean duration of mechanical ventilation was 8.1 \pm 2.2 (SEM) days. The mean dose of inhaled NO was 4.4 \pm 0.8 (SEM) ppm, the mean duration of NO-inhalation was 106 \pm 19 (SEM) hours. The mean methemoglobin concentration was 1.2 \pm 0.2 (SEM)%. Hemodynamic data and arterial oxygen saturation before inhaling NO and 15 minutes later are given in Table 1.

	pre-NO	NO-inhalation	p
SaO ₂ (%)	86 \pm 1	94 \pm 1	0.01
MAP(mmHg)	59 \pm 4	65 \pm 14	0.01
CVP(mmHg)	21 \pm 1	18 \pm 1	0.01
LAP(mmHg)	8 \pm 1	9.7 \pm 0.9	0.01
TPG(mmHg)	14.3 \pm 0.8	9 \pm 0.6	0.01

All but one patient survived.

Conclusion: Inhaled NO is a very effective selective pulmonary vasodilator. It significantly improves critical pulmonary circulation after bidirectional Glenn- and Fontan-procedures leading to a decreased transpulmonary pressure gradient and improved oxygenation.

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EARLY RESPONSE TO INHALED NITRIC OXIDE MIGHT PREDICT OUTCOME IN CHILDREN WITH SEVERE HYPOXAEMIC RESPIRATORY FAILURE
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Acute hypoxaemic respiratory failure (AHRF) in children occurs in a heterogeneous group of diseases with pulmonary pathophysiological processes ranging from reversible physiological intrapulmonary shunting to fixed structural lung damage. We hypothesized that inhaled nitric oxide (iNO), a selective pulmonary vasodilator, might identify those patients with potentially reversible disease, i.e. large response may indicate a greater likelihood of reversibility and thus survival.

Methods: A retrospective review of the early response to iNO in 30 infants and children (aged 1 month to 13 years, median 7 months) with severe AHRF(18 with ARDS). The mean $P(A-a)O_2 / PaO_2 / FiO_2$, oxygenation index (OI) and acute lung injury (ALI) score prior to the commencement of iNO were 568 ± 9.3 , 56 ± 2.3 , 41 ± 3.8 and 2.8 ± 0.1 respectively. The magnitude of response to iNO was quantified as the % change in OI occurring within 60 minutes of 20 ppm iNO therapy. This response was compared to patient outcome data.

Results. There was a significant correlation between response to iNO and patient outcome, Kendall tau B $r=0.43$, $p<0.02$ (table). Overall, 12 patients (40%) survived, 9 with ongoing conventional treatment including iNO, and 3 with ECMO support.

	< 15% Change OI	15 to 30% Change OI	> 30% Change OI
Survived (n)	0	4	8
Died (n)	6	7	5

Conclusion: In AHRF response to iNO appears to define a subgroup of patients with improved outcome compared to non-responders. We speculate that response to iNO may be useful in selecting patients with potentially reversible lung disease for special support therapies such as ECMO. Randomised controlled trials are needed to define the role of iNO in paediatric AHRF.

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High frequency oscillation and NO versus conventional ventilation and NO in the treatment of pediatric "adult respiratory distress syndrome" (ARDS).

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In children with ARDS, prospective studies have demonstrated a significant oxygenation improvement with NO added to conventional mechanical ventilation (CMV) or with high frequency oscillation (HFOV). (S. Abman, J Pediatr 1994 and J. Arnold, Crit Care Med 1994)

Aim of the study To assess oxygenation improvement with NO combined to HFOV compared to NO combined to CMV, in the treatment of children ARDS.

Methods Children were included in the study if they had the following criteria : Body weight ≥ 5 kg and ≤ 35 kg, oxygen index (OI) ≥ 15 , Murray score > 2.5 . Patients included were divided in 2 historical groups *i*) from 01/94 to 10/95, NO was added to CMV. *ii*) from 11/95 to 02/96, the 3100A (SensorMedics, Bilthoven, the Netherlands) availability modified our ventilation strategy. HFOV with an aggressive volume recruitment strategy was first performed, if there was no pulmonary hypertension on echocardiography. NO was added to HFOV if OI remained ≥ 15 . Oxygenation was evaluate on OI.

Results	CMV-NO n=6	HFOV-NO n=6
Age (year)	4.6 ± 4.0	3.4 ± 2.0
Weight (Kg)	16.4 ± 10.6	10.0 ± 3.6
PRISM	19 ± 3	21 ± 6
Immunosuppressed (n)	5	2
NO at H24 (ppm)	16 ± 11	6.1 ± 3.7
OI at H0	35.5 ± 19.5	49.0 ± 9.6
OI at H24	23.4 ± 14.2	12.8 ± 3.8
Survivors (n)	2	5

Conclusion To improve oxygenation, high frequency oscillation ventilation combined to NO seems better than conventional ventilation combined to NO. Impact of this strategy on outcome requires further studies.

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TREATMENT OF MECONIUM ASPIRATION SYNDROME (MAS) WITH HIGH FREQUENCY OSCILLATION VENTILATION (HFO) AND NITRIC OXIDE (NO)
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Until recently, MAS with severe gas-exchange disturbance [persistent oxygenation index (OI) > 40 ; OI = mean airway pressure (MAwP) \times FiO_2 / PaO_2] was associated with high mortality without extracorporeal lung support (ELS). HFO and NO-inhalation have dramatically changed this situation.

Patients/Methods: Between May 1994 and December 1995, 22 patients (pts) were treated for MAS. Treatment groups were: group I only O₂; 6 pts; group II conventional mechanical ventilation (CMV): 11 pts; group III HFO: 1 pt; group IV HFO+NO: 4 pts. Therapy was stepwise intensified until oxygenation improved (I \rightarrow II \rightarrow III \rightarrow IV). "High volume strategy" was used with HFO (MAwP 18-24 cm H₂O). The initial NO-concentration was 20-30 ppm, with rapid reduction down to 5-10 ppm once oxygenation improved.

Results: One pt (group II) died of hypoxic-ischemic encephalopathy (termination of therapy); all other newborn babies survived. In group IV pt 1 and 2 showed barotrauma prior to HFO. Pt 1, 2 and 4 were treated with additional MgCl₂ (max. Mg serum concentration 2.8 - 6.5 mmol/l).

Pt	OI before NO+HFO	OI after NO+HFO	NO duration (d)	HFO duration (d)	CMV+HFO (d)
1	42	23	14	24	28
2	55	28	5.3	6.5	9.7
3	50	25	0.9	1.9	4.0
4	95	46	3.5	3.6	5.7
mean	61	31	5.9	9	12

Conclusion: HFO and NO drastically improved oxygenation rendering survival in pts with MAS possible without the use of ELS. Early transfer of severely ill infants to a tertiary center for HFO and NO treatment is advised, in order to prevent ventilator induced lung injury.

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Follow up studies from four Paediatric Intensive Care Units (PICU) after Nitric oxide (NO)-inhalation to newborn and paediatric patients.

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Background:

Following the identification of inhaled nitric oxide (INO) as a selective pulmonary vasodilator (Frostell et al 1992) and the first description of its successful use in the treatment of persistent pulmonary hypertension of the newborn (Kinsella et al 1992) this still experimental therapy has rapidly gained widespread use in neonatal and paediatric intensive care units. A number of studies and case series have now been published regarding short term efficacy and safety, however, so far the information concerning the long term evaluation of INO is scarce.

Aim:

The aim of the present study was to investigate the long term (> 6 months) morbidity and mortality in paediatric patients following treatment with INO. We would like to present data from four different paediatric intensive care units, on infants who all have inhaled NO in studies or on a compassionate basis, and survived.

Material:

From November 1992 to July 1995, 87 patients were treated, 32 in Göteborg, on 35 occasions, 19 in Stockholm, 14 in Oslo and 22 in Sydney. Of these, 40 have been included in a follow up study and have been examined for respiratory, circulatory or neurologic disorders at 6 months or more after the NO-administration. Another 14 have been examined at 2 months or more after INO. The indication for INO was postoperative heart surgery (42), paediatric ARDS (22), MAS (17), CDH (6), IRDS (2).

Results:

Of 87 severely hypoxic or pulmonary hypertensive children, treated with INO or INO+ECMO, 62 survived. Three were treated twice. Ten patients went on to ECMO, of which 5 survived. In the CHD-group 28 patients were followed up, 14 had symptoms associated with their heart disease. Five are completely healthy. In the paediatric ARDS-group 12 patients survived, 3 are completely healthy, 3 have respiratory symptoms with infections and obstructive bronchitis and one has a brain injury after cardiac arrest. Among newborns with MAS, CDH and IRDS 19 out of 25 survived and 5 of those have symptoms from the airways. Extended data will be presented.

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RELATIONSHIP BETWEEN RESPONSE TO INHALED NITRIC OXIDE AND OUTCOME IN NEWBORNS WITH ACUTE HYPOXEMIC RESPIRATORY FAILURE

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Objective: to evaluate whether an acute and/or sustained response to low dose inhaled nitric oxide (NO) could be correlated to a better short-term outcome in term and preterm newborns with acute hypoxic respiratory failure. **Design:** prospective nonrandomized clinical study. **Subjects:** 10 term and 13 preterm infants with severe respiratory failure, with an oxygenation index (OI) >25, despite at least one dose of exogenous surfactant, in absence of congenital heart defects. **Interventions:** inhaled NO was given at an initial dose of 10 ppm. PaO₂, the oxygenation index (OI) and the alveolar-arterial gradient of O₂ (AaDO₂) were evaluated before NO inhalation, and at the 1st, 3rd, 6th and 24th hour during NO treatment. According to the short-term outcome, patients were divided in two groups: survivors (group A), and non survivors or treated with extracorporeal support (ECMO)(group B). Data are expressed as mean \pm SEM. Statistical analysis included the Wilcoxon matched-paired test and the Mann-Whitney U test.

Results: Of the 23 patients, 10 were survivors (group A), and 13 were non survivors(7) or treated with ECMO(6)(group B). Mean gestational age (GA) was 36.4 ± 1.18 weeks in group A, and 33.4 ± 1.55 in group B ($p=0.20$). Mean birth weight (BW) was 2547 ± 290 and 2212 ± 223 gm in group A and B, respectively ($p=0.55$). Diagnoses were RDS (8 cases), sepsis (5), MAS (3), CDH (3), PPIN (2), lung hypoplasia (1), barotrauma (1). Mean initial NO dose was 11 ± 1.0 in group A, and 12.2 ± 2.1 in group B ($p=0.78$), while maximal NO dose was 20.7 ± 2.9 vs 40.5 ± 5.9 , respectively ($p=0.016$). Mean duration was 73.3 ± 13.2 hours in group A, and 88.3 ± 37.9 hours in group B ($p=0.22$). The Table shows the different patterns of response during NO inhalation in the two groups.

		Before NO	1st hour	3rd hour	6th hour	24th hour
PaO ₂	Group A	33 ± 6.5	$67.4 \pm 10.7^{***}$	$65.7 \pm 11.7^*$	$62.7 \pm 6.2^{**}$	$67.3 \pm 5.3^{**}$
	" B	33.2 ± 4.8	33.8 ± 3.7	32.6 ± 5.0	43.9 ± 6.9	43.7 ± 4.8
OI	Group A	78.3 ± 12.4	$31.0 \pm 6.9^{***}$	$24.4 \pm 4.2^{***}$	$24.8 \pm 4.1^{***}$	$19.5 \pm 3.2^{**}$
	" B	71.1 ± 7.5	73.8 ± 10.8	82.2 ± 14.3	71.6 ± 17.5	47.9 ± 8.9
AaDO ₂	Group A	620 ± 9.3	$539 \pm 36.7^*$	$489 \pm 40.4^{***}$	$502 \pm 37.1^{**}$	$465 \pm 38.5^{**}$
	" B	614 ± 13.1	630 ± 5.3	630 ± 5.4	617 ± 6.3	626 ± 6.3

Data are compared to baseline values within each group. * $p<0.05$, ** $p<0.03$, *** $p<0.01$

Among 12 patients who fulfilled ECMO criteria, 6 improved with NO and did not required extracorporeal life support. Three out of 6 ECMO patients eventually survived.

Conclusions: in our study low-dose of inhaled NO showed a variable effect on oxygenation in newborns with acute respiratory failure. An acute response to NO appeared to be correlated with a better short-term outcome and the avoidance of extracorporeal support in ECMO candidates. Differently, lack of acute and/or sustained response was associated with death or need for ECMO. Although the nature and severity of the underlying disease or the degree of prematurity may play an important role in these patients, we believe lack of acute response to NO may be an early predictor of bad outcome, prompting toward alternative treatments such as ECMO or liquid ventilation.

Renal

072

HYPERAMMONEMIC COMA (HC) IN NEWBORNS WITH INBORN ERRORS OF METABOLISM : TREATMENT BY CONTINUOUS ARTEROVENOUS HEMODIALYSIS (CAVHD).

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Successful prevention of handicaps or death in newborns with HC depends on rapidity and efficiency of treatment. Poor response to nutritional and/or pharmacological treatment requires extracorporeal removal of NH4. Efficiency and cardiovascular tolerance are often difficult to obtain with peritoneal or hemodialysis in neonates. We report the results of CAVHD in 3 newborns with HC. **Methods:** vascular access: femoral vessels. Blood flow: 10-35 ml/min. Dialysate flow: 200-500 ml/h. Filter: Amicon Minifilter Plus™(polysulfone membrane; 0.08 sq.m.). No ultrafiltrate(UF) production. **Patients:** Case 1 with carbamylphosphate synthetase deficiency (body weight -bw-: 3.2 kg) showed HC at day 4. A relapse of HC occurred at day 14 due to an infectious event. Case 2 and 3 (bw: 3.0 and 2.8 kg), both affected by propionic acidemia, showed HC at day 5 and day 7, respectively.

Plasma NH4 ($\mu\text{g}/\text{dl}$) decrease is shown in the table:

	0	4	8	12 (hours)
Case 1	2200	220	145	208
Case 1	1100	1000	750	265
Case 2	1900	260	100	87
Case 3	1640	254	210	200

Complications: transitory ischemia of arterial cannulation limb and transitory thrombocytopenia occurred in case 1; surgical repairing of artery after CAVHD was necessary in case 3; no cardiovascular instability was observed during CAVHD. **Outcome:** all patients recovered from HC in less than 1 day; case 1: alive, mild hypotonia at 34 mos; case 2: dead after 10 days from CAVHD withdrawal for pulmonary hemorrhage; case 3: alive, normal development at 7 mos. **Conclusions:** 1) In newborns with HC, CAVHD provides good cardiovascular tolerance, high efficiency and quick removal of NH4, even without UF production (i.e. only by diffusion). This allows easier management (no need of fluid and electrolyte balance). 2) Arterial complications seem frequent in neonates treated by CAVHD. Venovenous circulation could overcome this problem.

073

Evaluation of various renal replacement therapy in the treatment of neonatal maple syrup urine disease (MSUD). P Jouvet, F Poggi, D Rabier, JM Saudubray, N Man, USIP and INSERM U90, Hôpital Necker-E. Malades. Paris.

MSUD results from an inherited impairment of catabolic pathway of branch chain amino-acids. High leucine blood levels may induce acute brain dysfunction. This dramatic complication led us to propose leucine removal procedures as continuous hemofiltration.

Aim of the study To evaluate efficiency and tolerance of three continuous venovenous techniques in acutely ill newborns with MSUD i.e. hemofiltration (HF), hemodiafiltration (HDF) and hemodialysis (HD).

Patients and methods Three newborns in acute MSUD onset were treated by HF, HDF and HD. Extracorporeal circulation was performed through a 6.5 Fr catheter, a circuit with a blood pump (priming volume = 40 ml). Patients and procedures characteristics are summarized below in the table.

Cases	Weight(g)	Age(d)	Filter	Flow (ml/min)		
				Blood	UF	Dialysate
1.	3650	12	FH 22 Gambio	20	2	0
2.	2890	11	Miniflow 10 Hospital	20	1	16
3.	2000	22	Miniflow 10 Hospital	20	0	25

Efficiency evaluation included leucine plasma level and integrated clearance. Tolerance evaluation included BP, HR, temperature, blood chemical and hematologic tests.

	HF (12,5h)	HDF (11h)	HD (12h)
Leucine at T_0 ($\mu\text{mol}/\text{l}$)	2186	3465	2536
Leucine at T_{end} ($\mu\text{mol}/\text{l}$)	1131	1275	488
Clearance (ml/min)	1.63	3.89	3.23

Tolerance was good, excepted an hypothermia (case 2 and 3) and a hematocrit decrease in all cases ($\approx 10\%$).

Conclusions Continuous venovenous hemodiafiltration or hemodialysis allow better removal of leucine level within 12 hours than hemofiltration in MSUD. Optimisation of continuous venovenous hemodialysis should reduce dialysis duration and improve tolerance.

074

ROLE OF POLYMORPHONUCLEAR NEUTROPHILS IN PROGNOSIS OF HAEMOLYTIC URAEMIC SYNDROME IN CHILDHOOD

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Background. The implication of polymorphonuclear neutrophils (PMNs) in the physiopathology of children's haemolytic-uraemic syndrome (HUS) becomes more and more evident. The purpose of the present study is to rule out their impact among other prognostic elements during the course of the disease. **Patients and methods.** Diarrhoeal prodrome and its duration, patient's age, maximal blood nitrogen level, anuria and dialysis time, extra-renal involvements, white cell and PMN counts and thrombopenia duration have been retrospectively analysed in 18 infants with good outcome and in 8 another children with unfavorable outcome. **Results.** Neither diarrhoea or its duration, nor children's age, nor blood nitrogen level, nor anuria or dialysis time had any predictive value for the disease evolution in the acute phase of our patients. Adversely, extra-renal involvements was accompanied by severe and complicated courses of the disease ($p<0.02$). The elevation of white cells and PMNs (beyond $20 \times 10^9/\text{l}$) and PMNs (more than $15 \times 10^9/\text{l}$) as well as its persistence beyond a week were most frequently observed in complicated forms ($p<0.001$, $p<0.001$ and $p<0.01$, respectively). A transient thrombopenia (less than 5 days) in patients with elevated counts of white cells may be a further obvious sign of an unfavorable course of the disease ($p<0.02$). **Conclusion.** The elevated count of white cells and PMNs, either alone or associated to one rapid regeneration of platelets, seems enabled to predict an unfavorable evolution of the HUS in children.

075

ALUMINIUM ACCUMULATION DURING SUCRALFATE THERAPY

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Sucralfate (an aluminium salt of sucrose octa sulfate) is used to prevent and treat upper gastrointestinal bleeding in critically ill patients. With minimal absorption, the potential for side effects is thought to be limited, though aluminium toxicity has been reported in patients with chronic renal failure. These patients may already have had high body stores of aluminium. We report 5 critically ill children with high serum concentrations of aluminium following sucralfate therapy. All 5 had renal impairment. The normal aluminium level is $< 0.4 \mu\text{mol}/\text{L}$ and in patients with chronic renal failure $< 2.2 \mu\text{mol}/\text{L}$. None of these patients had known preexisting chronic renal disease.

Diagnosis	Age	Peak Aluminium ($\mu\text{mol}/\text{L}$)	Peak Creatinine ($\mu\text{mol}/\text{L}$)	Dialysis
1 Blunt Trauma	4	0.58	304	No
2 Dermatomyositis	6	3.24	236	Peritoneal
3 HaemolyticUraemic Syndrome	3	12.3	614	Peritoneal
4 Meningococcal sepsis	5	3.77	382	Peritoneal
5 Meningococcal sepsis	6	0.95	574	Peritoneal

In peritoneal dialysate from the last two patients, aluminium levels were undetectable in one ($< 0.05 \mu\text{mol}/\text{L}$) and in the other patient were $0.3 \mu\text{mol}/\text{L}$. This gives an estimated peritoneal clearance of $0.7 \text{ ml}/\text{min}$ and $< 1.4 \text{ ml}/\text{min}$ in these two cases. Both children were anuric. When sucralfate is used in critically ill children with renal failure aluminium concentrations should be monitored.

Cardiac surgery

076

HORMONAL CHANGES IN CHILDREN WITH CONGENITAL HEART DISEASE UNDER CARDIOPULMONARY BYPASS (CPB)

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Children under CPB commonly have haemodynamic instability related to CPB duration (mainly over 60min), grade of hypothermia, water restriction and myocardial capacity. The aim of this study is to observe the presence of hormonal adaptation and if this changes can induce the maintenance or worse of haemodynamic stability. We evaluate 19 patients (from 0.5 to 12 years) divided in three groups according CPB and esophageal temperature. Moderate hypothermia was considered when $28^{\circ}\text{C} < \text{t} < 30^{\circ}\text{C}$. The blood samples were obtained at basal condition, after anaesthetic induction and thoracic opening each 30min. during CPB and 24h after surgery. The results are showed on table and expressed in mean (standard deviation).

	CORTISOL		TIROXIN(T4)	
	Basal	< value	Basal	< Value
Grupo 1	24(7,4)	11(5,1)*	9(2,1)	4,3(1,4)
Grupo 2	34(12)	31(18)	10(1,8)	6,7(1,9)
Grupo 3	29(13)	19(13)	8,6(2,5)	7,2(2,4)
	TSH		INSULIN	Glucose
	Basal	> value	Basal	> value
Grupo 1	4(1,7)	5(3,4)	17(12)	21(16)
Grupo 2	5,7(1,0)	4,2(1,9)	20(6,2)	30(11)
Grupo 3	3,8(0,8)	3,7(1,3)	19(16)	22(18)
				91
				0,24

group 1: n=13 (with CPB and hypothermia); group 2: n=3 (with CPB and normothermia);

group 3: n=3 (without CPB). Statistical analysis (test t); * level of significance p<0,05.

In group 1 there was significant reduction on cortisol and T4 levels, insufficient secretion in spite of hyperglycemia, low insulin/glucose rate and maintained TSH level in spite of T4 reduction. Despite normothermia, in group 2 we observed insulin resistance during CPB. In group 3 there was no significant change in hormonal secretion. After 24h hormonal normalization occurred in all groups. We conclude that patients under CPB presents hormonal alterations partially related to moderate hypothermia that can be responsible for the maintenance of inadequate systemic vascular resistance and should be considered on therapeutic approach of patients with persistent shock.

077

ATRIAL NATRIURETIC PEPTIDE (ANP), CYCLIC GUANOSINE MONOPHOSPHATE (cGMP), TOTAL NITRITES (NO_2) AND NITRATES (NO_3) IN INFANTS UNDERGOING CARDIAC OPERATIONS. RELATIONS TO POSTOPERATIVE CHANGES

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The course of ANP, cGMP/ANP (as indicator for atrial natriuretic peptide biological activity), and NO_2 and NO_3 (as indicator for endogenous nitric oxide (NO) synthesis) was investigated in 19 infants (median age 4 months) undergoing cardiopulmonary bypass (CPB). Patients were divided into 2 groups according to whether they had (group 1, n=13) or not (group 2, n=6) preoperative heart failure (HF) and pulmonary hypertension (PHT). Group 1 patients had preoperatively significantly higher levels of ANP ($p<0,005$), cGMP ($p<0,02$) and NO_2 and NO_3 ($p<0,02$) but had significantly lower cGMP/ANP ($p<0,05$) than group 2 patients. During CPB, ANP was significantly higher in group 1 patients ($p<0,02$). As compared with prebypass values, cGMP/ANP was reduced in both groups during CPB ($p<0,0001$). cGMP/ANP inversely correlated with duration of CPB and aortic clamping time ($p<0,001$, respectively). NO_2 and NO_3 were significantly higher in group 1 than in group 2 patients ($p<0,05$) without any intraoperative change during CPB. From the early postoperative period on ANP, cGMP/ANP and NO_2 and NO_3 were similar in both groups. After CPB, ANP correlated in both groups with blood pressure ($p<0,001$) and diuresis ($p<0,05$). NO_2 and NO_3 inversely correlated with pulmonary arterial pressure immediately after CPB ($p<0,05$).

Conclusions:

- We show increased ANP and NO synthesis and decreased ANP biological activity in infants having HF and PHT.
- CPB-operations increase ANP secretion but decrease its biological activity, without any effect on NO synthesis.
- ANP could be involved in the control of fluid balance and systemic vascular tone and NO synthesis might control pulmonary vascular tone.

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078

IMMEDIATE POSTOPERATIVE DYSRHYTHMIAS (DR) AFTER CARDIOPULMONARY BYPASS (CPB) IN CHILDREN

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Distribution and risk-factors of dysrhythmias occurring early after CPB-operations for congenital cardiac defects were studied in 126 children (median age 44 months). CPB was conducted under deep hypothermia ($T, 16^{\circ}\text{C}$) and cardiocirculatory arrest (CCA) or under hypothermia ($T, 24^{\circ}\text{C}$) and low-flow perfusion. Continuous Holter-electrocardiograms (H-ECG) were recorded from the immediate postoperative (PO) period on for 72 hours. H-ECG were also recorded prior to the operation and before discharge. Following DR were observed: supraventricular (SV) and ventricular (V) extrasystoles (ES) ($>50/24\text{h}$), SV and V tachycardia (SVT and VT), accelerated junctional rhythm (AJR) and junctional ectopic tachycardia (JET), and 2nd and 3rd degree atrioventricular block (AVB2 and AVB3). The incidence of PO DR was 20% in the pre-op H-ECG, 74% on the 1st, 33% on the 2nd, 34% on the 3rd PO day and 21% before discharge. Compared to the pre-op findings, an increased incidence of SVES, VES, SVT and AVB3 on the 1st PO day was observed, whereas VT and AJR or JET were exclusively observed PO. All types of DR were observed up to the 3rd PO day. Type of DR before discharge was similar to pre-op findings and there was no definitive AVB3. Considering patient groups according to the most frequent isolated op-procedure, the incidence of DR on the first PO day was 56% after ASD II-closure (n=23), 74% after subaortal VSD-closure (n=19), 75% after correction of a complete AVSD (n=8), 80% after correction of a tetralogy of Fallot (n=20) and 100% after Fontan-operation (n=10). Incidence and type of DR were not significantly different between groups. Longer CPB-duration and use of CCA were risk factors for PO VES and VT ($p<0,005$ and $p<0,05$, respectively) whereas use of CCA and degree of hypothermia were risk factors for the development of AJR and JET ($p<0,02$ and $p<0,0001$, respectively).

Conclusions:

- Our results indicate that PO DR after CPB in children are frequent but mainly transient.
- In our series, specific CPB-related parameters are of greater influence than surgical procedure itself for the development of DR and are discriminant risk factors for particular types of DR.

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079

VALUE OF POST-OPERATIVE CARDIOVASCULAR SURGERY (POCVS) pH. COMPARISON WITH OTHER VARIABLES.

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Introduction: Tonometer determined intramucosa gastric pH (pHi) has been shown to be of value in POCVS to predict early complications in adults (1). This has not yet been demonstrated in pediatric patients (2). Our goal was to determine the utility of pHi when compared with other independent variables (PRISM, arterial pH, PCO₂ in the tonometer and arterial lactic content) in predicting adverse effects during POCVS which had required extracorporeal circulation.

Methods: We prospective studied 57 patients, mean age $4,1 \pm 3,5$ years old. In all patients pHi was determined within the first two hours and twelve hours of being admitted to the PICU after cardiovascular surgery. The considered dependent variables (adverse reaction or complications to predict) were: 1- Multiple organ failure, 2- Infection, 3- Hemodynamic instability (Hemodynamic Clinical Score > 2)(3). 4- Magnitude of Therapeutic Resources Employed (MTRE)(4). The predicted importance of independent variables was determined by multiple logistic regression analysis, expressed as Odds Ratio (OR). The confidence interval (CI) at 95 % was obtained by SD of B coefficient.

Results: Twenty four patients presented one or more post operative complications. Of all the co-variants observed, PRISM was the only one to show significant predictive value for the following independent variables: Infections, ($p < 0,032$, OR=1,27, CI=1,03-1,57) and MTRE ($p < 0,035$, OR=1,61 CI 1,05-2,49). No complications due to tonometer placement were observed.

Conclusions: 1- We were not able to determine the predictive value of pHi for adverse events in pediatrics POCVS. 2- Of the other variables studied, PRISM was the only one to show some predictive value.

References: (1)Crit Care Med 1988;16:1222-1224. (2) Crit Care Med 1993;21 (suppl):S148 (3)Hemodynamic Clinical Score (1 point each item): a: Systolic arterial pressure $< 65 \text{ mmHg}$ ($< 1 \text{ year}$) or $< 75 \text{ mmHg}$ ($> 1 \text{ year}$). b: Heart Rate $> 160 \text{ b/m}$ ($< 1 \text{ year}$) or > 150 ($> 1 \text{ year}$). c: rectal temperature $< 36^{\circ}\text{C}$. d: capillary refill $> 3 \text{ sec}$. e: diuresis $< 1 \text{ ml/Kg/h}$. (4) MTRE: One or more of the following items: two or more inotropic drugs during the first 24 hours. b: volume expansions ($> 40 \text{ mL/Kg}$ or more) c: Mechanical ventilation required for more than 48 hs.

080

PATIENTS AFTER A FONTAN-TYPE OF PROCEDURE HAVE LOWER GASTRIC MUCOSAL pH THAN AFTER OTHER TYPES OF CARDIAC SURGERY

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Patients after a Fontan-type of procedure have elevated central venous pressures (cvp) leading to congestion in the gastrointestinal system and often ascites. Purpose of this study was to evaluate whether this causes a different postoperative gastric mucosal pH (pHi).

Methods: We evaluated a series of 35 patients, who underwent cardiac surgery with cardiopulmonary bypass (age: 5 days to 18 years (mean 2,2 yrs), weight: 3.2 to 37kg (mean 10.2 kg). A commercially available tonometer (Tonometrics®) for sigmoidal use in adults was inserted into the stomach after induction of anesthesia. The pHi measurements were done according to manufacturer recommendations. We compared three groups of patients: 1) acyanotic (n=20), among them 9 P with VSD and 5 P with AVSD; 2) cyanotic (n=10): TOF: 6P, TGA: 4P; 3) cyanotic after a Fontan-type procedure (n=5). Phi were measured at PICU arrival and after 6h. Furthermore we compared lactat levels at these time points. Differences between the groups were evaluated with one way ANOVA on ranks with pairwise multiple comparisons (Dunn's method). The relationship between CVP and pHi was investigated by regression analysis.

Results: The median pHi for groups 1, 2 and 3 were 7.28, 7.27 and 7.13 at arrival and 7.30, 7.25 and 7.21 after 6h respectively. At PICU arrival group 3 was significantly ($p<0.05$) different from groups 1 and 2. There was no significant difference between the latter two groups. After 6h group 1 was different from group 3, there were no other significant differences. The median lactate levels for groups 1, 2 and 3 were 2.2, 3.2 and 4.1 at arrival and 1.6, 3.1 and 3.3 after 6h respectively. At PICU arrival group 3 was significantly ($p<0.05$) different from group 1, after 6h there were no significant differences. There was a weak negative correlation between cvp and pHi: $r = -0.21$; $p<0.05$.

Conclusion: Patients after a Fontan-type of procedure have lower pHi than patients after other cardiac surgical procedures. However, this is only in part due to the elevated cvp and venous congestion.

082

MID-TERM FOLLOW-UP AFTER MULTIPLE ORGAN FAILURE (MOF) FOLLOWING CARDIAC SURGERY IN CHILDREN

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Eleven children were investigated 32 months (median) after postoperative MOF. MOF was defined as the failure of at least two vital organ systems (kidney, liver, lung, central nervous system) in addition to cardiac insufficiency and high fever.

Underlying surgical procedure was repair of Tetralogy of Fallot (n=3), Fontan- (n=7) or Senning procedure (n=1). All patients fulfilled criteria for MOF in the 3 first postoperative (PO) days. Six patients needed peritoneal or hemodialysis for 31 days (median) during the PO period. One patient showed cerebral infarction due to thromboembolism in the territory of the right internal carotid artery immediately after the operation.

The follow-up protocol consisted of extensive investigations of heart-, renal-liver-, and lung functions as well as complete neurological and psychological examinations.

All patients had adequate cardiac examination. Lung function was normal in all but 2 patients who had an obstructive syndrome. Only 1 patient showed an isolated decreased creatinine clearance. Abnormalities of the liver function tests were only noticed in patients after Fontan procedure. Severe neurological sequelae such as paraplegia (n=1) and diplegia (n=1) were observed in 2 of the 11 patients. The remaining 9 children presented with a delayed graphomotorical and speech development associated with normal intelligence.

Conclusions:

- In our series the most frequent and severe sequelae after postoperative MOF were neurological.
- Abnormal liver function tests are more likely to be a consequence of the Fontan hemodynamics than a sequel of MOF.

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081

GASTRIC MUCOSAL TONOMETRY ASSESSMENT IN THE CONGENITAL HEART DISEASE DURING CARDIOPULMONARY BYPASS (CPB).

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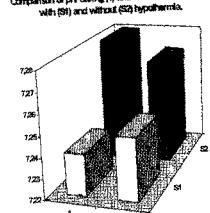
Objective: Comparative data analysis in patients during CPB with and without hypothermia and after finishing CPB.

Material and methods: Intramucosal pH (pHi) measurements were performed with gastric tonometer catheter in 14 patients undergoing cardiac surgery with CPB. These patients were divided into two groups. Group A: 8 patients with hypothermia during surgery. 6 male and 2 female, average age = 4y 5m, average weight = 13,2 kg and average time of CPB = 91min. Group B: 6 patients without hypothermia during surgery, 3 male and 3 female, average age= 3y2m, average weight= 11,5 kg and average time of CPB= 42 min. The measurements were made 30 min after the start of CPB and after the end of CPB.

Statistical analysis: Average and standart deviation and test "t" Student.

Results: Group A: pHi average during CPB was $7,29 \pm 0,09$ and after CPB $7,25 \pm 0,07$. Group B: pHi average during CPB was $7,28 \pm 0,08$ and after CPB $7,27 \pm 0,09$.

HYPOTHERMIA		NORMOTHERMIA	
Time of	end of	time of	end of
CPB	30'	CPB	30'
105'	7,27	7,37	7,26
90'	7,09	7,20	7,77
86'	7,27	7,25	7,43
101'	7,22	7,24	7,23
126'	7,33	7,24	52' 7,26
38'	7,17	7,18	7,34
74'	7,21	7,19	30' 7,22
103'	7,37	7,32	7,37
Average	7,24	7,25	7,28
SD	0,09	0,07	0,08



Conclusion : In this sample there wasn't significant difference in the pHi, in both groups. Therefore the hypothermia during surgery of congenital heart disease with CPB wasn't a factor of protection for gastrointestinal function or perfusion.

Neonatology

083

A RANDOMIZED TRIAL COMPARING TWO OR MORE DOSES OF SURVANTA: EFFECT ON SURFACTANT PHOSPHOLIPIDS AND FUNCTION
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The optimal dosing schedule of surfactant therapy for the treatment of neonatal respiratory distress syndrome (RDS) remains unclear. **Goal:** Surfactant function and the concentration of phospholipids (PL) in tracheal aspirates are compared in a prospective randomized trial involving neonates with RDS who received either TWO or MORE (3 or 4) doses of Survanta. **Methods:** Ventilated neonates <35w with RDS were treated with Survanta 100 mg/kg if $\text{FiO}_2 \geq 40\%$ or mean airway pressure $\geq 7.5 \text{ cm H}_2\text{O}$. After 6h a 2nd dose was given (same criteria). If the support still exceeded the criteria 12h after the 2nd dose, the patient was randomized to no extra dose (TWO), or to an extra dose of Survanta (MORE) (and a 4th dose 12h later; same criteria). PL was measured in tracheal aspirates and corrected for dilution with the urea method. "Active" large aggregates and "non-active" small aggregates of surfactant were separated by centrifugation and quantified. Surface tension of the large aggregate fraction was measured by pulsating bubble surfactometer. **Results:** 13 neonates were randomized, 6x TWO and 7x MORE (5x3 and 2x4 doses). Gestational age was $31.7 \pm 2.4 \text{ w}$ and birth weight $1582 \pm 568 \text{ g}$. Most patients had severe RDS with initial ventilation: rate 63.1 ± 11.1 , peak inspiratory pressure (PIP) $24.3 \pm 6.4 \text{ cm H}_2\text{O}$, $\text{FiO}_2 75.3 \pm 21.0\%$. At randomization: rate 63.5 ± 6.9 , PIP $20.3 \pm 2.5 \text{ cm H}_2\text{O}$, $\text{FiO}_2 29.5 \pm 15.7\%$, and 24 h after randomization: rate 45.9 ± 17.1 , PIP $18.7 \pm 2.2 \text{ cm H}_2\text{O}$, $\text{FiO}_2 26.8 \pm 6.6\%$, without signif. differences between the groups. There was 1 relapse (again $\text{FiO}_2 \geq 60\%$ within 72h) in group TWO and 1 BPD in group MORE. In total, 112 tracheal aspirates were analyzed. PL was not signif. different before randomization (TWO 27.5 ± 15.7 vs MORE $24.5 \pm 11.4 \mu\text{mol/ml}$), but neither after randomization (TWO 21.2 ± 11.0 vs MORE $19.3 \pm 7.0 \mu\text{mol/ml}$). There was no difference in the % small aggregates (TWO 4.2 ± 1.9 vs MORE $6.9 \pm 5.5\%$). The surface tensions (mN/m) were not signif. different (each time TWO vs MORE): before randomization 10.0 ± 2.3 vs 14.2 ± 7.2 , in the 24h after randomization 12.6 ± 5.0 vs 11.2 ± 3.8 , or 24-48h after randomization 17.0 ± 5.5 vs 12.8 ± 9.8 , or 48-72h after randomization 15.7 ± 4.0 vs 13.7 ± 5.6 . **Conclusion:** Neonates who received more than two doses of Survanta did not have higher PL, nor a better surfactant function than neonates who received only two doses of Survanta. Continuation of the trial is necessary to evaluate clinical outcome.

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FATTY ACID (FA) COMPOSITION OF SURFACTANT PHOSPHATIDYLCHOLINE (PC) IN PRETERM INFANTS

J.E.H.Bunt, V.P.Carnielli, R.H.T.van Beek, I.H.T.Luijendijk, J.den Ouden, P.J.J.Sauer, L.J.I.Zimmermann, Dept. Pediatrics, Div. Neonatology, Sophia Children's Hospital / Erasmus University, 3015 GJ Rotterdam, The Netherlands. Few studies have focused on FA composition of surfactant PC in preterm infants before and after surfactant therapy. **Methods:** Tracheal aspirates were collected in 7 ventilated infants from birth until extubation ($27.6 \pm 1.7 \text{ wk GA}$, $859 \pm 155 \text{ g BW}$). After lipid extraction, t.l.c., and methylation, FAs of PC were quantified by gaschromatography. Intralipid^R (53.2% linoleic acid, 18:2ω6) was started 48h after birth. **Results:** Six infants developed respiratory distress syndrome (RDS) and received Survanta^R 100mg/kg (S^R), all doses within 18h after birth (1x S^R n=1, 2x S^R n=3, 3x S^R n=2). One child did not develop RDS. In all patients, the palmitate % in PC was ~ 65% (before S^R=natural composition), increased to ~ 85% after S^R, and remained >80% for 15h after 1x S^R, $22.3 \pm 11.8 \text{ h}$ after 2x, and $38.5 \pm 3.3 \text{ h}$ after 3 doses. In 4 patients, intubated long enough, the palmitate % decreased with a half-life of $78.7 \pm 42.8 \text{ h}$ to a new plateau which was still higher than baseline after 1 week. Linoleic acid % was 5.85 ± 2.3 (with RDS), decreased after S^R and returned to baseline due to the decrease in palmitate %. Thereafter the linoleic acid % increased linearly with 0.021% per h, in 1 patient even up to 15.1%. Other FAs did not increase after return to baseline.

PERCENTAGES OF MOST ABUNDANT FA IN SURFACTANT PC (mean ± sd)						
	14:0	16:0	18:0	18:1ω9	18:2ω6	20:4ω6 other
RDS, before S ^R	2.8 ± 0.6	61.9 ± 5.8	7.8 ± 2.5	9.0 ± 2.0	5.8 ± 1.5	5.9 ± 1.9 6.8
No RDS, no S ^R	4.1	63.0	3.4	10.2	3.4	5.4 10.7
6 hr after last S ^R	2.2 ± 0.6	84.6 ± 0.9	3.2 ± 0.3	5.7 ± 1.6	0.8 ± 0.3	0.8 ± 0.2 2.7
100 hr after last S ^R	3.8 ± 0.2	67.9 ± 4.1	3.3 ± 0.2	8.6 ± 1.8	5.3 ± 3.4	3.2 ± 0.8 7.9
150 hr after last S ^R	3.3 ± 1.1	66.1 ± 4.2	3.6 ± 0.4	9.4 ± 0.8	6.7 ± 3.8	3.5 ± 0.5 14.1
Survanta ^R	2.3	85.8	2.9	5.4	0.3	0.1 3.2

Conclusion: Surfactant administration increases the palmitate % in PC and decreases the % of other FAs. The increase lasts for more than 1 week ($t_{1/2} = 79 \text{ h}$) and the duration could be related to the number of doses of S^R. Alveolar type II cells probably incorporate linoleic acid from Intralipid into PC.

085

ELEVATED TSH AND LOWERED T4 IN INTENSIVE CARE NEONATES MAY NOT INDICATE NEED FOR TREATMENT

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Aim of the study: The finding of elevated TSH and decreased T4 in the newborn usually is classified as "transient hypothyroidism", thus the elevation of TSH is classified as consequence of the lowered T4. But on the other hand several data sets show that TSH elevation as well as low T4, one independently of the other one, are associated with different kinds of perinatal stress. Each of these laboratory deviations, if not associated with the other value being abnormal too, is generally accepted not to be an indication for treatment. From this we conclude, that more perinatal stress, as in intensive care neonates, may produce TSH elevation as well as low T4, but only coincidentally, not the TSH elevation being the consequence of low T4, thus not to be classified as "hypothyroidism", thus not indicating treatment.

If this hypothesis is right, we should find an association of increasing perinatal stress with an increasing number of neonates from TSH and T4 normal via TSH or T4 abnormal to high TSH and low T4.

Method: In the newborn screening program in Germany we determine primarily TSH, and only in the neonates with elevated TSH, in addition we determine T4. Thus in our study we asked whether we find an association of increasing perinatal stress with an increasing number of neonates from TSH normal via TSH abnormal while T4 normal to high TSH and low T4.

Definitions for this study were: TSH elevation = $>20 \text{ mU/l}$ (as usual in the German screening programs), T4 lowered = $<6 \mu\text{g/dl}$. Perinatal stress score was 0 or 1 or 2 or 3 in dependency of the neonate having stress in none to all of the following three categories: (a) forceps or vacuum extraction or sectio (b) birth weight below 2500 g (c) at the 5th day existence of a relevant neonatal disorder (RDS, icterus gravis, infection/sepsis, vitium cordis with hemodynamic relevance, severe malformation).

Results: Our data of 1131 neonates show a high significant association ($\chi^2 = 84$, $p < 0.001$) of, on one hand, perinatal stress score 0 with normal TSH, versus, on the other hand, perinatal stress score 2 or 3 with high TSH and low T4.

Discussion: Facing the background given above, in the intensive care newborn, the constellation of high TSH and low T4 may be only a coincidental addition of two independent abnormalities. In these cases - the high TSH not being the consequence of low T4 - the classification as "hypothyroidism" is not justified, thus a therapy not indicated. On the other hand of course there exist rare cases with high TSH as consequence of low T4 thus with hypothyroidism thus with indication for therapy. Unfortunately we have no criteria, that enable a certain discrimination of these two categories thus in respect to the question of therapy or not.

Conclusion: Further research has to be done to learn how to discriminate the coincidental high TSH and low T4 from the causal constellation of high TSH and low T4. Until we have certain discrimination criteria we have to treat both groups of neonates.

086

CENTRAL VENOUS OXYGENATION IN NEONATES WITH RESPIRATORY FAILURE F.B. Plötz, R.A. van Lingen, A. P. Bos. Dept. of Pediatrics, Sophia Hospital Zwolle, The Netherlands.

In neonatal medicine the current parameters, arterial oxygen saturation and arterial oxygen pressure, are poor indicators for oxygen delivery and oxygen demand. The purpose of this study was to obtain venous blood samples from the inferior vena cava in stable neonates with respiratory failure and to determine a parameter that reflects more adequately the balance between oxygen delivery and oxygen demand.

The study included 22 neonates requiring mechanical ventilation for severe respiratory insufficiency. An umbilical venous and arterial catheter were inserted in the inferior vena cava and in the aorta respectively. Paired blood samples were obtained at the time that the patients were hemodynamically stable. Fifty paired arterial and mixed venous blood samples were analyzed. Linear regression analysis showed the following correlations:

	Ca-vO2	FOE
PaO2	-0.005	-0.114
PvO2	-0.528	-0.592
Sat art	-0.057	-0.139
Sat ven	-0.634	-0.712

This study showed the feasibility of measuring mixed venous blood samples in the inferior vena cava via an umbilical vein catheter. This simple and safe method provides more adequate information about the oxygen delivery and oxygen demand status of critically ill neonates, due to the good correlation between the mixed venous oxygen saturation and the oxygen extraction ratio (FOE), than the current parameters of oxygenation.

087

RETINOPATHY OF PREMATURITY. INCIDENCE AND FACTORS. B.H. Doray and J. Orquin, Neonatology and Ophthalmology, Université de Montréal, Canada.

In a neonatal intensive care unit adjacent to a delivery room caring for 4000 mothers per year, (with a referral of 400 mostly for preterm delivery), virtually every neonate <1500g was seen by the same ophthalmologist, J.O. The incidence of retinopathy of prematurity (ROP) was in 1976-80 of 11 cases (464 preterms <1500g with 58% surviving to discharge, and 4% ROP in survivors; 8% if less than 30 weeks). In 1987-1993, 57 cases of ROP were diagnosed by the same ophthalmologist. 679 were born at less than 30 weeks, of which 452 (66%) survived to discharge, and among those survivors, ROP was present in 53 (12%), with rates varying from 58% at 24 weeks to 5% at 29. The incidence of ROP varied throughout the year for the survivors <1500g: December, 32%, July and August, 22%. When compared for different birth and neonatal factors with paired controls, mother's tocolysis with indomethacin, bronchopulmonary dysplasia, proven infection of the neonate are more frequent in ROP cases ($p<0,05$). Mother's hypertension, intra-uterine growth retardation, RDS requiring surfactant, increased length of time on IPPV, although not significantly so, were factors more frequently associated with ROP. However mother's medication with betamimetics, corticosteroids and magnesium sulphate did not differ between ROP and controls.

088

ORAL BIOAVAILABILITY OF DOXAPRAM IN THE PRETERM INFANT.
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Introduction

Doxapram hydrochloride is a central and respiratory stimulant which is used in neonatal intensive care units to treat caffeine-resistant apnoea of the newborn. Routinely, doxapram is administered intravenously. Oral administration would be much easier but data on bioavailability after oral administration are limited (two studies) and show a large variation.

Methods

We therefore studied the oral bioavailability of doxapram in 8 preterm infants. Doxapram treatment was started with an intravenous loading dose of 2.5 mg/kg during 15 minutes, followed by a continuous infusion of 1 mg/kg/h. After 24 h the intravenous administration was changed to continuous oral administration with the same dosage. Blood samples were collected 24 h after both the intravenous and oral administration and analyzed by HPLC-assay. Apnoea rates per 6 hours were listed before and after starting doxapram treatment.

Results: median [range]

Doxapram level (mg/L) after i.v.	1.72 [0.99 - 4.80]
Doxapram level (mg/L) after oral	0.91 [0.43 - 3.12]
Absorption ratio	0.53 [0.43 - 0.65]

The median apnoea rate per 6 hours declined from 9 to 2 after both the intravenous and oral administration.

Conclusions

1. The oral bioavailability of doxapram is between 43 and 65%, indicating that the oral route can be used effectively in these infants
2. There were no differences in the decline of the apnoea rate after intravenous versus oral administration of doxapram.

089

TITLE: Comparison of Different Methods of Intravenous Teicoplanine Administration in Neonates.

Authors: Tréluyer J.M, Bastard V, Sertin A, Settegrana C, Bourget P, Hubert P. **Objective:** to compare a method of teicoplanine (Teico) infusion using an electrical syringe-pump with a manual injection.

Methods: infusion of Teico was simulated through a standard neonatal I.V. system. The infusion system consisted of an Life Care 4 infusion pump (ABBOTT Lab.) with its i.v. set for maintenance intravenous fluid (flow ≤ 6 ml/h) connected to a 3-way stopcock. An 1 meter extension tubing (VYGON Lab.) was placed between the stopcock and a neonatal catheter. An another 1 meter tubing (injection tubing) was connected to the stopcock. The volume of the injection circuit was 2.6 ml. Simulations were realised for 2 weights (1 or 3 kg), with a doses of 8 mg /kg and a injected volume of 0.8 ml to 3 ml. Our goal was to perform a complete infusion in 10 minutes.

We compare one method of infusion with an electrical syringe-pump with 2 manual methods:

A: Teico was infused with a syringe-pump Pilot C (Becton & Dickinson Lab.) according to a protocol using 1) a priming before connecting the syringes to the tubing (for immediate starting of infusion), 2) a programmed volume injected in 5 minutes (the drug volume was greater than the dose prescribed to avoid loss of Teico into the syringe), 3) a 5 ml wash out was performed over 5 minutes with the syringe pump. **B:** Teico was manually injected in a few seconds in the tubing followed by a 5 ml wash out over 10 minutes. **C:** idem as B but a Nu Site valve (Medex) was connected to the proximal end of injection tubing to avoid leakage between removal of the Teico syringe and connection of the wash out syringe. During each run, serial samples were collected every ten minutes over a one hour period. The samples were assessed using HPLC method.

Results: the amount of drug delivered at 10 minutes was calculated and expressed as a percentage of the total amount of Teico prescribed. Results are a mean of 5 to 8 runs.

	A	B	C
1 Kg	94.2 ± 17.9 %	86.8 ± 9.1 %	94.4 ± 6.4 %
3 Kg	95 ± 4.9 %	72 ± 13.4 %	90.9 ± 6 %

Conclusion: with a drug volume injected < circuit volume and a valve, a direct i.v. administration of the drug in the circuit followed by a wash out seems an accurate alternative to drug infusion controlled by a syringe pump and is easier to perform.

090

Clinical Comparisons of Natural and Synthetic Surfactant

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Eleven randomised clinical trials have compared different surfactant preparations. Seven trials involving 2488 babies with respiratory distress syndrome (RDS) compared Survanta^R and Exosurf^R. Babies treated with Survanta^R had lower oxygen requirements for at least 3 days than those treated with Exosurf^R. Babies treated with Survanta^R also had less neonatal mortality (OR 0.81; 95% CI 0.65-1.01), retinopathy of prematurity (OR 0.81; 95% CI 0.66-0.99) and death or bronchopulmonary dysplasia (OR 0.86; 95% CI 0.75-0.99) when compared to those treated with Exosurf^R. Infasurf^R has been compared with Exosurf^R in two studies; one as prophylaxis and the other a rescue trial. Similar, although non-significant benefits were found for the natural surfactant. In 6 trials there was a significant reduction in pulmonary air leaks (OR 0.53; 95% CI 0.41-0.64) for babies treated with natural compared to synthetic surfactants. For 7 trials (3545 babies) comparing natural and synthetic surfactants for RDS (6 comparing Survanta^R and Exosurf^R, and one Infasurf^R and Exosurf^R) neonatal mortality was significantly reduced (OR 0.80; 95% CI 0.66-0.97) with natural compared to synthetic surfactant treatment.

In two further trials different natural surfactant preparations were compared. Reduced oxygen needs for 24 hours after treatment were found for Infasurf^R and Curosurf^R respectively when each was compared to Survanta^R. Apparent longer-term benefits from these surfactants were not statistically significant. Further trials will be needed to ascertain differences between various surfactant preparations.

Infectious disease

091

SEVERE DENGUE HAEMORRHAGIC FEVER IN PEDIATRIC CRITICAL CARE DEPARTMENT DR. KARIADI HOSPITAL, SEMARANG, INDONESIA.

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ABSTRACT

A preliminary study was done in 68 cases with severe Dengue Haemorrhagic Fever (DHF) in the period of 1st October 1995 until now. The age was between 1 - 14 years. The diagnosis of DHF was based on the criteria of WHO with positive Dengue Blot Test. Severe DHF consisted of Dengue Shock Syndrome (DSS), DSS with prolonged or recurrent shock, DSS with severe bleeding, DSS with pulmonary edema. The aim of the study is to know of severe DHF and factors which influenced the outcome.

Result of the study: there was a tendency in increasing mortality rate in cases with high serum lactic acid level, high anion gap, high arterio- alveolar O₂ gradient level and low serum albumin level.

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HEMORRHAGIC SHOCK AND ENCEPHALOPATHY SYNDROME IN THE NEGEV AREA OF ISRAEL: SEVERITY AND INCIDENCE

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Objective and study design: A retrospective study was performed for all patients diagnosed with hemorrhagic shock and encephalopathy syndrome (HSE) during 1984 to 1994. Soroka Medical Center is the only medical facility in the southern Negev region of Israel serving a population of ~400,000 residents, consisting primarily of Jews and Bedouins.

Results: 20 patients (17 Bedouins and 3 Jews) were diagnosed with HSE. Main features on arrival included profound shock and coma with convulsions. Active bleeding and/or disturbing coagulation tests with falling hemoglobin levels and thrombocytopenia was noted in every case. All infants developed diarrhea shortly after arrival. Elevated urea, creatinine and liver enzymes was noted in all cases. Annual incidence for infants <1 year of age was 5:10,000 for Bedouins and 0.6:10,000 for Jews. Patients ranged in age from 6-32 wks and arrived at the hospital late night/early morning (2:00am-11:00am), during winter/early spring (November-April). All were healthy prior to admission, with short prodromal symptoms of upper respiratory tract or gastrointestinal infection noted in 10 cases. Most infants had markedly elevated body temperature on arrival. A history of overwrapping and/or excessive heating was obtained in 4 of 20 infants. Bacteriological and virological cultures were negative in all infants. One infant died and neurological sequelae were observed in all survivors.

Conclusion: The high prevalence of hyperpyrexia during sleep in the presence of negative microbiological results with no evidence of excessive heating, and the high incidence of HSE among a closed, culturally isolated society known to have a high incidence of congenital malformations, may support previous assumptions that HSE results from hyperpyrexia, originating in most cases from a "physiologic" heat induced trigger which starts and peaks during the night in previously healthy infants with susceptible, predisposing genetic underlie.

093

ICU MORTALITY IN PAEDIATRIC BACTERIAL MENINGITIS: A DESCRIPTIVE STUDY

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INTRODUCTION Bacterial meningitis is a common cause of admission in the paediatric age group, and one which still carries a high morbidity and mortality. These complications are strongly associated with a delay in antibacterial therapy. A significant proportion of these patients require mechanical ventilation; it is in this particular group of patients that survival is greatly diminished. The identification of risk factors for mechanical ventilation associated with bacterial meningitis may help improving survival by shortening the delay to ICU referral. The Paediatric Risk of Mortality Score (PRISM) is the most widely used scoring system in the paediatric ICU literature; the accuracy of PRISM on predicting outcome in meningitis has been shown to be poor. AIM We aimed to describe our population of patients with bacterial meningitis requiring ventilation, and then to identify predictors of survival. **METHODS** This study was conducted at the Baragwanath Hospital in South Africa which is an University-affiliated institution with an average annual paediatric admission of 4500 patients. Baragwanath ICU admits 250 non-neonatal paediatric patients per year. A retrospective chart review from January 1991 to December 1995 of 42 consecutive paediatric ICU admissions with bacterial meningitis was performed. **RESULTS** Approximately 150 cases of bacterial meningitis are admitted to the general paediatric wards every year; this constitutes ± 3% of all admissions. The mortality of these patients is ± 14%. During this time 42 (23M, 19F) patients (7%) were accepted for ICU admission, with a mortality of 42.2%. The median age was 9 months (range 15 days to 17 years). The median delay to hospital admission was 48 hours, and the median delay to ICU admission was a further 4 hours. The median duration of ICU stay was 48 hours (40 for non-survivors, 120 for survivors). The main presenting features were convulsions (34%), altered mental state (40%), fever (50%), respiratory symptoms (24%), headache (18%), and diarrhoea and vomiting (32%). The most common indications for ICU admission were seizures (55%), coma (36%), shock (26%), respiratory failure (29%) and acidosis (21%). In 29% of patients there was a cardiorespiratory arrest prior to admission. The most common organisms in the CSF was pneumococcus (57%), haemophilus influenza (15%) and E. coli (12%). The presence of leucopenia (WCC < 5), a low platelet count (<100), acidemia (pH<7.2), and the need for inotropic support were strongly associated with non-survival. Tachycardia and hypotension were not significantly associated with poor outcome, as has been previously reported. **DISCUSSION** Early diagnosis of meningitis and prompt institution of antibiotic therapy requires a high level of clinical suspicion. Paediatric patients with bacterial meningitis that require mechanical ventilation have a poor prognosis. There is little evidence to suggest that non-survival can be predicted prior to ICU admission, but a rapid deterioration requiring ventilation and inotropic support with evidence of severe sepsis (low platelet count, leucopenia) is almost invariably associated with a fatal outcome. The long term functional outcome of these patients make this disease even more devastating; the role of ICU in the management of these patients has yet to be fully established.

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SEVERE RESPIRATORY SYNCYTIAL VIRUS-ASSOCIATED RESPIRATORY FAILURE: PATTERNS OF LOWER RESPIRATORY TRACT DISEASE IN YOUNG INFANTS

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Approximately 10% of hospitalised infants with respiratory syncytial virus (RSV) infection require mechanical ventilation. Our general practice is not to use specific antiviral therapy. We have undertaken studies of RSV-infected mechanically ventilated patients without underlying congenital heart disease or immunodeficiency.

Study I (n=45): A retrospective review of 45 infants (mean post-conceptual age 48 weeks; median duration of intubation was 8 days (interquartile range 5-11). Blinded review of chest x-rays during the first three days of mechanical ventilation revealed a spectrum of lower respiratory tract findings from marked diffuse consolidation in all zones without hyper-inflation (n=10) to gross hyperinflation without consolidation (n=5), with the remaining patients have an intermediate picture (n=30). Death occurred only in patients who were at the poles of this continuum (4/10 consolidation and 1/5 hyperinflation). Patients at these poles could be differentiated by gender predominance, birth gestation, alveolar-arterial (A-a) oxygen gradient ($p<0.01$), oxygenation index ($p<0.01$), peak inspiratory pressure ($p<0.05$), and intubation days ($p<0.01$).

Study II (n=28): Prospective audit of infants with the aim of verifying the above differentiation. Separating patients based on their early x-rays and A-a gradient we confirmed the above predictable difference in duration of supportive therapy (consolidation v intermediate: 6(4-7) v 14(12-33) $p<0.01$).

Severe lower respiratory tract RSV-infection in young infants results in different distinctive patterns of disease with characteristic radiological and clinical features, and each has a predictable timecourse. Conflicting reports on special therapy should be interpreted with respect to these observations before making conclusions about the efficacy of any specific treatment.

095

NOSOCOMIAL INFECTION AS A MORTALITY RISK FACTOR IN A PAEDIATRIC INTENSIVE CARE UNIT IN A DEVELOPING COUNTRY.

S. Campos, E. Quiñones, A. Dávalos, X. Sevilla

INTRODUCTION: Globally, nosocomial infection is a major determinant influencing mortality in intensive care units, with an estimated incidence of 20% to 70%. In developing nations, this figure is often significantly higher due to limited resources and noncompliance with infection control procedures.

OBJECTIVES: To identify the incidence of and establish the prognosis for patients diagnosed with nosocomial infection in a paediatric intensive care unit (PICU).

METHODS: The 275 patients admitted to the PICU at Hospital Baca Ortiz, Quito from January 1995 through October 1995 were prospectively studied. Nosocomial sepsis cases were selected according to CDC criteria. Nosocomial pneumonia cases included mechanically ventilated patients following clinical, radiological and bacteriological criteria (positive culture of tracheal aspirate). Nosocomial central venous catheter (CVC) infections were diagnosed by positive cultures obtained from the catheter tip.

RESULTS: Of the 275 patients admitted, 18 (6.5%) developed nosocomial infection documented by positive blood culture. Mean length of stay in the PICU was 27.4 ± 30.6 days for infected patients versus 4.3 ± 4.2 days in uninfected patients ($p=0.005$). For 12 of the infected patients, the admitting diagnosis was a neurological condition including head trauma ($n=2$), convulsive disorder ($n=2$), and Guillain Barre ($n=1$). 158 (58%) of the 275 patients underwent mechanical ventilation. Of these, 8 cases (5%) developed nosocomial pneumonia. Average elapsed time between admission to PICU and pneumonia diagnosis was 7.5 days (range 4 to 15 days). Gram negative pathogens, the most commonly identified organisms, were found in 94% of pneumonia cases, and included *Pseudomonas aeruginosa* ($n=4$), *Klebsiella pneumoniae* ($n=2$), *Escherichia coli* ($n=2$), *Citrobacter freundii* ($n=1$) and *Acinetobacter calcoaceticus* ($n=1$). Fungi were second most common ($n=4$) and finally gram positive cocci ($n=1$). Mortality due to nosocomial pneumonia was 40%, and rose to 66% when associated with culture proven bacteraemia. 95 (35%) of the 275 patients had central venous catheters placed. Of these, 76 (80%) developed infections at the catheter tip. In 70% of patients with infected CVC, the only indication for placement was I.V. fluid administration. Most common pathogens isolated from CVCs were gram negative bacteria.

CONCLUSIONS: Our data indicate that nosocomial infection represents an important risk factor influencing outcomes in PICUs in a developing country. Nosocomial infections were most common in patients who underwent mechanical ventilation and CVC placement. More stringent infection control procedures should be initiated, in addition to more clear indications for the need for mechanical ventilation and CVC placement.

097

CONVENTIONAL VERSUS LIPOSOMAL AMPHOTERICIN B IN CHILDREN.

A. Rodriguez-Núñez and the Ad Hoc Spanish Pediatric Intensive Care Society's Collaborative Study Group*.

Objective: To assess the comparative antifungal efficacy and safety of two amphotericin B formulations in children with invasive mycosis.

Material and methods: The clinical data of 186 children which suffered from a severe mycosis between Jan.1990-Dec.1994 and which were treated with amphotericin B in 10 spanish hospitals were collected. Mean age was 6 ± 3.9 years; 157 were male (84%) and 29 female (16%). The most common underlying diseases were leukemia/lymphoma (31%) and congenital heart defects (20%). The major pathogens isolated were candida albicans (61%), other candida (18%) and aspergillus (17%).

Results: Conventional amphotericin (CA) was administered in 118 children (63%) and liposomal amphotericin (LA) in 68 (37%). In the CA group, the starting dose was 0.3 ± 0.1 mg/kg, reaching a maximal dose of 0.9 ± 0.3 mg/kg after 4.7 ± 3 days. Maintenance time was 14 ± 10 days and the cumulative dose: 12 ± 17 mg. In the LA group, the starting dose was 1.1 ± 1 mg/kg, reaching a maximal dose of 2.9 ± 3.4 mg/kg ($p<0.01$) after 5 ± 5 days. Maintenance time was 19 ± 16 days ($p<0.05$) and the cumulative dose 42 ± 37 mg ($p<0.05$). The reasons for LA use were: elective in 66% of cases, previous renal failure in 29%, and CA inefficacy in 4%. Hepatic or renal function impairment was two times more frequent in LA group than in CA group. The antifungal efficacy was 62% for CA and 67% for LA. Therapeutic failure or toxicity induced withdraw of CA in 7% of cases, vs. 1.5% for LA ($p<0.01$). Mortality was not different in both groups (21 vs. 22%). Adverse effects were related to CA in 28 events vs. only one in LA group ($p<0.01$). The commonest side effects in CA patients were fever (18%), chills (10%) and nausea (9%). In CA group, 44 cases (37%) developed analytical abnormalities related with amphotericin, vs. 10 cases (15%) in LA patients ($p<0.001$). In the first group, the commonest serum alterations were hypokalemia (25%), raised creatinine (14%) and bilirubin (6%). In the second one, hypokalemia presented in 7% of cases ($p<0.01$), raised bilirubin in 6% and creatinine in 3% ($p<0.05$).

Conclusions: The antifungal efficacy of LA is at least the same of CA. From the clinical and analytical points of view, LA is much less toxic than CA. LA can be used at a greater dose than CA and is safe in children with renal failure.

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NOSOCOMIAL INFECTIONS IN 18 FRENCH NICU AND PICU :
THE « REAPED » NETWORK.

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The French « Reaped » network was created to implement a nosocomial infections (NI) quality care program in NICU and PICU. The first objective was to describe the annual NI incidence rate in each ICU population : all patients stayed more than 48 hours in ICU.

Methods : NI criteria were defined by the Reaped group according to CDC criteria. All data were collected by a medical and nursing team. All infection data were validated by an external investigator.

Results : 4525 patients were admitted over a 14 months period. 68% were newborns. 371 NI were identified among 311 patients. The overall NI incidence rate (IR) was 8.2% and 5.9% per person day (from 5.0 to 8.2% according to age, lowest rate for newborns). Septicemia (50% of NI) and pneumonia (41% of NI) were the two main NI. According to age, the septicemia IR varied from 6.8 to 10.9% per catheter day (lowest rate for newborns) and the pneumonia IR from 3.9 to 7.4% per ventilator day (lowest rate for newborns). There were very few other infections (UTI : 4%, IR : 7.4% per catheter day). Gram positive cocci were isolated in 73% of septicemia (70% of them were coagulase negative staphylococcal). Gram negative bacilli were isolated in 53% of pneumonia (40% of them were pseudomonas). 5% of NI were caused by candida, mostly septicemia. The septicemia and pneumonia IR varied according to unit even after adjustment for age.

Discussion : One explanation proposed by the Reaped network is the different uses and maintenance procedures of central line devices in each unit.

Conclusion : Central line related septicemia IR would be considered as a good indicator of quality of care by the Reaped network. Further studies would precise the definition of central line related infection in neonates and describe the different central line uses in each unit.

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POPULATION PHARMACOKINETICS OF TOBRAMYCIN (TOBRA) IN THE NEWBORN.

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Introduction

The aminoglycoside antibiotics are frequently used in newborns for the treatment of severe infection and sepsis due to Gram-negative microorganisms. The currently recommended dosage schedule for TOBRA (2.5 mg/kg q18h) does not take into account differences in gestational or postnatal age during the first 4 weeks of life. We questioned the validity of these recommendations and studied the population kinetics of tobramycin to establish predictive equations that enables the clinician to select the appropriate initial dosing schedule.

Methods

TOBRA trough ($t=0$) and peak values ($t=1$) were taken on day 2-4 after birth in 460 newborns. TOBRA was administered as a 30-minute intravenous infusion already in an adapted dosage schedule: 3.5 mg/kg q24h in infants with GAs < 28 weeks; 2.5 mg/kg q18h in infants with GAs between 28-36 weeks and 2.5 mg/kg q12h in infants with GAs > 36 wks. TOBRA concentrations were analyzed by TDX-assay.

A one-compartment model was assumed and non-linear mixed effect modelling (using NONMEM) was applied to the data. A trough level < 2 mg/L and a peak level between 6 and 10 mg/L was required.

Results

With the present dosage scheme 40% of the trough levels were too high and almost 60% of the peak levels too low. Calculations showed that the following dosage schedule should result in optimal levels of TOBRA.

preterm infants GAs < 28 wks:	6 mg	q48h
preterm infants GAs 28-36 wks:	4.5 mg	q36h
preterm infants GAs > 36 wks:	3 mg	q24h

Conclusions

1. The currently recommended dosage schedules for TOBRA result in high trough and low peak levels.
2. Prolongation of the dosing interval and increasing the amount of drug per dose according to the above scheme will improve TOBRA level control.

ECMO/PPHN

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Preliminary Results of the Collaborative ECMO Trial

G.A. Pearson & D. Macrae on behalf of the Steering Group

Since January 1993 British clinicians have been conducting a randomized controlled trial of neonatal ECMO. Mature infants (≥ 35 weeks gestation and birthweight ≥ 2 kg) with severe cardiopulmonary failure have been randomized to receive continued care in their referring institution or referral to a designated ECMO centre for further management. We now present the preliminary results which have prompted closure of recruitment to this trial. The final outcome will be assessed as intact survival against death or severe disability at one year of age for all the recruited patients.

Patients were categorised by diagnosis such as isolated persistent fetal circulation, secondary persistent pulmonary hypertension of the newborn or congenital diaphragmatic hernia and by severity of illness at the point of first contact with the clinical coordinators of the trial - judged primarily by the oxygenation index (≥ 40 before randomization).

180 patients were randomized (90 in each arm). Hospital outcome data are reported for all patients and 1 year outcomes on 118 (65 survivors). At this stage 26 of the babies allocated to ECMO are known to have died compared to 52 of those allocated to conventional management (RR 0.5; 95% CI 0.35-0.72; P=0.0002). Fewer deaths have been observed amongst ECMO allocated babies in all the diagnostic categories used. A 28% incidence of disability and impairment has been observed amongst survivors. This rate is similar in both groups and the survival advantage is not offset by an increased rate of disability or impairment following allocation to ECMO.

We consider that these data combined with those available from other studies provide conclusive evidence that the survival to discharge from hospital is substantially higher in patients allocated to ECMO than in comparable infants not so allocated. Therefore recruitment to this trial has been closed whilst awaiting complete one year outcome data.

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PROLONGED ECMO FOR TREATMENT OF SEVERE MYOCARDITIS

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The mortality rate of pediatric patients with acute myocarditis is 20-60% according to the severity of myocardial damage. A 15 month old girl presented with high fever, respiratory and cardiac failure. Diagnosis of acute myocarditis was made and the patient was ventilated with high pressures and FIO₂ of 1.0. She required high doses of inotropes. Echocardiography revealed a dilated LA and LV with severe MR. LVEDD was 41 mm and LVSF 9%. Calculated oxygenation index was 55. She was resuscitated after a cardiac arrest. She was commenced on ECMO (using Biomedicus centrifugal pump and Avecor 800 oxygenator) at a flow of 100 ml/kg/min with immediate improvement of hemodynamics, oxygenation and pCO₂. Respiratory assistance and vasoactive drugs were reduced. The patient was transported by air, on ECMO, to the ECMO center. She developed ARF and CVVH-D was performed. Cardiac function started to improve after 12 days. ECMO was discontinued on day 18. Echo revealed LVEDD 34 mm and LVSF 24%. IPPV was discontinued on day 20. On discharge, a month later, her LVEDD was 29 mm and LVSF 28%. She behaves normally for age without neurologic or other medical sequelae. Literature search revealed no case of acute myocarditis, as severe, that was treated successfully. Survivors of disease this severe usually suffer dilated cardiomyopathy and permanent disability. The use of ECMO allows myocardial rest which prevents long term myocardial damage.

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PROLONGED ISOFLURANE SEDATION ON ECMO DOES NOT CAUSE FLUORIDE TOXICITY

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Isoflurane is a safe and effective means of long term sedation in both children and adults in the intensive care setting. The use of isoflurane, by adding it to the sweep gas allows the use of this volatile anaesthetic agent in patients on ECMO, enabling rapid control and weaning of sedation. A potential problem with the long term use of isoflurane is fluoride ion accumulation with the possibility of renal toxicity. The purpose of this study was to assess plasma fluoride levels in patients receiving prolonged isoflurane on ECMO.

Method: Fifteen infants and children (aged 1 day - 10 years, median 2 weeks) receiving ECMO support for either cardiac or respiratory failure were recruited to this study. The patients were sedated with isoflurane as well as intravenous agents (morphine and midazolam). Isoflurane was administered (0% - 3%) via a calibrated vaporiser to the sweep gas, adjusting the level to maintain adequate sedation. Blood samples were obtained on a daily basis for plasma inorganic fluoride assay. The relationship between plasma fluoride and amount of isoflurane administered, as %·hours (vaporiser setting in % x hours) was calculated by linear regression.

Results: The duration of ECMO ranged from 42 to 532 (mean 207) hours, during which the amount of isoflurane administered varied from 7 to 418 (mean 168) %·hours. 75 blood samples were analysed, demonstrating individual peak plasma fluoride levels of 2.7 to 16.5 µmol/l, mean 7.1 µmol/l (toxic threshold = 50 µmol/l). The plasma fluoride positively correlated with the %·hours of isoflurane (r = 0.65, p = < 0.001).

Conclusion: This study shows that although there is a dose related accumulation of inorganic fluoride ions in patients sedated with isoflurane on ECMO, the peak fluoride levels are well below the suggested toxic threshold.

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HOW TO DOSE AMOXICILLIN AND CEFOTAXIME DURING EXTRACORPOREAL MEMBRANE OXYGENATION (ECMO)

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Introduction

ECMO is increasingly used in the care of critically ill newborns. Despite the frequent use of betalactam antibiotics in the treatment of these infants there are no data available on the disposition of cefotaxime (CTX) and amoxicillin (AM) during ECMO. The purposes of this study were to determine the pharmacokinetics of these two drugs in infants on ECMO and consequently formulate appropriate dosing regimens.

Methods

We therefore studied the pharmacokinetics of CTX (100 mg/kg q12h) and AM (50 mg/kg q6h) in 8 term infants on day 3 after birth. Blood samples were taken before (t=0) and 0.5, 1, 2, 4, 6 (AM) and 12 h (CTX) after the intravenous bolus injection and analyzed by HPLC-assays. The pharmacokinetics of both AM and CTX followed a one-compartment open model.

Results: mean \pm SD.

	AM	CTX
Serum half-life (h)	4.96 \pm 1.47	3.41 \pm 0.79
Volume of distribution (mL)	2920 \pm 1260	1970 \pm 400
Total body clearance (mL/h)	400 \pm 70	410 \pm 90
Trough levels (mg/L)	46 \pm 9	10 \pm 4

Conclusions

1. CTX 100 mg/kg q12h results in adequate serum levels of CTX in fullterm infants on ECMO.
2. AM 50 mg/kg q6h results in very high serum trough levels. Recalculation based on the known volume of distribution and elimination serum half-life of these infants resulted in the following dosage recommendation: 50 mg/kg q12h.

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PERSISTENT PULMONARY HYPERTENSION OF THE NEW-BORN (PPHN) IS ASSOCIATED WITH BRONCHOCONSTRICION AND BRONCHIAL SMOOTH MUSCLE HYPERSTROPHY.

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Persistent pulmonary hypertension of the new-born (PPHN) is characterised by rapid fluctuations in pulmonary artery pressure (PAP) and a clinical impression of stiff lungs.

Lung mechanics were measured in 35 term infants, mean age 1.5 ± 0.7 days who were paralysed and ventilated within the first three days of life.

Fourteen infants had PPHN with systemic or suprasystemic PAP measured by echocardiography. In these patients, the respiratory system resistance was 29.4% higher ($p < 0.001$) and compliance 22.4 % lower ($p = 0.03$) during systemic or suprasystemic PAP compared to when the pulmonary hypertension had resolved. In contrast, there were no changes in resistance in the 14 infants with respiratory distress syndrome (RDS) and no pulmonary hypertension or in the seven infants with normal lungs, where two readings were taken 24 hours apart. The changes in lung mechanics interfered with mechanical ventilation, resulting in a 12.5 mmHg rise in PaCO_2 ($p=0.007$) during pulmonary hypertension.

Inhalation of nitric oxide 10 PPM resulted in a 16% decrease in respiratory system resistance and an improvement in oxygenation.

The bronchial and vascular smooth muscle was increased by 120% in post-mortem lung samples from eight infants with PPHN compared to six age matched post-mortem controls with normal lungs ($p<0.001$).

These findings suggest a co-constriction and co-hypertrophy of bronchial and vascular smooth muscle during PPHN. Anatomically the pulmonary vasculature and bronchi lie in close proximity to each other. Thus mediators such as Endothelin-1 released locally may act on both vascular and bronchial smooth muscle to produce the observed vasoconstriction, bronchoconstriction and smooth muscle hypertrophy.

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Asthma

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CLINICAL CHARACTERISTICS OF ASTHMATIC CHILDREN ADMITTED TO BARAGWANATH INTENSIVE CARE UNIT.

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INTRODUCTION An increasing mortality in asthmatic children has been reported. The increased severity of asthmatic illness leads to an increased demand for ICU admission, and a corresponding increased need for mechanical ventilation. Geographic and environmental factors are thought to be partly responsible for differences in disease severity throughout the world. For this reason, epidemiological studies from diverse areas are important. Risk factors for ICU admission, and for the institution of mechanical ventilation should be identified, to optimise ICU admission criteria and to avoid unnecessary delays in admitting at-risk patients. **AIM** To document the clinical characteristics of ventilated and non-ventilated asthmatic patients admitted to ICU.

METHODS This is a retrospective study of all paediatric asthma ICU admissions from January 1990 to December 1995. **RESULTS** There were 65 patients admitted to the ICU for acute severe asthma in the study period. The male:female ratio was 33:32, the mean age 76.1 ± 57.3 months, the mean PRISM 8.5 ± 11.1 , and the mean duration of admission 135 ± 129 hours. There was no seasonal variation in admissions. Only 40% (26/65) patients required mechanical ventilation. In 22% of all patients this was the first presentation with asthma. There were some significant differences between ventilated and non-ventilated patients (see Table). There was a significantly higher incidence of concomitant and nosocomial pneumonias in the ventilated patients (84.0% vs 21.1%) as well as segmental lung collapse (68.0% vs 26.3%). There were no deaths. **DISCUSSION** The need of mechanical ventilation significantly increases the morbidity of and duration of ICU stay of asthmatic patients. Younger asthmatic paediatric patients have a significantly higher risk of ventilation. The need for ventilation is predicted principally from a worsening pCO₂ and respiratory acidemia, which is often independently interpreted by the clinician as respiratory exhaustion. This study has shown that ICU admission is important in the management of young paediatric patients with acute severe asthma and respiratory failure.

	VENTILATED	NOT VENTILATED
Age (months)	53.9 (34.8 - 73.1)	90.8 (71.6 - 110.0)
PRISM (%)	15.3 (9.4 - 21.2)	3.8 (2.7 - 4.8)
Duration of admission (hrs)	254 (204 - 305)	55 (42 - 67)
Prehospital symptoms (hrs)	27 (19 - 35)	36 (24 - 48)
Delay to ICU admission (hrs)	11 (6 - 16)	18 (0 - 36)
Admission pH	7.27 (7.20 - 7.34)	7.34 (7.29 - 7.38)
Admission pCO ₂	46.5 (37.3 - 55.6)	38.3 (29.5 - 47.2)
First ICU pH	7.27 (7.21 - 7.33)	7.40 (7.39 - 7.43)
First ICU pCO ₂	51.1 (42.6 - 59.7)	31.5 (29.4 - 33.6)
Worst pH first 24 hrs	7.17 (7.11 - 7.24)	7.33 (7.24 - 7.41)
Worst pCO ₂ first 24 hrs	74.5 (57.5 - 91.4)	27.1 (12.6 - 41.7)

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INTRAVENOUS TERBUTALINE IN PICU

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Introduction: The admission to a PICU of children with respiratory failure secondary to an acute obstructive lower airway disease is a common event, especially during winter seasons. These diseases have several causes, but most of them (especially asthma and chronic airway disease) have a good response to the administration of B2-adrenergic drugs.

Objective: To find the dose of intravenous terbutaline that is safe, efficient and with minimal adverse effects when used in children admitted to a PICU with acute obstructive lower airway disease and respiratory failure.

Material and Methods: We study the records of all children that were admitted to our PICU during the winter of 1995. Only the patients that had respiratory failure and acute lower airway disease and who needed the use of IV terbutaline were selected. The records were divided in two groups: less than 12 months and more than a year old. These two groups were compared in the following aspects: the minimal and maximal dose, and the length of time of use of IV terbutaline, frequency of tachycardia, hypokalemia, and mechanical ventilation. To establish any difference in the two groups we use the T exact test of Fisher and λ^2 , with $p < 0.05$.

Results: During the period of study were admitted 367 patients to the PICU, and 38 (10.3%) of them used of iv terbutaline. The mean age was 14.2 ± 12.2 month, used iv terbutaline during 7.24 ± 3.75 days (0.5 to 17 days), the initial rate was $0.55 \pm 0.26 \mu\text{g}/\text{kg}/\text{min}$, and the means of therapeutic dose was $2.48 \pm 1.18 \mu\text{g}/\text{kg}/\text{min}$ (ranged from 0.5 to 4.4). Twelve (31.5%) patients had tachycardia an obstacle to the increases in the rate of use of iv terbutaline during any time. Mechanical ventilation was necessary in 22 patients (57.8%) and 11 (28.9%) patients died. The children under 1 year of age used initial dose of iv terbutaline lower than the children up of 1 year old ($0.45 \mu\text{g}/\text{kg}/\text{min} \times 0.57 \mu\text{g}/\text{kg}/\text{min}$, $p < 0.001$), but without difference in the length of use, the maximal dose, the rate of mechanical ventilation and tachycardia. The frequency of hypokalemia was most common in the group of children under year of age.

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Intravenous salbutamol in the emergency department management of severe asthma in children.

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It is postulate that if an initial intravenous loading dose of salbutamol is given in severe asthma, a more rapid clinical response will occur, reducing requirements for continued high doses of nebulised salbutamol with fewer side effects.

This double blinded study was conducted in the Emergency department of Westmead Hospital a university hospital in Sydney, Australia. All children with severe asthma had initial nebuliser therapy (5mg of salbutamol with 4mL of saline). If asthma remained severe 20 minutes later, they were given a dose of intravenous hydrocortisone (5mg/kg) and either normal saline or salbutamol 15microgm/kg intravenously. Frequent nebulised salbutamol therapy continued during the initial first hour if clinically indicated. Continuous respiratory and haemodynamic monitoring occurred in the first 2 hours. Serum potassium and glucose determinations were made at study commencement and 1 hour after intravenous therapy. Salbutamol determination was made at study commencement. Children remained clinically monitored for the next 22 hours, with their ongoing treatment determined by clinical response.

29 children with severe asthma 12 months to 12 years of age were studied, with 14 given intravenous salbutamol and 15 given intravenous saline. The intravenous salbutamol group (IVSG) showed rapid reduction in asthma severity scale in the first 2 hours, with reduced need for high frequency nebuliser therapy (\leq hourly), occurring 8.78 hours earlier. No clinically significant side-effects were found in either group, although, tremor more frequent in the IVSG. Biochemistry and salbutamol concentrations were similar in both groups.

The use of intravenous salbutamol (15 microgm/kg) in the management of severe childhood asthma is a safe and effective therapy with no significant side-effects and the potential to abort severe asthma attacks in the emergency department.

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PRESSURE SUPPORT VENTILATION IN CHILDREN WITH ASTHMA

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Acute respiratory failure during status asthmaticus may require mechanical ventilation. Current therapy includes paralysis, pressure control ventilation (PCV) and permissive hypercapnia to limit pulmonary barotrauma and its hemodynamic consequences. Asthmatic children exert a significant amount of respiratory effort during exhalation. With paralysis, this expiratory effort is lost. Unloading the inspiratory work of breathing while maintaining the patient's expiratory effort using pressure support ventilation (PSV), may be beneficial.

Methods: Children receiving PCV (peak inspiratory pressure (PIP) = 4 kPa, rate 10 breaths/min) and $\text{PCO}_2 > 8$ kPa were switched to PSV. Children were initially ventilated with PSV 3.7 kPa and PEEP = 0.3 kPa (Servo 900C). All children received beta agonist therapy, ipratropium and anesthesia with ketamine or inhalational anesthesia, and were breathing spontaneously. Respiratory parameters and blood gases are shown before PSV, within 30 minutes (Start) and when the pH had normalized (During). Data are presented as median and range, * $p < 0.03$ compared to before PSV.

	PIP kPa	pH units	PCO ₂ kPa	PO ₂ kPa	I:E
Before	median range	4 3.8-4.2	7.25 6.87-7.28	11.1 8.4-20.7	23.2 8.9-41.3
Start	median range	3 2.8-3.8	7.22 6.95-7.34	11.3 7.0-20.6	16.6 13.2-46
During	median range	3.2 2.5-3.8	7.41* 7.39-7.43	5.9* 5.2-6.3	14.7 10.5-23.7

Results: Children with hypercarbia during PCV responded to PSV, normalizing PCO₂ and pH within 6 hours. The mean respiratory rate decreased from a median of 45 (31-46) to 35 (22-35) while the PIP was decreased to 3.2 (2.5-4.0) kPa within 6 hours. The I:E ratio also significantly decreased.

Conclusion: PSV permitted patients to actively exhale while unloading the inspiratory work of breathing. Perhaps this strategy shifts the patient's respiratory effort from inspiration to exhalation, thus permitting the child to meet the excess work of breathing caused by bronchoconstriction.

108**CONTINUOUS INFUSION OF KETAMINE IN MECHANICALLY VENTILATED PEDIATRIC PATIENTS WITH BRONCHOSPASM.**

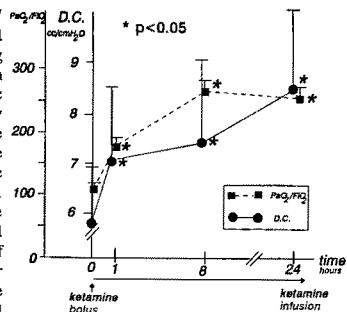
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Introduction: Mechanical ventilation of patients with severe bronchospasm can be difficult, due to poor chest compliance and increased airway resistance. Ketamine is a commonly used anesthetic agent that has been shown to have bronchodilator properties. The purpose of this study was to determine if a continuous infusion of ketamine had an effect on the oxygenation and chest compliance of children with severe bronchospasm who were mechanically ventilated.

Methods: A retrospective chart review was conducted of pediatric patients in severe bronchospasm who were mechanically ventilated in our PICU and treated with a continuous ketamine infusion. All patients were receiving aggressive bronchodilator therapy and adequate sedation prior to ketamine. Patients were excluded if any new bronchodilator or sedative agents were started within 24 hours of initiation of ketamine treatment. All patients were simultaneously treated with benzodiazepines. For each patient, the $\text{PaO}_2/\text{FiO}_2$ ratio and dynamic compliance [tidal volume/(peak insp. pressure - PEEP)] was determined immediately prior to ketamine, and at 1, 8, and 24 hours post-ketamine initiation. Data are presented as mean \pm S.D., and were analyzed using one way ANOVA and the multiple comparison method of Bonferroni.

Results: Over a 3 year period, 17 patients (age 6.0 ± 5.7 yrs.) received ketamine for severe bronchospasm during mechanical ventilation in our PICU. Both the $\text{PaO}_2/\text{FiO}_2$ ratio and dynamic compliance increased significantly following initiation of the ketamine infusion (see figure). The mean ketamine dose was 32 ± 10 mcg/kg/min, and the mean infusion duration was 40 ± 31 hours. One patient required glycopyrrolate to control excessive airway secretions, and one patient required an additional dose of diazepam to control hallucinations after cessation of ketamine. All patients were successfully weaned off mechanical ventilation and discharged from the PICU.

Conclusion: Continuous ketamine infusion to mechanically ventilated pediatric patients with refractory bronchospasm results in a significant improvement in oxygenation and dynamic compliance of the chest.

**109****STATUS ASTHMATICUS IN THE PEDIATRIC INTENSIVE CARE UNIT: A THREE YEAR REVIEW.** VJ Wang, NR Patel, and CJL Newth. Division of Pediatric Critical Care, Childrens Hospital Los Angeles (CHLA), Los Angeles, CA, USA 90027.

Reports of adults with status asthmaticus document significant morbidity and mortality, whereas studies in children have had more varied results. Different centers report mechanical ventilation (MV) in 10 to 33% of admissions, occurrence of pneumothoraces or pneumomediastinums in 2 to 11%, and mortality in up to 7% of patients.^{1,2,3} We retrospectively reviewed 113 status asthmaticus admissions to the pediatric intensive care unit (PICU) between January 1993 and December 1995. Seventy-five of these patients were admitted from the emergency department of CHLA (ER Admit). The mean length of stay in the PICU was 2.1 days and the mean length of stay in the hospital was 4.6 days. Based on 95 patients who had arterial blood analyses, 36 patients had hypercapnia ($\text{pCO}_2 > 45$). All patients received oxygen, inhaled albuterol (Alb), and corticosteroid therapy. Ninety-five percent of patients also received methylxanthine (MX) therapy. Of the 113 admissions, 12 patients (11%) required MV. Only 4 of these patients were admitted through our emergency department, whereas the remaining 8 patients were intubated at outside facilities. Twenty-three cases required intravenous beta-agonist therapy, either isoproterenol (Isop) or terbutaline (Terb). Half of the cases reviewed were complicated with hypokalemia ($K^+ < 3.5$). Complications of pneumothoraces or pneumomediastinums were seen in 10% of transported patients, but in only 4% of ER Admit patients. Only 2% of these were in mechanically ventilated patients. There were no deaths in the review.

Patients	Alb	Cont Alb	Steroid	MX	Isop	Terb	MV
Total	100%	78%	100%	95%	10%	11%	11%
Transport	100%	82%	100%	97%	16%	13%	21%
ER Admit	100%	76%	100%	93%	7%	9%	5%

With aggressive management at a pediatric institution, using beta-agonists, corticosteroids and methylxanthines, the morbidity and mortality of critically ill children with status asthmaticus is less than previously reported.

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Monitoring

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CAN PIEZOELECTRIC TRANSDUCERS BE USED TO EVALUATE RESPIRATORY MECHANICS IN VENTILATED CHILDREN?

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Respiratory mechanics measurements are useful in mechanically ventilated children to optimize ventilator settings. Nevertheless, the transducers used to measure flow (F) and pressure (P) remain expensive. **Objective.** To evaluate the performances of piezoelectric P transducers (350 US Dollar) in measuring F and P. **Methods.** We used a previously described monitoring system measuring respiratory parameters [1]. In this study F was obtained by a differential piezoelectric P transducer ($\pm 12.7 \text{ cmH}_2\text{O}$, Honeywell) whose sensitivity has been reduced to $\pm 2 \text{ cmH}_2\text{O}$ by an electronic amplification equipment and P by a piezoelectric P transducer ($\pm 70.3 \text{ cmH}_2\text{O}$, Honeywell) connected to a grid pneumotachymeter (PNT) (Fleisch 0 or 1). Volume (V) (5 to 400 ml) obtained by numeric integration of F (0.125 to 10 L/min) and P (2 to 70 cmH₂O) were respectively delivered through a calibrated seringe and an electronical manometer (Pic 400 Premier) and calculated by the computer. Bland and Altman analysis was used for assessment of results bias. Coefficient of repeatability (CR) was estimated by the standard deviation of repeated measurements of the parameters as calculated in a one-way analysis of variance. **Results.** Mean difference (Mdif) between injected V (5 to 50 ml) and measured V using PNT 0 was 0.15 ml, SD = 0.13 ml. Difference and mean V were not correlated. SD of repeated V measurements were not correlated to V. CR was 0.4 ml. Mdif between injected V (25 to 400 ml) and measured V using PNT 1 was 3 ml, SD = 6 ml. SD of repeated V measurements were not correlated to mean V. CR was 6 ml. Mdif between injected P and measured P was 0.3 cmH₂O, SD 0.4 cm H₂O. SD of repeated P measurements were not correlated to mean P. CR was 0.3 cmH₂O. **Conclusion.** Inexpensive piezoelectrical transducers can be used to measure F and P and evaluate respiratory mechanics in ventilated children.

Reference. [1] Logier R et al. Proceedings of the 15th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 1993, Vol 15, 2, pp 1004-5.

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EFFECT OF PLATEAU PHASE AND AIR LEAK ON STATIC AND DYNAMIC COMPLIANCE. Montgomery VL. Dept. Pediatrics, Kosair Children's Hospital, U. of Louisville, Louisville, Kentucky, USA.

During mechanical ventilation, an air leak (AL) and plateau phase duration (PL) may influence dynamic and static compliance (Cdy and Cst, respectively). This study evaluated the effect of AL and PL on two methods of measuring Cdy and Cst. **Methods.** 13 intubated, ventilated patients in a Pediatric Intensive Care Unit were evaluated after obtaining informed consent. Patients were intubated with a cuffed endotracheal tube and ventilated with a Servo 900C ventilator. Cdy and Cst were determined using the Servo and SensorMedics 2600. Four treatment conditions were evaluated: A=no AL, 10% PL; B=no AL, 20% PL; C=AL, 10% PL; and D=AL, 20% PL. Data were analyzed by within-groups repeated measures ANOVA. **Results.** See Table 1. The absence of an AL, regardless of PL, produced a greater Cdy by the Servo compared to the SensorMedics. (p=0.009) The Servo overestimated Cst compared to the SensorMedics, regardless of treatment condition. (p=0.005) **Conclusions.** Cdy and Cst obtained by these methods have a predictable relationship, regardless of AL or PL. Calculation of Cdy and Cst from ventilator measurements when more formal evaluation is not possible may identify changes in Cdy and Cst even though it may not provide an accurate measurement of Cdy or Cst.

	Tx A	Tx B	Tx C	Tx D
Cdy				
Servo	0.50 \pm 0.07	0.52 \pm 0.06	0.46 \pm 0.08	0.43 \pm 0.09
SensorMedics	0.39 \pm 0.07	0.39 \pm 0.06	0.49 \pm 0.09	0.46 \pm 0.09
Cst				
Servo	0.70 \pm 0.10	0.64 \pm 0.07	0.72 \pm 0.10	0.70 \pm 0.10
SensorMedics	0.50 \pm 0.08	0.55 \pm 0.09	0.49 \pm 0.09	0.52 \pm 0.09

Table 1. Mean \pm SEM. Units are mL/cmH₂O/kg

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INTRAPATIENT VARIABILITY IN PULMONARY FUNCTION TEST (PFT) IN VENTILATED PRETERM INFANTS.

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Previous studies have already shown the problem of the reproducibility of PFT in preterm ventilated babies.

Were studied 10 preterm ventilated babies (mean weight 1128 gr) in the first week of life in clinically stable condition, measuring flow, airway pressure and esophageal pressure simultaneously. Each baby was studied twice with an interval of one hour and each study was done increasing the rate till 60 to inhibit spontaneous breaths. None sedative has been used. Only mechanical breaths were analyzed. Compliance and resistance were calculated with a computer system using the linear regression method. We expressed quantitatively the intrapatient variability as the percentage of variation of tidal volume, compliance and resistance between the two studies in each baby. Then Intraclass correlation coefficient test (ICC) was applied to confirm qualitatively our results (total agreement =1, good reproducibility > 0.75).

We noted an acceptable variability for compliance while the variability for resistance was much higher (20%). The ICC showed a good accordance between the two studies only for compliance (> 0.90). The authors confirm the importance to have standardized methodology to obtain accurate measurements of pulmonary mechanics, and suggest that compliance is the more accurate value of it.

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REPERCUSSION OF AUTO-PEEP IN RESPIRATORY MECHANICS AND ARTERIAL BLOOD GASES IN CHILDREN DURING MECHANICAL VENTILATION.

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Objective: evaluate the repercussion in respiratory mechanics and arterial blood gases and the impact of the ventilator adjustments on the auto-PEEP magnitude.

Material and Methods: the measurement of the auto-PEEP was performed using an eletronic-pneumatic controlled device with a occlusion valve installed between endotracheal canulla and the ventilator circuit. The device was connected to a solenoid to detect the end of inspiratory phase and thus, the activation of the occlusion valve. The signs of pressure and flow were monitorized using a differential transducer and it was processed using a PC computer and Pneumoview® software. The study were divided in 2 phases: phase A where the ventilator adjustments was performed using the routine of the unit and phase B, where the targets of mechanical ventilation were to minimize the auto-PEEP.

Statistical Analysis: Wilcoxon test with p<.05 as a valid value. The results presents in mean and standart deviation.

Results: we submitted 17 children with neuromuscular disease or respiratory distress in this study.

	phase A	phase B
VT (ml/kg)	57.90 (31.60)	58.70 (37.10)
mean Paw (cmH ₂ O)	10.19 (3.07)	9.32 (2.31) a
C (ml/cmH ₂ O)	3.42 (2.01)	3.30 (2.07)
inspiratory (cmH ₂ O/L/sec)	48.00 (2.01)	49.80 (26.90) a
expiratory (cmH ₂ O/L/sec)	44.40 (21.60)	46.70 (21.40)
auto-PEEP (cmH ₂ O)	5.37 (3.24)	4.06 (2.60) a
pH	7.37 (0.12)	7.42 (0.05) a
PaCO ₂ (mmHg)	40.10 (11.10)	33.10 (7.40) a
PaO ₂ (mmHg)	65.00 (13.90)	57.90 (12.60) a

a = p<.05

Conclusions: the knowledge of the values of auto-PEEP permitted the adjustments in ventilator settings to minimize the auto-PEEP in phase B, with reduction of the mean Paw and the PaO₂ and improvement in the PaCO₂ and the pH.

114**Pulmonary mechanics during neonatal and pediatric ECMO**

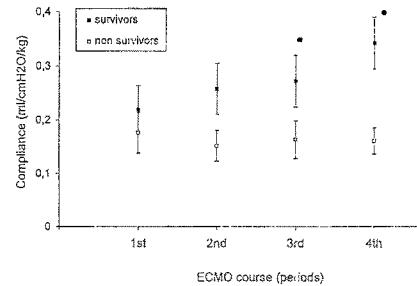
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Serial measurement of pulmonary mechanics have been proposed to follow the lung recovery or to predict successful weaning in neonates during ECMO. From April '93 to January '96, eighteen patients have been treated with extracorporeal membrane oxygenation at our Institution for respiratory or cardiovascular support. Three patients were placed on ECMO for pure cardiovascular support while fifteen needed ECMO because of severe respiratory failure. Eight of these patients were in the neonatal age (1 to 15 days) and seven ranged from 3 months to 14 years at the time ECMO was initiated. All patients were placed on ECMO with an oxygenation index over 40 on three consecutive determinations in a three hours period, on maximal ventilatory support and after no response to nitric oxide inhalation. The duration of ECMO treatment ranged from 63 to 506 hours (median 177).

8 patients gradually improved and were successfully weaned from the extracorporeal support. 7 patients failed to show any clinical improvement and died after ECMO was suspended. Pulmonary mechanics were evaluated in all patients before starting the bypass and during the ECMO course using the System 2600 (Sensormedics,Anahei,CA).

Static compliance (Crs) was measured by the single-breath occlusion technique, using a mean of ten occlusions for analysis. Passive respiratory resistance measurements and the tidal breathing flow-volume loops were also obtained, while the ventilatory settings were significantly reduced soon after ECMO was started. Before ECMO Crs measured in all patients was $0.23 \pm 0.03 \text{ ml/cmH}_2\text{O/kg}$ (mean \pm SEM). For each patient the ECMO course was divided into four periods, proportional to the duration of the treatment, and the best value of Crs in each period was chosen for analysis. As shown on the figure, Crs significantly improved ($*p < 0.05$) from the second half of the ECMO course in the group of patient that finally were successfully weaned from ECMO. No change in compliance was measured in the group of patients who failed to respond to the extracorporeal lung support. Our data suggest that compliance measurements during ECMO can be useful together with overall clinical evaluation to predict both outcome and duration of extracorporeal support in the neonatal and pediatric population.

**115****Non-invasive Brain Temperatures in healthy Prematures: Effect of Local Insulation, Environmental Temperature, Body Activity and Time Course.**

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Objectives: Brain temperature determines the amount of neuronal damage caused by hypoxic insults. Thus measuring brain temperature at standardised conditions is in request. We investigated whether brain temperature of neonates varies with head insulation environmental temperature, body activity and time course.

Patients and Methods: We investigated non-invasive brain temperature analogues in 19 healthy prematures less than two weeks of age in an incubator (gestational age 31.5 ± 2.1 wks; $x \pm SD$, weight 1653 ± 370 g). We measured nasopharyngeal temperature (Tnasoph) by a thermistor placed in the nasopharynx via a feeding tube, zero-Heatflux Temperature (zHT) at the temple by a thermistor and heatflux transducer, insulated by two pads, as well as rectal and incubator temperatures. Patient activity was documented by video taping. Measurements were performed during periods of increased insulation 1) by turning the head with its measuring site on to the mattress (15min) 2) by an insulating cap 30 min ON and 30 min OFF the newborn's head 3) increasing the incubator temperature by an average of 1.6°C (60min).

Results: Both zHT and Tnasoph changed nearly identical. Representative, zHT temple increased by $0.51 \pm 0.2^\circ\text{C}$ when turning this measuring site onto the mattress, by $0.11 \pm 0.2^\circ\text{C}$ with the cap ON and decreased by $0.02 \pm 0.2^\circ\text{C}$ with the cap OFF. Comparing zHT temple under identical insulating conditions 60 min later showed an increase of $0.1 \pm 0.2^\circ\text{C}$ with time. zHF temple and Tnasoph did not, but Trect did increase significantly ($p 0.006$) with increasing incubator temperature. Patient activity had no significant effect on brain temperatures.

Conclusions: The brain temperature analogues are kept fairly constant during short term local insulation, increased incubator temperature or body activity and are regulated to increase less in warmer environment than other body parts.

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PLATELET-ACTIVATING-FACTOR (PAF) INDUCED PULMONARY HYPERTENSION IS INHIBITED BY WEB 2170 IN FETAL PIGS

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Elevated PAF levels are found in neonates with persistent fetal circulation (PFC). We evaluate the role of PAF and PAF inhibition by WEB 2170 on fetal circulation using near term fetal pigs. Under maternal GA, fetal piglets were acutely instrumented with an EM-flow probe around the left pulmonary artery (LPA) and catheters in PA, Aorta (AO), right and left atria (RA, LA). Part A: PAF (1 to 10 ng/Kg) was given over 15 sec in PA and its hemodynamic effect monitored for 15 min. Part B: WEB 2170 (1 mg/Kg) given over 15 sec in RA, PAF (5 ng/Kg) added at 30 min and hemodynamic effects monitored for additional 15 min.

Results of calculated pulmonary arteriolar resistance (% changes, SEM in parenthesis, time post PAF):

PAF (ng/Kg)	N=	0.5 min	1 min	2 min	5 min	10 min	15 min
1	4	2 (5)	3 (5)	-2 (6)	4 (5)	0 (6)	4 (3)
2.5	2	4 (5)	25 (10)	20 (12)	8 (5)	5(10)	-2 (7)
5	6	38(22)	112 (34)	170 (48)	51 (27)	20 (18)	5(15)
7.5	3	38(19)	125 (21)	185 (29)	120 (30)	70 (30)	30 (20)
10	4	53 (30)	133 (28)	182 (33)	157 (24)	154 (34)	110 (45)
WEB 2170 (1mg/Kg)							
5 at 30 min	3	3 (5)	-4 (6)	5 (6)	4 (3)	5 (4)	-3 (6)

The vehicle had no effect. PAF caused dose dependent rise in AO and PA pressure and reduction in flow to LPA (up to 80%). Pretreated (WEB 2170) fetuses did not show hemodynamic responses to 5ng/kg PAF.

Unlike fetal lambs, PAF is a pulmonary vasoconstrictor in porcine fetuses regardless of dosage. Its effect is abolished by WEB 2170. Circulatory responses may be more representative of the human. PAF Inhibitors such as WEB 2170 may have a potential role in treating PFC.

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EFFECTS OF ADRENALINE INFUSION ON THE SYSTEMIC, PULMONARY AND CEREBRAL HEMODYNAMICS IN THE NEWBORN PIGLET WITH SURFACTANT DEFICIENCY.

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Adrenaline is extensively used for resuscitation in neonates with RDS. However, effects of adrenaline on systemic, pulmonary and cerebral hemodynamics have not been defined in newborns with RDS. Thirteen anesthetized, and ventilated newborn piglets were subjected to repeated saline lung-lavage series while mean systemic arterial pressure (ABP), mean pulmonary arterial pressure (PAP), mean left atrial pressure (LAP) and mean central venous pressure (CVP), cardiac output and blood flow in the internal carotid artery (ICA) were measured. Systemic vascular resistance (SVR), pulmonary vascular resistance (PVR) and cardiac index (CI) were calculated. Sixty minutes after lung-lavage, the adrenaline group (A) (n=6) received adrenaline as a continuous infusion of 1.2 µg/kg/ml, while the control group (C) (n=7) received saline. None of the variables were changed by saline. However, significant increases in ABP ($p<0.0001$), PAP ($p<0.0001$), CI ($p<0.001$) and SVR ($p<0.01$) were observed after administration of adrenaline, while PVR and ICA were not modified. Mean±SD for ABP/PAP (P/A), PVR/SVR (P/S) and CI (ml/min/kg) were:

Baseline	Lavaged	Post-infusion (minute)					
		Pre-infusion	5'	10'	20'	30'	45'
P/A	C 0.23±0.06	0.40±0.12	0.40±0.11	0.40±0.11	0.40±0.12	0.41±0.12	0.44±0.14*
A 0.37±0.14	0.45±0.17	0.37±0.13	0.35±0.10*	0.34±0.08#	0.36±0.12	0.36±0.08#	
P/S	C 0.20±0.04	0.36±0.11	0.38±0.11	0.37±0.11	0.36±0.11	0.37±0.12	0.41±0.12
A 0.41±0.19	0.50±0.23	0.41±0.17	0.38±0.12*	0.36±0.10#	0.39±0.14*	0.38±0.10	
CI	C 201±45	175±55	188±61	186±62	182±60	177±58	176±57
A 204±27	209±43	241±56	251±51*	258±59#	258±66	264±66#	

* $P<0.05$ (Pre vs. Post-infusion), # $P<0.01$ (Pre vs. Post-infusion).

Ratios of PAP/ABP and PVR/SVR significantly increased following infusion of adrenaline. These data suggest: 1) the cerebral perfusion is preserved during the infusion of adrenaline; 2) effect of the adrenaline infusion on the systemic circulation is more pronounced than its effect on the pulmonary circulation in newborn piglets with surfactant deficiency.

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POTASSIUM CHANNELS MODULATE THE ENDOCARDIAL ENDOTHELIAL HYPOXIC RESPONSE

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Like the vascular endothelium, the endocardial endothelium (EE) has a significant impact on adjacent myocytes, and may critically alter myocardial function.¹ We have previously shown that EE cells are capable of sensing and responding to hypoxia by the release of prostacyclin (PGI₂).² Potassium channels in other cell types have been reported to be oxygen sensitive. To determine whether potassium channels modulate the EE hypoxic response, we investigated the effects of three potassium channel inhibitors on hypoxia-induced PGI₂ release from EE cells.

Methods: Ovine endothelial cells were harvested and passaged onto 30 µ microcarriers. Cells were constantly perfused with normoxic and hypoxic Krebs's solution, and with three potassium channel blockers: glibenclamide (GB, 3 µg/ml), tetraethyl-ammonium (TEA, 10 mM) and 4 aminopyridine (4AP, 10 mM). Perfusate was assayed for prostacyclin (RIA). Data were compared by analysis of variance. * $p<.05$ compared to 3normoxic control; # $p<.05$ compared to hypoxic control.

ng/gm protein/min	CON	GB	CON	TEA	CON	4 AP
Normoxia	mean	518	452	973	1026	1688
	sem	116	63	330	321	293
Hypoxia	mean	682*	422	1440*	630#	2499*
	sem	133	71	521	147	548

Results: Glibenclamide and TEA decreased PGI₂ release during hypoxia, but not during normoxia from perfused endocardial endothelial cells. 4 AP blunted both normoxic and hypoxic PGI₂ release.

Conclusion: These data demonstrate that potassium channels may be involved in endocardial endothelial sensing and/or transduction of hypoxic stimuli.

¹ Brutsaert DL & Andries LJ: Am J Physiol 263:H985, 1992.

² Mebazaa A, Wetzel R, et al: Am J Physiol 268:H250, 1995

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INHALED NITRIC OXIDE (NO) FOR TESTING OF OPERABILITY IN CHILDREN WITH CONGENITAL HEART DEFECTS COMPLICATED BY PULMONARY HYPERTENSION

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Inhaled NO is a short acting selective pulmonary vasodilator. We studied the effects of 80 ppm NO and 100% oxygen during heart catheterization in 16 children (age 1 - 6 years, median 9 years) with heart defects and elevated pulmonary vascular resistance index (PVRi) in order to assess the value of NO as a tool of decision making for corrective cardiac surgery.

Patients were eligible for testing when they were more than one year old and had a pathologically elevated PVRi in a previous heart catheterization. Intubation, anesthesia and muscle paralysis were performed in all patients during testing of pulmonary reactivity. Calculations of pulmonary vascular resistance and flow were based on the Fick method. Response to NO was assumed when PVRi declined more than 30%.

9 of the 16 patients were responders to NO. Effects of NO and oxygen on PVRi, mean pulmonary arterial pressure (mPAP) and pulmonary vascular flow (Qp) in all responders are described in the table below. Cardiac surgery was offered to all responders, and 5 of them were successfully operated. Surgery is planned in another 3 patients and parental consent for surgery was not given in one patient.

FiO ₂	0.21	1	0.21	1
NO (ppm)	0	0	80	80
mPAP (mmHg)	56 ± 14	57 ± 18	53 ± 17	51 ± 18
PVRi (U x m ⁻²)	9.1 ± 5.1	4.2 ± 2.4	4.7 ± 3.7	3.9 ± 2.4
Qp (l/min)	4.3 ± 1.9	9.0 ± 3.7	9.7 ± 6.9	10.1 ± 4.8

In our opinion inhaled NO is a valuable tool for testing of pulmonary vascular reactivity in patients with congenital heart defects.

120**DIAGNOSIS AND MANAGEMENT OF POSTOPERATIVE JUNCTIONAL ECTOPIC TACHYCARDIA****Kunovský P, Kováčikova L, Csader M, Siman J**

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Rapid junctional ectopic tachycardia (JET) develops within hours of operation in approximately 5% of children undergoing open heart operations, and it can be lethal. The arrhythmia is self-limited if hemodynamic consequences can be controlled. Nevertheless, there is substantial risk of death with conventional anti-arrhythmic treatment. Initially with the rates higher than 180, there is no response either to atrial overdrive or electrical cardioversion.

During the last 30 months, since we introduced our JET management protocol, 470 children had open-heart operations and from these 12 developed JET (2.6%). Their age ranged from 20 days to 4 years (mean 18.2 months, SD 16.8, median 10 months). Our management algorithm is as follows: 1) High degree of suspicion whenever patients develops tachycardia early after open-heart operation with difficult, prolonged course, confirmed by surface and atrial ECG. 2) Controlled whole body cooling with the aim to achieve core temperature around 34°C. 3) Muscle relaxation with continuous infusion of Atracurium and mechanical ventilation. 4) Atrial pacing as soon as heart rate adequately slows down with the stimulation frequency 10 beats higher than the underlying rhythm. 5) Only if above mentioned steps fails despite core temperature down to 32°C, intravenous infusion of Amiodarone is started, initially as a bolus of 20ug/kg/min. for 4 hours, after that 5ug/kg/min until sinus rhythm returns. 6) After 24 hours of stability, the patient is left to rewarm spontaneously to 37°C. If JET recurs, the cooling continues for further 48 hours.

The mean time from operation to JET was 1.5 days (range 0-4 days, SD 1.6, median 1 day). The initial JET rate was 189.5 (mean (range 170-220, SD 15, median 190). The mean rate after the treatment was 130 (range 110-160, SD 14.6, median 130). The mean core temperature after cooling was 34.2°C (range 32-37, SD 1.95, median 34). The mean duration of cooling was 33.3 hours (range 5.4-72 hours, SD 20, median 24).

There was no mortality in the group of our 12 patients with JET treated according our management protocol and all patients are doing well.

121**TRANSESOPHAGEAL PACING IN THE PEDIATRIC INTENSIVE CARE UNIT**

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BACKGROUND: Transesophageal pacing (TP) is effective and safe both for diagnosis and treatment of pediatric arrhythmias.

MATERIAL AND METHODS: Eleven consecutive patients are included. A tri or quadripolar 6 or 7F temporal transvenous catheter with an interpolar distance of 13 to 22 mm was advanced through the nares and positioned to the point with the largest amplitude of atrial deflection. Surface ECG and a bi or monopolar electrogram were recorded simultaneously, selecting filters when needed (5 to 100 MHz). Pacing was performed with a programmable stimulator (Medtronic 5328) beginning with 2 ms and increasing mA to 10 and then increasing up to 9.9 ms. Narula method was selected to diagnose sinus node dysfunction (SND) and overdrive pacing to treat tachyarrhythmias.

RESULTS: TP was useful in all the 11 patients and no complications were observed: in 3 patients a SND was diagnosed (one needing a definitive pacemaker), in two patients with Atrial Flutter (type I) sinus rhythm was recovered, in one patient with a postoperative Junctional Ectopic Tachycardia we were able to get atrial synchrony with marked hemodynamic improvement, and 5 patients with Paroxysmal Supraventricular Tachycardia sinus rhythm was easily and quickly restored (2 of them required repeated episodes of TP until pharmacological levels of antiarrhythmic drugs were raised). Mean age and weight were 31 months and 12.7 kg (one patient had 2.1 kg). There was a close relation between height and depth insertion ($r = 0.98$). Mean stimulation parameters were 9.1 ms and 13.5 mA.

DISCUSSION: In experienced hands TP is an effective and safe way to treat and diagnose cardiac arrhythmias even in newborns. It should be tried before endovenous pacing is established and it is faster than pharmacological treatment.

122**IN NEONATES, PULMONARY INSUFFICIENCY WORSENS THE CARE OF EBSTEIN DISEASE.**

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In Ebstein disease, during the first days of life, the ability of right ventricle to propel blood to the pulmonary artery is impaired due to high pulmonary vascular resistances. The flow is mainly directed to left atrium through tricuspid insufficiency, right atrium and foramen ovale. To decrease pulmonary resistances and increase pulmonary blood flow, high frequency oscillations, mechanical ventilation, nitric oxide and prostaglandin are required. After few days, a forward circulation is normally established.

We cared two newborns with Ebstein disease where this approach was hindered by a large pulmonary valve insufficiency. Both of them were diagnosed in utero, showing a large tricuspid insufficiency with a non opened pulmonary valve and a ductal left to right shunt. One fetus was hydropic. At birth, blood stream from the ductus arteriosus was directed to the right ventricle through the pulmonary valve insufficiency then to right atrium, left atrium and ventricle, aorta and ductus arteriosus. A low pulmonary blood flow was demonstrated by low mean velocities (10cm/sec). A high reverse flow was seen in descending aorta with a negative flow in the renal artery. Both of these newborns were oliguric because of ductus arteriosus steal. Pulmonary blood flow Doppler evaluation allowed different strategies of ventilation, switching between HFO and conventional ventilation, modulation of PGE1 doses, inhaled pulmonary vasodilators (nitric oxide) and surfactant. The hydropic baby died, the other survived after 3 weeks of intensive care complicated by supraventricular arrhythmia (WPW).

In conclusion, during neonatal period, in Ebstein disease, a large pulmonary insufficiency leads to a vicious circle where lungs are excluded, inducing severe asphyxia and high pulmonary resistances. The blood is backward propelled from the aorta through the ductus arteriosus to the right ventricle and atria, then left cavities to aorta. AREC must be considered when pulmonary blood flow does not increase despite optimal therapy.

123**BALLOON VALVOTOMY OF CRITICAL AORTIC STENOSIS IN FIRST MONTH OF LIFE**

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To assess the outcome of balloon valvoplasty in infants with cardiac failure caused by critical aortic stenosis a retrospective study was performed. Between 1986 and 1995, 33 neonates, aged 1 - 28 days (median 9 d), weight 2.1 - 4.1 kg (median 3.3 kg) with critical valvar aortic stenosis were dilated by balloon (AoVP) as the first line treatment. 21 patients received Prostaglandin E1, 18 needed inotropic drugs and 16 mechanical ventilation.

Associated cardiac lesions : Persistent ductus arteriosus (PDA) in 27 patients (restrictive PDA in 8 cases), a mitral regurgitation (MVR) in 27 cases (15 severe and 12 moderate or mild MVR), angiographic findings of endocardial fibroelastosis (EFE) in 12 patients, mitral stenosis (MiVS) in 8, coarctation of the aorta (CoA) in 2, and finally a small muscular ventricular septal defect (VSD) in 1 patient.

Vascular approach for ballooning : A. axillaris in 20 cases (61%) a. femoralis in 10 (30%) and v. femoralis in 3 cases (9%). The median ratio between inflated balloon and aortic valve diameter was 0.99.

Dilatation was achieved in all 33 cases. The peak systolic gradient across the aortic valve (pre AoVP) ranged from 0 to 137 mmHg (median 50 mmHg) and was reduced to 0 to 55 mmHg (median 15; gradient reduction is significant ($p < 0.01$)). Aortic regurgitation (AoVR) was absent or mild in 30, moderate in 2 and severe in 1 patient after AoVP.

23 children survived (actual survival rate: 70%; early mortality: n = 3; late mortality: n = 7). Mid term follow up (0-8.8 years; mean 2.7 years) showed an increase of the systolic peak doppler gradient across the aortic valve (median 41 mmHg) but no increase of AoVR. 10 re-interventions (Re-AoVP: n = 3, commissurotomy: n = 2, mitral valve replacement n = 2, resection of subaortic stenosis: n = 1, resection of coarctation: n = 2, VSD-closure: n = 1) were performed in 6 patients.

Conclusion: Balloon dilatation of the aortic valve in the first month of life is an acceptable first line palliation in critically ill neonates with valvar aortic stenosis. Early survival rate (≤ 1 month) was 91%. 2/3 early deaths were related to intervention. The late outcome depends on the left ventricular volume, aortic and mitral valve size, mitral regurgitation and the presence of endocardial fibroelastosis.

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AN RV INJURY MODEL IN IMMATURE SWINE: EFFECTS OF CATECHOLAMINES ON RV CONTRACTILITY AND PULMONARY VASCULAR MECHANICS. James J. McGovern, Damian M. Craig, A. Resai Bengur, Ira M. Cheifetz, Peter K. Smith, Ross M. Ungerleider, Jon N. Meliones, Duke Medical Center, box 3046 Durham, NC 27710

RV contractility and pulmonary vascular mechanics(PVM) in immature animal models are poorly understood. We developed an acute RV injury model to measure RV contractility and PVM in response to commonly used catecholamines. Ten anesthetized piglets (9-12kg) were instrumented with micromanometers in the LV, RV, PA, and LA. A pulmonary artery flow probe was placed to measure cardiac output(Qpa). Ultrasonic dimension crystals were sutured to the myocardium and dynamic chamber volumes estimated using shell subtraction methodology. RV injury was induced with 3-7 cryoprobe injuries at -50 to -70°C for 3-4 minutes each. DA at 10mg/kg/min, DB at 10mg/kg/min, and EP at 0.1mg/kg/min were infused in random order. RV contractility was evaluated by calculating a load independent measure of contractility, the preload recruitable stroke work(PR SW), during vena caval occlusions. To describe PVM, input resistance(Ri), characteristic impedance(Z0), total power(TP), and efficiency(E=Qpa/TP) were measured. Measurements were made pre- and post-injury, during infusions, and between infusions. Cryoablation decreased PR SW (22.8±7.8 to 13.8±4.1, p<0.001). At the end of the experiment, PR SW remained depressed to this level indicating stability of the model.

(*p<0.05 vs drug baseline, #p<0.05vsDA, EP)

Index	Base DA	DA	Base DB	DB	Base EP	EP
PR SW	12.4±5.2	24.3±9.3*	13.7±6.7	28.8±7.9#	14.3±6.8	22.9±7.7*
erg/L						
Qpa	601±186	710±248*	618±173	781±222*	617±178	801±280*
ml/mm						
Ri	1402±407	1552±483	1377±532	1084±684	1469±626	944±535*
d*s/cm						
TP	22.5±10.9	33.2±22.9*	23.9±9.6	32.9±16.7*	24.8±9.9	28.8±12.*
mW						
Ef	28.9±6.9	24.9±7.7*	27.3±6.4	26.3±8.3	26.5±6.4	29.2±6.9*
LWmn						

All inotropes increased Qpa, TP and RV PR SW while Z0 did not change. EP decreased Ri and increased Ef. While DB provided the greatest increase in RV contractility, epinephrine may be more beneficial by increasing RV contractility, decreasing Ri, and increasing Ef. This immature animal model of RV injury can be utilized to independently evaluate the effects of various therapeutic interventions on load independent measures of RV contractility and PVM.

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THORACIC AUGMENTATION OF LEFT VENTRICULAR FILLING IN NEONATES: THE EFFECTS OF INSPIRATORY TIME

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The effects of conventional mechanical ventilation (CMV) on left ventricular (LV) diastolic filling in neonates are not well established. One approach to improve LV filling is the use of CMV to provide a phasic increase in airway pressure (thoracic augmentation). This phasic increase in airway pressure may result in an increase in LV filling similar to that which occurs with CPR. Thoracic augmentation has not been evaluated in neonates with ventricular dysfunction who frequently demonstrate increased heart rates. Attempts to maintain low peak airway pressures during CMV may result in a prolonged inspiratory time that occurs over multiple cardiac cycles. This may alter LV filling in the later cardiac cycles.

To determine the effects of inspiratory time on LV diastolic filling, 10 infants were examined with Doppler echocardiography less than 24 hrs after surgery for the arterial switch procedure. Pulsed Doppler recordings of the mitral valve (MV) were obtained with the inspiratory time adjusted to occur over 3 cardiac cycles (≥ 1 sec.). A pressure transducer was placed in line with the ventilator, and the respiratory cycle was recorded superimposed on the Doppler tracing to provide accurate determination of inspiration and expiration. Doppler recordings were obtained from the apical 4-chamber view and the following measurements were made: peak E and peak A velocities, E/A ratio, and deceleration time.

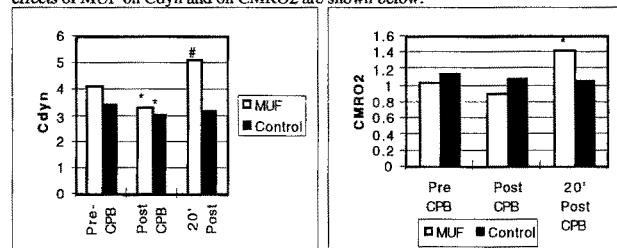
Compared to the expiratory phase of CMV, the initial beat during the inspiratory phase of CMV resulted in an increase in MV peak E (.53 ± .06 vs .65 ± .08 m/s, p<0.05) and peak A (.47 ± .07 vs .63 ± .09 m/s, p<0.05) velocities with no change in MV deceleration times (p<.01). Compared to the initial beat during the inspiratory phase, the third beat during the inspiratory phase resulted in decreased peak E (.65 ± .08 vs .40 ± .05 m/s, p<0.05) and peak A (.63 ± .09 vs .40 ± .05 m/s, p<0.05) velocities with no difference in deceleration times.

Thus, CMV augments LV filling during the initial phase of inspiration. However, as the increase in airway pressure is distributed over multiple cardiac cycles, LV filling falls below baseline levels. These observations indicate that while thoracic augmentation may be beneficial, to optimize LV filling the inspiratory time of CMV must be < 3 cardiac cycles.

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Effects of Modified Ultrafiltration (MUF) on Immediate Post CPB Pulmonary and Cerebral Function: A Randomized Investigation in Infants. Frank H. Kern, Scott S. Schulman, Barbara G. Wilson, Bea Baldwin, William Greeley, Ross M. Ungerleider, Jon N. Meliones Duke Medical Center Durham NC 27710

One factor contributing to organ dysfunction for infants undergoing repair of congenital heart defects (CHD) is their "inflammatory response" to cardiopulmonary bypass (CPB). This response is characterized by an increase in cytokine release, complement activation and endothelial injury. Modified ultrafiltration (MUF) is a method for removing tissue water and inflammatory mediators by rapid ultrafiltration following CPB. MUF may acutely improve post-operative end organ function. In this study, we evaluated the effects of MUF on the pulmonary and cerebral function of infants undergoing CPB for repair of CHD. We prospectively randomized 30 infants (≤ 5 mos) to either MUF (n=16) or no MUF (n=14)(Control) following correction for CHD. The study intervals were 1) before CPB, 2) immediately after CPB, and 3) 20minutes after CPB. Pulmonary function was evaluated by measuring dynamic compliance (Cdyn) and airway resistance (Raw). For 13 pts (MUF=6 pts; Control=7 pts) exposed to a period of deep hypothermic circulatory arrest (DHCA), cerebral metabolism (CMRO2) was calculated at each interval using the Xe¹³³ clearance technique for cerebral blood flow measurements and arterial and jugular bulb saturation measurements to calculate CMRO2. A reduction in CMRO2 has been consistently demonstrated after DHCA. The effects of MUF on Cdyn and on CMRO2 are shown below:



*p<0.05 vs pre-CPB; #p<0.05 vs post-CPB

*p=0.06 vs. post-CPB

This study demonstrates that immediately following exposure to CPB, MUF will improve pulmonary compliance. Raw was not different between groups. There was no significant difference in hours of post-op ventilation for either group. In those pts exposed to DHCA a trend towards better cerebral metabolic recovery compared to control was demonstrated. This is the first technique applied to infants undergoing DHCA where CMRO2 after CPB was greater than preCPB measures. Although this may be beneficial to postoperative hemodynamics, ventilatory management and long-term neurologic recovery, more patients and longer follow up will be necessary to verify such an effect.

Nutrition/Metabolism

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Energy expenditure in pediatric orthotopic liver transplantation.

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Pediatric patients undergoing orthotopic liver transplantation (OLT) are often malnourished. This condition and the surgical stress, both play a role on the metabolic status of the early postoperative period.

Subjects. We have prospectively studied 30 OLT, 8 retransplants, in 22 children (11 boys, 11 girls). Measured energy expenditure (MEE), VO₂, VCO₂, and RQ were determined by indirect calorimetry with the Deltatrac II MBM-200, Datex, Helsinki. Measurements were obtained pre-OLT, on admission and subsequently from day 1 to 7. PRIMs and TISS scores were assessed daily.

Results. Calorimetry was performed on CMV (n=37), IMV (n=44) and on spontaneous breathing (n=14). Exclusions were made if leaks >20%, time of calorimetry < 30 min and variability >15%. Predictive EE overestimates MEE in 8% to 25%. MEE was increased on admission in relation to pre-OLT values (33.3 ± 4.1 vs 47.3 ± 3.1 Kcal/kg/day) p<0.05. Patients showed a significant decrease on EE after the first 24 h (50.5 ± 4.1 vs 45.5 ± 2.1 Kcal/kg/day) p<0.01. EE decreased in patients with primary graft failure (PGF) after retransplantation (51.3 ± 2.1 vs 40.7 ± 1.9 Kcal/kg/day, p<0.05). A correlation was found between MEE, VO₂, PRIMs score and clinical conditions such as infection and rejection.

Comments. Calculated EE does not reflect energy metabolism in children undergoing OLT, because of increasing metabolic demands due surgical stress and clinical conditions such as PGF, rejection and infection.

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INDIRECT CALORIMETRY IN MECHANICALLY VENTILATED INFANTS AND CHILDREN.

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Objective: To determine the metabolic and nutritional state of mechanically ventilated infants and children in relation with severity of disease.

Patients and methods: 37 Mechanically ventilated infants and children, median age 7 months (range 3 days to 13 years), were studied. Severity of illness was assessed using PRISM, PRISM-III and TISS-scores. Oxygen consumption (VO₂), energy expenditure (MEE) and respiratory quotient (RQ) were determined by indirect calorimetry. Total urinary nitrogen(TUN) and creatinine excretion, levels of albumin and CRP were determined in 16 patients. In these patients daily caloric intake and substrate utilization were assessed. They were categorized in subgroups: A partial feeding (recent admission to PICU), B complete feeding.

Results: MEE of the total group (n=37) correlated well with predicted resting energy expenditure (PEE) according to Schofield; r=0.94, p<0.001. MEE/PEE was 0.97 (range 0.49 to 1.39). Poor correlations were found between PRISM and TISS vs VO₂/kg. Enumeration of PRISM with TISS correlated weakly with VO₂/kg (r=0.4, p=0.03).

The ratio of energy intake vs MEE was 0.86 in group A and 1.56 in group B (p=0.002). There was no difference in MEE/kg between both groups. RQ of group A vs B was ; 0.88 vs 0.97 (p=0.027). Substrate utilization showed lipogenesis (resulting in a RQ >1) in 5 patients, all in group B. Substrate intake and (relative) participation of glucose, fat and protein oxidation in MEE in group A vs B were determined (table).

	Group A (n=7)	Group B (n=9)	P-value
Carbohydrate (mg/kg/min)	I 5.9±2.7 (78±19%) U 5.3±2.0 (56±17%)	I 8.3±3.8 (54±15%) U 7.8±2.7 (79±16%)	0.2 (0.02) 0.06 (0.02)
Fat	I 1.0±0.9 (18±16%) U 1.4±1.2 (27±22%)	I 3.0±1.2 (36±13%) U 0.5±0.9 (11±16%)	0.002 (0.03) 0.1 (0.1)
Protein	I 0.6±0.5 (4±4%) U 1.8±0.8 (17±8%)	I 1.8±0.7 (10±3%) U 1.4±0.7 (11±5%)	0.001 (0.01) 0.3 (0.1)

I=intake g/kg/day (% total intake); U=utilization g/kg/day (% total production). Nitrogenbalance was negative in all patients in group A (mean -227.7 ±176.4 mg/kg/day) and positive in all but one patient in group B (mean 84.9±109.0 mg/kg/day, p=0.001). No significant correlations were found between creatinine height index, CRP, albumine, TUN vs VO₂/kg.

Conclusions: The mean measured energy expenditure does not exceed predicted resting energy expenditure, but there is a wide range. In a majority of patients with complete feeding high carbohydrate intake resulted in high RQ and lipogenesis. In patients with partial feeding the highly negative nitrogenbalance suggests that in the early phase of disease an higher protein intake should be provided. Severity of illness scores and biochemical markers of physiologic stress correlated poorly with oxygen consumption.

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RELATION OF STRESSED MEASURED ENERGY EXPENDITURE TO CLINICAL AND NUTRITIONAL INDICES IN CRITICALLY ILL CHILDREN

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Objectives: To determine the actual caloric requirements of critically ill children and evaluate the correlations between measured, stress-predicted and repleted energy expenditure and the severity of illness.

Design: A prospective, clinical study.

Setting: Tertiary care pediatric ICU in a university hospital.

Patients: Ten patients aged 6 to 210 months with disorders prompting PICU admission, including sepsis, respiratory failure, solid organ transplantation, and cardiovascular surgery.

Interventions: All patients were studied within 24 hrs of major surgery or transplantation, or following acute illness. All patients were severely stressed clinically and all but two were intubated by cuffed tubes. In three of them, still in a stress state, the study repeated on the third day of the disease. Energy expenditure measurements (MEE), as well as illness severity scoring systems, multisystem organ failure scores and various anthropometric and clinical indices of nutritional status, the stress-predicted energy expenditure (S-PEE), the basal metabolic rate (PBMR), the repleted energy (RE) and the recommended dietary allowances (RDA) were measured or calculated in each patient. Multiple regression analysis was used to analyze the data.

Measurements and Main Results: Although the mean MEE was significantly lower than the mean S-PEE (37.6 ± 11 kcal/kg/day vs. 50.3 ± 16 kcal/kg/day, p<.002), it did not differ significantly from the PBMR (mean difference -2.62 kcal/kg/day, range -10.07 to +9.06 kcal/kg/day). The S-PEE/MEE ratio ranged from 1.04 to 2.07, while the RE/RDA ratio (21.2±4 kcal/kg/day)/(75.8±7 kcal/kg/day) ranged from only .1 to .5. The PRISM/TISS ratio was not correlated better with MEE than the diagnostic category ($r^2=.36$ vs. .38, respectively). The RE was positively correlated with the MEE ($r^2=.65$, p=.07) while negative correlation has been found between MEE and age, mid-arm circumference, triceps skinfold and the use of vasoactive agents ($r^2=-.81$, -.88, -.67, p<.005 and -.71 respectively).

Conclusions: If S-PEE is used for caloric repletion in the stressed critically ill child, these patients will be substantially overfed by as much as 100%. Although PBMR appears to approximate the MEE by ±10%, other clinical and nutritional indices should also be considered.

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NUTRITIONAL SUPPORT IN A PEDIATRIC INTENSIVE CARE UNIT - A HISTORICAL COHORT STUDY

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Objectives: 1) to evaluate patterns of use and monitoring of nutritional support in critically ill children;

2) to evaluate an education program in nutrition support given throughout the resident physician training in the Pediatric ICU.

Patients and methods: records of 37 patients receiving nutritional support during 1993 were reviewed. After this first phase, knowledge and understanding of the role of nutrition support was conveyed to the residents through didactic lectures. In a second phase the data were reevaluated in 35 children who were given nutrition support in 1995.

Results: From a total of 425 days of therapy, the single parenteral route was utilized in 80.5%, the digestive route (tube feeding or oral route) in 19.5% of this time. A previous nutritional assessment was performed in 3 children; no patient had the nutrition goals set. The nitrogen to nonprotein calories ratio ranged among 1:80 and 1:250. Only 29.7% of the patients had their estimated caloric needs supplied and this goal was achieved only in those patients who were on enteral tube feeding. Patients did not achieve their goals for vitamins. The supply of oligoelements was adequate except the zinc. Nutritional monitoring parameters including weight, serum albumin and serum triglycerides were performed in almost all the patients but without uniformity. The reevaluation of these parameters showed adequacy of protein and micronutrients supply; however deficiency in nutritional monitoring and infrequent enteral feeding were still detected.

Conclusion: There were lacks in the implementation of nutritional support, which were partially corrected in the 2nd phase of the study. Although the training of residents may have contributed to give them cognitive skills, it didn't change policies and procedures as desired. We recommend reinforcement of the education program concerning basic nutritional aspects, and the organization of a multidisciplinary team in charge of coordinating the providing of nutritional support.

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SIMULTANEOUS MEASUREMENT OF THE RATES OF APPEARANCE (Ra) OF PALMITIC (PA) AND LINOLEIC (LA) ACID IN CRITICALLY ILL INFANTS. Paola Cogo, Giuseppe Giordano, Tomora Badon, Alberto Orzali, Luc Zimmerman, Pieter Souer, Virgilio Carnielli. Clinica Pediatrica dell' Università di Padova, ITALY & Sophia Children's Hospital, Erasmus University, Rotterdam, THE NETHERLANDS.

Plasma free fatty acids (FFA) are the major energy source for most tissues. During fasting FFA are released from the breakdown of triglycerides in adipose tissue (AT). Lipolysis, i.e. the rate of release of FFA, has been measured in humans by means of stable isotope techniques using labeled PA or glycerol as tracers. No information is available to date on the Ra of LA. We infused albumin bound ^{13}C -PA and ^{13}C -LA in 7 critically ill infants, receiving 20 kcal/kg/day of IV glucose and no oral feeding (weight 3.61±3 kg, range 1.9–5.8; age 57±64 days, range 1–149) and measured simultaneously the Ra of PA and LA from the isotopic enrichment of plasma FFA by gas chromatography-mass spectrometry at 1:50, 2:00 and 2:10 hours from the start of the infusion. A subcutaneous glutelid AT biopsy was obtained for fatty acid (FA) composition. We intended to (1) compare the Ra of PA and LA and to (2) study whether the Ra's simply reflect the AT composition or there is selectivity between FA during lipolysis. Main results are reported below.

Patient	AT•PA mol %	AT•LA mol %	Ra PA $\mu\text{mol}/\text{kg}/\text{min}$	Ra LA $\mu\text{mol}/\text{kg}/\text{min}$	Ratio	
					Ratio RaPA/AT•P A	Ratio RaLA/AT•L A
1	42.2	2.6	2.53	0.30	0.06	0.12
2	30.8	10.1	4.41	2.35	0.14	0.23
3	34.1	5.4	6.07	1.40	0.18	0.26
4	48.8	1.6	2.87	0.34	0.06	0.21
5	35.2	6.1	5.51	1.92	0.16	0.32
6	43.2	8.7	9.55	2.41	0.22	0.28
7	45.8	3.1	9.14	0.68	0.20	0.22
Mean	40.0 #	5.4 #	6.26 §	1.34 §	0.16 *	0.25 *
SD	6.7	3.2	2.63	0.92	0.06	0.06

In the infants studied AT•PA was higher than AT•LA ($p<0.001$) and the Ra of PA was higher than that of LA ($p=0.005$). However the ratio of the Ra's to the respective FA in AT was higher for LA than for PA ($p=0.02$). In conclusion the Ra of LA was higher than expected from the FA composition of AT. We speculate that LA is preferentially released during lipolysis and its contribution to the energy metabolism of the sick infant could be larger than what is normally assumed from the FA composition of AT and of plasma FFA.

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ARTERIAL OR VENOUS KETONE BODY RATIOS IN CRITICALLY ILL CHILDREN?

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The arterial ketone body ratio (AKBR) is established as a valuable tool in the management of adult patients undergoing surgery for severe liver disease. The redox theory emphasises the central role of the liver in preserving homeostasis and the importance of the hepatic mitochondrial redox potential (NAD⁺/NADH) in monitoring liver function and integrity. The AKBR (plasma acetoacetate/3-hydroxybutyrate) is a measure of hepatic mitochondrial redox status, reduced ratios associated with poorer outcome. The venous ketone body ratio (VKBR) is influenced by peripheral ketone utilisation and therefore thought unreliable in assessing hepatic redox. Its use has been dismissed as no correlation with the ratio in hepatic venous blood was found. Inspite of this, VKBR is used in the diagnosis of lactic acidosis and respiratory chain defects. The objective of this study was to determine the relationship between the AKBR and VKBR in a paediatric intensive care population.

31 children admitted to the paediatric intensive care unit, with indwelling arterial and central venous lines as part of their routine care, were recruited for the study. The median (range) age was 2.0 years (0-16.6 years) with PRISM score 10 (0-36). Simultaneous AKBR and VKBR were measured. Suppression of ketogenesis was confirmed using a rapid 3-hydroxybutyrate strip test (Ketofilm, Genzyme Diagnostics) prior to sampling.

The median VKBR 0.50 (range 0.13-1.46) was lower than median AKBR 0.56 (range 0.11-1.33). There was good agreement between arterial and venous ratios, Bland-Altman analysis giving a 95% confidence interval for relative bias of -0.13 to -0.03. There was a significant correlation between VKBR and AKBR $r^2=0.8271$, $p<0.001$ (intercept 0.02, slope 0.85).

Conclusions: Values for AKBR tend to be higher than VKBR, however there is a consistent relationship in critically ill children. In paediatric patients in whom ketogenesis is suppressed, VKBR may be considered equivalent to AKBR. This simple test may prove to be a useful adjunct in predicting mortality in critically ill children.

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PREVENTION OF STARVATION IN THE PERIOPERATIVE PERIOD

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Preoperative starvation can be prevented in infants undergoing non GI surgery by continuing feeds till as long as it is safe to do so. Some GI disorders require withholding of feeds for a long period. For these and for infants already suffering from PEM, parenteral feeds are given preoperatively.

Peroperatively nutrition is maintained by ensuring adequate glucose supply in the infusion fluid and its smooth metabolism. Proper placement of feeding tubes are also carried out peroperatively.

Postoperative early resumption of oral feeds is ensured by new techniques of anaesthesia and pain relief and methods to ensure early return of peristalsis.

Enteral feeds of pre digested substances and feeds through transanastomotic tubes and through gastrostomies and jejunostomies can prevent starvation in many situations.

Parenteral feeding is carried out only when enteral feeding is not possible, for example in necrotising enterocolitis, gastroschisis, short gut syndrome, high enteric fistula and acute pancreatitis.

Poster Presentations

Organisation/Outcome/Scoring

P001

A SURVEY ON PEDIATRIC INTENSIVE CARE UNITS IN CHINA

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To understand the present status of pediatric intensive care in China, we conducted a survey between October and December, 1993, involving 20 hospitals in 14 provinces and municipalities. The results showed that there were totally 41 ICUs for pediatric patients, including 19 pediatric ICUs (PICU), 18 neonatal ICUs (NICU) and 4 pediatric surgical ICUs (SICU), with total of 403 beds. The physicians to bed and nurses to bed ratios were 1:1.5 and 1:0.91 respectively. The average number of equipment per bed was 0.47 ventilator, 0.34 multi-function monitor and 0.47 infusion pump. Very few of the ICUs had portable X-ray machine, biochemical and blood gas analyzers, and hemodialysis machines. The most frequently treated diseases/conditions were pneumonia, intracranial infections, post-operation and sepsis in PICUs, and neonatal pneumonia, hypoxic ischemic encephalopathy and sclerema in NICUs. Pneumonia and respiratory failure accounted for 33.29% and 26.50% of all the diseases/conditions treated in the ICUs and the mean case fatality rate of respiratory failure was 24.50%. The results of the survey suggest that there is shortage of ICU beds and modern equipment, and treatment is often delayed due to excessively strict criteria for mechanical ventilation. A set of simple, and nationally acceptable criteria for evaluation of severity and cure of the diseases/conditions is urgently required.

P002

A STATISTICAL STUDY OF 286 CASES ADMITTED TO PEDIATRIC INTENSIVE CARE UNIT: A 1 - YEAR EXPERIENCE

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The aim of this study is to document children admitted to the Pediatric Intensive Care Unit (PICU) of Hacettepe University İhsan Doğramacı Children's Hospital in a period of 1 year between January 1st, 1995 and December 31st, 1995.

The medical reports of 286 children were reviewed and each admission was analysed in terms of age, sex, diagnosis, management within the hospital, length of hospital stay and type of poisoning. The youngest age was 23 days and the oldest was 16 years. Hundred and twelve (39.5%) of the children were girls and 174 (60.5%) were boys. The most common (26.5%) reason of admission was intoxication among all of the cases and the greatest group (73.7%) of the poisoned children had ingested medication which was followed by another group of patients (9.2%) who had eaten mushrooms. The peak incidence of drug ingestion was salicylate intoxication (20%). Forty drug poisonings were accidental while 16 was intentional. The majority (82.4%) of the cases that committed suicide was between 12 and 17 years old, and the main cause of suicide was being unsuccessful at school.

We conclude that poisoning - especially salicylate intoxication - is still a major problem in Turkey and we believe that emphasis on the need to store all kinds of drugs in a secure place and re-examination of a child resistant packaging should help to reduce childhood poisoning significantly which is a preventable condition.

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P003

Limitation of life-sustaining treatment in a Dutch tertiary care children's hospital.

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The circumstances of dying, divided in four groups (brain death [BD], failed cardiopulmonary resuscitation [failed CPR], death following a do not resuscitate order [DNR] and death following withholding or withdrawal of therapy [W/W]) were analysed in a Dutch tertiary care children's hospital. Included were all patients who died in the hospital, except those treated in the neonatal ICU (predominantly premature and SGA newborns) and those who died in the emergency room. Among a total of 7179 hospital admissions (excluding the neonatal ICU and emergency room), 99 patients died (1.4%). Of these 99 patients 73 (74%) died in the pediatric ICU, 18 (18%) in the ward and 8 (8%) in the operating room. A chronic underlying disease was present in 66 (67%). Withholding or withdrawal of therapy was implemented in 48 (48%) children, 27 (27%) died due to failed CPR, 20 (20%) were brain dead and 4 (4%) died following a DNR order. Justification for therapeutic restrictions in the 52 patients of the DNR and W/W groups was imminent death in 32 (62%), lack of future relational potential in 12 (23%) and excessive health burden in 8 (15%). Withdrawal or withholding of therapy was carried out by extubation in 46%, vasoactive drugs were stopped in 25%, and mechanical ventilation was withdrawn in 21%. Analgetics and sedatives were frequently used (in 73% and 79%, respectively). Hence decisions concerning restrictions of treatment are common in pediatric practice, mostly due to imminent death. Patients in which treatment was restricted were characterised by a longer hospital stay, a worse prognosis, a higher frequency of chronic underlying diseases and a lower acute mortality risk. Despite restrictions of intensive therapy, most patients were allowed to die in the pediatric ICU.

P004

MICROALBUMINURIA LEVELS ARE CORRELATED WITH PRISM SCORES IN PAEDIATRIC CRITICAL PATIENTS

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Background. Microalbuminuria (MCA), a subclinical increase in urinary albumin, reflects glomerular and overall vascular permeability¹⁻². An increase in urinary excretion of albumin occurs after burns and trauma. Transcapillary albumin escape rate is also increased in response to elective surgery³ and in critically ill adult patients⁴. We investigated a possible relationship between urinary albumin levels and clinical instability, as measured by Pediatric Risk of Mortality (PRISM) scores.

Method. We studied 26 consecutive patients (median age of 13 months, range 2-100). Patients with nephropathies or any abnormality of urine analysis were excluded from the analysis. PRISM scores, MCA (mg l^{-1}) (immunonephelometric) and urinary creatinine (Cu) (mmol l^{-1}) (Jaffé) (48 hour collection sample) were determined within 48 hours from admission to the PICU. The MCA/Cu ratio (mg mmol l^{-1}) was used to correct for urine output variability. Diagnoses included respiratory failure (6), postoperative (5), neurologic (5), sepsis (4), trauma (3) and miscellaneous cases (3). Pearson's correlation was performed to correlate data.

Results and Conclusions. Mean PRISM score and MCA/Cu were 16.9 ± 5.9 SD and 100 ± 39 SD, respectively. A significant correlation was found between MCA/Cu and PRISM scores ($R=0.80$, $p<0.001$). Our observations show that, independently of the initial insult, the paediatric unstable patient may have increased capillary permeability, which is correlated with the degree of physiological derangement, as measured by PRISM scores. Microalbuminuria can be rapidly determined since it is routinely used in the management of diabetic patients, it is inexpensive, simple to measure and blood-sampling. Therefore, it might have a role in the clinical assessment of capillary permeability and transcapillary albumin escape rate.

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P005**EXPECTATION OF VENTILATORY SUPPORT-EXPERIENCE IN A PAEDIATRIC UNIT OF A TEACHING HOSPITAL IN NORTH INDIA****M Verma *, J Chhatwal *, LE Wilson *******Christian Medical College, Ludhiana, Punjab; ** Royal Hospital for Sick Children, Edinburgh, EH9 1LF**

Worldwide the demand for paediatric intensive care services exceeds the supply. In developing countries sporadic access to such services alters expectation of care and can lead to children being either mechanically or hand-ventilated in general paediatric wards.

The outcome of children requiring ventilation in a major teaching hospital in India was reviewed. Children were ventilated on an adult intensive care unit (AICU) if a bed was available, otherwise in the general paediatric wards.

Over a 4 year period 109 children were ventilated on AICU with 54 deaths. Yearly mortality rates varied between 43-58%. Over a 3 month period 37 patients were ventilated on the paediatric wards. Of the 15 patients over 4 weeks of age 11 died (Chi squared 0.1>P>0.05)

Reasons for the higher mortality rate on the paediatric ward likely include the higher patient:nurse ratio, and more limited resources. A predictor of mortality based on simple physiological observations without the need for expensive blood tests and including chronic health status would be a useful tool. The establishment of a paediatric intensive care unit is proposed to redress the balance of care.

P006**A REVISED THERAPEUTIC INTERVENTION SCORING SYSTEM FOR PAEDIATRIC INTENSIVE CARE UNITS.****Habibi B, Nadel S and Habibi P.**

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Introduction: The Therapeutic Intervention Scoring System (TISS) was last revised in 1983. Since many more interventions are now widely used, this TISS underscores the more ill patients and consequently the resource use in today's intensive care units.

Aims: 1. To develop a revised TISS incorporating the additional interventions, 4 Point: Exchange blood transfusion, 3 Point: CSF drains, Cuirass ventilation, Small Particle Aerosol Generator, ETCO₂, Special bed/mattress, 2 Point: TCPO₂/TCPco₂, Intraosseous/intra-peritoneal fluids, Continuous infusion of sedative drugs in the non-ventilated patient, 1 Point: Scheduled Nebulised drug therapy, Cervical collar, Pulse oximetry, Continuous drug infusions

2. To use the TISS to validate Intensive Care Levels. Level 1: the non intubated patient, Level 2: the unstable or ventilated patient and Level 3 the ventilated and unstable patient (e.g. MOSF).

Patients and Methods: 223 consecutive patients admitted to the PICU were scored using a new proforma developed to include the additional interventions and to improve accuracy of collection of data by nurses. Maximum values for New and Old TISS (NTISS, OTISS) and maximum intensive care level was computed for each patient admission.

Results: NTISS correlated well with OTISS ($R=0.984$, $y=0.053+1.158$). There was no significant difference between mean values for OTISS and NNTISS in Level 1 patients ($P=0.12$ paired t-test). For level 2 and 3 patients mean value of NNTISS was greater than OTISS ($P<0.0001$). There was a significant correlation between levels using either NNTISS or OTISS (mean difference Level 1 and 2, Level 2 and 3, ($P < 0.0001$)).

Conclusions: A new TISS has been developed and used in a PICU. Nurses were able to accurately score the interventions on their shift. The assignment of patients to intensive care levels correlates with TISS values allowing a quantitative measure of severity.

P007**ASSESSMENT OF A PEDIATRIC INTENSIVE CARE UNIT USING THE PEDIATRIC RISK OF MORTALITY (PRISM) SCORE****C.Vasconcelos, L.Ventura, I.Fernandes, R.Valente, A.Marques, D.Barata**

Lisbon - Portugal

To assess the performance of the Pediatric Intensive Care Unit of Hospital Dona Estefânia by an international standard score, the authors did a prospective study of 1149 consecutive admissions to the Unit during a period of 29 months.

Mean age was 50.63 ± 54.07 months; mean length of stay was 3.16 ± 5.59 days.

The effectiveness and efficiency were determined by the admission PRISM. Admission efficiency was defined by two criteria: a) mortality risk $> 1\%$ or b) the administration of at least one Intensive Care Unit-dependent therapy.

The cumulative observed mortality was 5.57% and the expected mortality was 5.97%, with a Standardized Mortality Ratio (SMR) = 0.933.

The overall performance of the PRISM score-based predictive model was found to be good (goodness-of-fit test χ^2 [5] = 6.387, $p=0.271$).

Of 1149 patients admitted, combining the two criteria (ICU-dependent therapy and mortality risk) an admission efficiency of 825 (71.8%) was found, equating to 3263 (89.94%) of 3628 ICU days.

CONCLUSION: In our study the assessment of the admission efficiency and of the effectiveness of the Unit was possible by using the PRISM score of admission.

P008**Preterm Birth at 25 to 32 weeks'gestation : neurological outcome and type of twin-placentation.****A.BURGUET*, A.MENGET*, E.MONNET**, J.JACQUIN*, C.FROMENTIN*, H.ALLEMAND**, JY.PAUCHARD*, ML.DALPHIN*.*****Réanimation Infantile Polyvalente CHU St JACQUES 25030 BESANCON Cedex.******Département de Santé Publique 25030 BESANCON Cedex, FRANCE.**

Objective: to compare the rate of cerebral palsy (CP) between monochorionic-twins, dichorionic-twins and singletons born at 25 to 32 weeks' gestation.

Design: two-year prospective cohort study.

Setting: geographically defined study (region of Franche-Comté, FRANCE).

Main outcome measures: type of placentation was obtained by anatomopathological, or macroscopic examination of placenta and comparison of 6 twins' blood-groups. Neurological assessment was performed at two years of age (uncorrected for gestational age) by family doctor (pediatrician or physician), or neonatologist of the ICU at tertiary center.

Sample: 167 of 171 survivors aged of two years (98% follow-up rate), born between 09/30/90 and 10/01/92. Triplets and chromosomal malformation were non included.

Results: Thirteen (11%) of the 119 singletons had CP, vs 3/29 (10%) of dichorionic twins and 6/19 (32%) of monochorionic twins ($p=0.04$). Four of the 19 monochorionic twins (21%), 2/29 dichorionic twins (10%) and 4/119 (3%) singletons suffer from quadriplegia ($p<0.01$). In a multivariate approach, monochorionic twin placentation was the strongest risk-factor of cerebral palsy (OR=9.7, IC 95% = 2.4-39, $p<0.01$). Others risk-factors of CP were: lack of father's profession (OR 11, 1.2-105, $p<0.03$), maternal antecedent of abortion (OR 3.2, 1-10, $p<0.04$), vaginal delivery (OR 3.4, 1-11, $p<0.03$), hyaline membrane disease (OR 3.4, 1.2-10, $p<0.02$).

Discussion: this is the first population-based study to uphold the role of monochorionic twin-placentation as a strong risk factor of CP for premature infants. CP is more severe in monochorionic twins than in other infants. Mechanism of cerebral deficiency is not clear since none of our infants with CP was survivor of an *in utero* cotwin's death, and none of these infants was exposed to twin to twin transfusion syndrome. Were these monochorionic-twins affected by an undiagnosed neurological structural defect that could lead both to prematurity and handicap remains an open question.

P009**OUTCOME OF CRITICALLY ILL ONCOLOGY PATIENTS IN THE PICU****I.A. von Rosenstiel MD, W.B. Vreede MD**

Abstract: over a 5-years period 105 patients with malignancies were admitted to the PICU of Emma's Children's Hospital AMC: 63 (60%) were admitted for postoperative procedures and 42 (40%) for medical emergencies and intensive treatment. Overall mortality during PICU stay was 24%, in the postoperative group 16% and in the group with acute multi system failure 36%. The group of MOSF (42) consisted of hematologic malignancies (22) mortality rate 41%, solid tumors (20) 30%. Respiratory insufficiency was the most common PICU admission (40%) followed by cardiovascular insufficiency (26%) and encephalopathy (26%). The highest mortality rate was associated with encephalopathy (55%); the mortality of the combination of severe neutropenia in hematologic malignancy requiring ventilation was 52%. For patients with failure of four organ systems and severe neutropenia mortality rate was 64%. In oncologic children with life-threatening conditions and neutropenia timing of PICU admission and supportive therapy (incl G-CSF) must be improved for meaningful recovery during treatment in a PICU.

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P010**EVALUATION OF INTERNATIONAL E-MAIL DISCUSSION GROUPS FOR PRACTITIONERS OF PEDIATRIC AND NEONATAL INTENSIVE CARE**

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Introduction: Many e-mail based discussion groups exist on the Internet to provide medical professionals with a rapidly responsive medium for the international exchange of ideas relating to patient care. Several such lists each serve more than a thousand professionals in more than 30 countries, each distributing a dozen or more messages each day to every subscriber. There is very little known about the time being spent by professionals interacting with these lists, and very little known about the impact of the discussions on patient care. We wished to test the hypothesis that these discussion groups provide information which is being used to change the care of individual patients and the general approach to patient problems.

Methods: In early January 1996 a pilot electronic survey was sent to a small fraction (N=63) of the memberships of 2 e-mail discussion groups, PICU@its.mcw.edu, and NICU-NET@u.washington.edu (the full memberships of both groups (N=1439 for NICU-NET, N=1045 for PICU) will be surveyed in early February of 1996). Participants were asked for demographic information, experience and skill level relating to e-mail, time spent with the discussion groups, perceived usefulness of different types of discussions, and the ways in which the discussions were used clinically. The pilot study was analyzed for construct validity by correlating an overall assessment question with a summary of the specific questions. Scale reliability was measured by Cronbach's alpha statistic.

Results: The pilot survey response rate was 30/63 (48%). The majority of respondents were male physicians, with an average age of 39±5 years, who had completed subspecialty training in intensive care, and were working at a university-affiliated hospital. Most had been using e-mail for more than 6 months, and considered themselves moderately adept in that use. 63% felt that the list helped weekly to keep them informed about current issues and practices in their field(s), and 57% felt that, at least monthly, they used information from the list(s) that was not readily available in medical journals. Overall, 75% agreed that the list improved their professional competency. When asked to compare the value of 6 months of membership on an e-mail discussion group with more traditional educational media, 34% compared it with attending a national conference, and 26% compared it to a journal subscription. Cronbach's alpha was .76. Construct validity testing yielded coeff=.50, p<.05.

Conclusion: Internet-based e-mail discussion groups for health care professionals can be an important part of a strategy for maintaining professional competency. Despite the very low cost of this medium for most, the value is felt to be comparable to that of far more expensive forums for education. Further study will include distribution of the full survey in early February of 1996.

P011**TEACHING TEACHERS TO TEACH IN THE PICU****I. David Todres, MD, Jon M. Courand, MD**

A vital role of the intensivist is to ensure that knowledge and practice are imparted to trainees in the ICU so that patients receive optimal care. Teaching effectiveness varies widely leaving gaps in knowledge and practice in the trainee. Being an effective teacher should not be a "gift" of a privileged few. The ICU provides a fertile ground for using a variety of methods for teaching, e.g. didactic, at the bedside, emergencies, and in the performance of procedures. In this environment, much can be learned.

We have embarked upon a program to facilitate this learning process. 1) Teaching needs to be recognized as the foundation of good clinical care, i.e., patient related, and in its ability to generate discussion and research investigation.

2) Teaching structurally has many components including the speaker, audience, varying situations, and the message delivered.

3) Establishment of a program using these components to enhance teaching abilities at all levels. a) Evaluate base-line teaching skills initially. b) Individualize interventions to improve teaching skills. c) Demonstration of learned skills with re-evaluation. This process is analogous to the analysis of a clinical disorder in a patient which, once recognized, interventions are then instituted and then re-evaluated.

4) Instill the desire to use these attained skills to teach and interest others to teach. Teaching excellence should be recognized through awards, honors, and academic advancement.

A major emphasis of this program is to provide participants with skills necessary to teach thought processes, decision-making skills (what to do, what to avoid) and implementing appropriate management during stressful emergency situations common to the PICU.

P012**PEDIATRIC INDEX OF MORTALITY (PIM)****Frank Shann, Tony Slater, Gale Pearson and the PIM Study Group**

We have developed a new score for predicting the risk of mortality in children admitted to intensive care. The score is calculated from only seven variables collected at the time of admission to ICU: mechanical ventilation (yes/no), booked admission after elective surgery (yes/no), the presence of any one of 14 specified underlying conditions, both pupils fixed to light (yes/no), the base excess, the PaO_2 divided by the FiO_2 , and the systolic blood pressure.

Most scores used to predict outcome in intensive care require the collection of a large number of variables (so many ICUs do not calculate them routinely), and they use the worst value of each variable in the first 24 hours in intensive care. This means they appear to be more accurate than they really are (about 40% of child deaths in ICU occur in the first 24 hours - so they are diagnosing these deaths rather than predicting them), and they blur the differences between units (a child admitted to a good unit who recovers will have a low score; but the same child who is mismanaged in a bad unit will have a high score - the bad unit's high mortality rate will be incorrectly attributed to its having sicker patients).

PIM was developed in the PICU at the Royal Children's Hospital in Melbourne, and has been tested in six other PICUs in Australia and one in the UK.

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P013**MULTIORGAN DYSFUNCTION SYNDROME IN CHILDREN: A REVIEW OF 173 CASES.**

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Objectives: To study the characteristics of the multiorgan dysfunction syndrome (MDS) in children.

Methods: A retrospective study with all the children with MDS diagnosed from January 1990 to June 1995 is presented. 173 children fulfilled the Wilkinson criteria (1). In all of them the number of organs affected and the PRISM score were determined during the first 24 hours. Several groups were performed according to the clinical diagnosis, the hospital of origin and the order of organs affected.

Results: The 173 subjects studied were an 8% of the Pediatric Intensive Care Unit admissions. 100 of them expired (58%). No differences in age, sex and weight were observed between the children dying and the survivors. The most common causes of MDS were sepsis, both nosocomial (25%) and meningococcal (14%) and acute respiratory failure. Sixty-five percent of the patients were from the hospital wards and the remaining were directly admitted to the PICU from the Emergency room. The systems affected were: respiratory (93%), cardiovascular (92%), hematologic (61%), central nervous system (52%), renal (43%) and (hepatic) liver (28%). The organs initially failing were: heart (39%), lung (28%) and central nervous system (18%). The children dying had a larger number of organs with failure than the survivors (3.89 v.s. 3.34, p<0.001). The PRISM score was higher in the children expiring than in the survivors (22.4 v.s. 17, p<0.001).

Summary: The MDS is a common pathology in PICU, with a high mortality. The mortality is higher in children with a larger number of organs affected and a higher PRISM score. Sepsis is the most common etiology.

(1) Wilkinson JD and Cols. Crit Care Med 1986; 14:271-4

P015**Multiorgan failure : a new score of severity in newborns and children.**

Preliminary study of feasibility.

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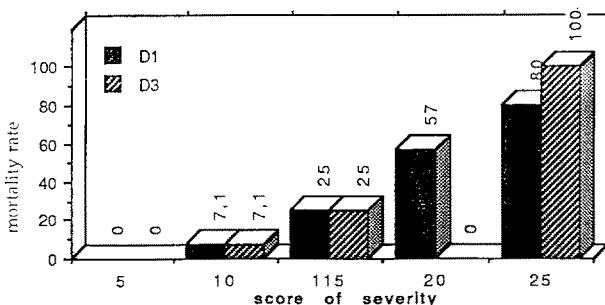
Methods : From June 1st to July 15th 1995, all patients admitted to the pediatric ICU were included. The score was measured at day 1 (D1) and day 3 (D3) and we used 10 variables.

For each organ system, we defined 2 categories : dysfunction or failure, which we respectively conferred 1 or 4 points.

Results : 56 patients were admitted : 22 newborns, 34 children. 23 were medical and 33 were surgical patients. 36 (64 %) patients had two or more organ failure at the admission. 12 (21.4 %) patients died, which 6 (50 %) in the first 48 hours. The mortality rate was the same for children with two or more organ failure at D1 and D3 : 6/36 (16,6 %) at D1, 4/22 (18,2 %) at D3.

The mean score is different for children who survived or who died : 8,6 versus 17,9 at D1 ; 10,6 versus 18,2 at D3.

When the score is ≥ 15 , the mortality rate is significant.



Conclusion : In this study, there is a good correlation between the score of severity and the mortality rate but we have few included patients. We need a prospective multicentric study to assess these results and we must compare this score to other scores of severity used in PICU.

P014**FOLLOW-UP CRITICAL ILLNESS AND BEREAVEMENT SUPPORT; A PARENTS PERSPECTIVE**

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The aim of the present study was to describe the practice, attitudes and needs of parents for follow-up support after critical illness or death in children admitted to intensive care. Data were collected by a humanistic counsellor trained in bereavement care using questionnaires and home interviews. Two groups of parents were described, 42 concerning coping with critical illness 24 coping with bereavement. Analysis of data in the critical illness group demonstrated that 13/42 parents benefitted from the PICU follow-up support while 12/30 strongly missed ongoing support by PICU staff. 12/43 indicated a strong need for meetings with the PICU staff and/or fellow-sufferers. All 24 patients in the bereavement group highly appreciated the provided follow-up meeting with the PICU staff. 10/24 missed follow-up meetings with other parents. PICU care should therefore include a design for follow-up facilities for parents not only concerning bereavement care, but also follow-up support after critical illness. Arrangements should include individual support by PICU staff as well as parent support groups. Empathy and comfort seems as important as medical expertise.

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P016**Validity of a Predictive Index (PRISM) in Brazilian Pediatric ICU**

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Introduction: The evolution of Pediatric intensive care instigated the growing need of prognosis. The prognosis methods were valorized when we figured out that the subjective capacity of the physician to predict is poor. **Objective:** To validate the Pediatric Risk of Mortality - PRISM model as a predictive method efficient for general and specified risk strata established in our population. **Design:** Prospective, observational, longitudinal, and comparative study of care, severity and outcome. **Setting:** Twelve bed of a pediatric intensive care unit (PICU) within a 500 bed tertiary care hospital. **Patients:** Consecutive and unselected patients admitted in the PICU during the period from June 1st, 1993 to March 30th, 1994. **Interventions:** None. **Measurements:** The variables in study were: a)demographic data, b)severity in admission evaluation, c) therapeutic modalities, and d) patient physiology. The patient physiology evaluation was set by PRISM score (fourteen physiologic data). **Main results:** Forty hundred fifty eight patients were included. The mean age was $41,9 \pm 46,3$ months, the mean staying time was $6,6 \pm 8,4$ days. The mean TISS in admission was $20,6 \pm 12,1$ and the TISS/patient/day was $22,6 \pm 9,3$. The mean of occupancy in PICU during study was 10,7 beds/day. The cumulative risk of mortality was 36,1 patients for a total death of 39 patients. The observed mortality was 8,5 %, and the expected was 7,9 %. The Standard Mortality Ratio was 1,08 ($\chi^2=0,58$; $p>0,100$). This agreement was confirmed by the Hosmer-Lemeshow goodness to fit test, for the total group of validation ($\chi^2=2,59$; $gl=5$; $p=0,76$). The analysis of the prediction power by construction of ROC curve shows the shape and the area under the curve ($Az=0,90 \pm 0,02$) is similar to the original PRISM validation model. **Conclusion:** The PRISM is a predictive index valid to be assessed in our population, where the mortality and the survival indexes found were similar to the indexes estimated by PRISM.

P017

EXPERIENCE WITH INTENSIVE CARE UNIT IN PEDIATRICS
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The department of Pediatrics at Shaikh Zayed Hospital, is an acute care area devoted to the treatment of children upto 13 years of age. On an average, 25-30% of those admitted to the ward require constant care and some form of cardiorespiratory monitoring. A six bedded "Intensive Care Unit" was organised to look after these children in September 1993.

With limited equipment, constant care was ensured by the presence of at least one nurse and one doctor round the clock. We present our experience of the first 18 months.

A total of 560 children were admitted to the I.C.U. comprising 23.66% of total pediatric admissions. A majority (63.1%) were males, were below 1 year of age (67.14%) while 27% were neonates. Most common reason for admission was, septicemia (30.71%) followed by diseases of CNS (20.71%) and respiratory problems (18.04%). The average duration of stay was 4 days and mortality 21.9%.

We conclude that those at highest risk seem to be the young infants and infections remain the commonest causes of very severe disease in children.

Neuroscience

P018

PROGNOSTIC VALUE OF BRAINSTEM AUDITIVE EVOKED POTENTIALS IN PEDIATRIC PATIENTS IN COMA

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In order to evaluate the usefulness of Brainstem Auditive Evoked Potentials (BAEP) in prognostic assessment of pediatric patients in coma treated with central nervous system depressor drugs, we studied 33 comatous patients (p.) with a Glasgow score ≤ 8 , between September 1992 and May 1995. Trauma was the etiology in 16 p., hypoxia in 7 p., infectious diseases in 7 p., metabolic disorders in 2 p. and bleeding in 1 p. BAEP was performed between 24 hours and 16 days (Median: 48 hours). Sensibility (Se), Specificity (Sp), Positive Predictive Value (PPV) and Negative Predictive Value (NPV) were calculated. **Results:** BAEP were absent bilaterally in 13 p., altered in 16 p. and normal in 4 p.

BAEP	ALIVE (w/w/o secuelæ)	DEAD	
Absent	0	13	PPV: 100%
Abnormal	14	2	NPV: 85%
Normal	3	1	Se: 81% Sp: 100%

BAEP were useful to diagnose brainstem lesions as well as to predict death. There is a chance for a false optimistic prognosis as patients may die for non neurological reasons or show a progressive neurological deterioration. If BAEP are absent and wave 1 is normal, a firm prediction of death could be made.

P019

RISK FACTORS AND PREDICTION OF POOR OUTCOME IN PEDIATRIC TRAUMATIC BRAIN INJURY. Susan L. Bratton, M.D., Robert L. Davis, M.D.

Background: Injury to the central nervous system is the cause of death in the majority of pediatric trauma victims. Studies have identified a wide range of factors associated with poor outcome from brain injury. However, when single features are analyzed, they are not sufficiently accurate predictors. Few studies have used a multivariate analysis of these factors and pediatric outcome.

Methods: Clinical and radiographic features of 164 comatose children after traumatic brain injury were analyzed. Clinical parameters, the initial cranial CT scan, and demographic characteristics were analyzed for an association with death or vegetative survival at 6 months. A tree diagram in which risk factors may differ within the study subpopulations was constructed using recursive partitioning.

Results: Children with a motor score ≤ 2 had an 11-fold increased risk of poor outcome compared to those with motor scores > 2 . Among patients with scores of ≤ 2 , those with abnormal pupillary reflexes experienced a 13-fold increased risk of death compared to those with normal pupillary reflexes. Among patients with a motor score > 2 , an intracranial diagnosis code (no pathology, mild shift ≤ 5 mm, swelling, shift > 5 mm, surgical mass lesions, or non-operative mass lesions) was highly predictive of poor outcome at 6 months. Children with CT findings other than normal or mild swelling had a 4-fold increased risk of poor outcome. Of children with swelling, shift or mass lesions, the pupillary light reflex was associated with outcome. Children with abnormal pupils had a 6-fold increased risk of poor outcome.

Discussion: A few clinical and radiographic features stratified comatose children into fairly distinct risk groups. Information available early after traumatic brain injury in comatose children provides useful prognostic information on the likelihood of death or devastating injury.

P020

THE EFFECT OF LATE INTUBATION ON COURSE OF THE PEDIATRIC PATIENTS AFTER SERIOUS CRANIO-CEREBRAL TRAUMA

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INTRODUCTION: To compare the effect of early intubation (immediately after accident, or during transportation) and late intubation (on admission) on the course (ICP, CPP trends, mortality and morbidity) of the pediatric brain trauma patients.

PATIENTS: 54 pediatric patients after serious cerebral injury. GCS less than 8 points. Mean age 6.4 years. 40 patients were intubated early and 14 were intubated only on admission. All were on complex neurointensive care (artificial ventilation, ICP, CPP monitoring).

METHODS: We registered hypoxic situations (cyanosis or SaO₂ less than 80 %) during the period from the accident to the beginning of complex neurointensive care. Statistic comparison of two study groups (late and early intubation) as for hypoxic situations, ICP, CPP trends and the results of the therapy. The calculation of relative risk index of hypoxic event in the late intubation group.

RESULTS: In the late intubation group (14) we noticed 9 hypoxic situations. In the early intubation group (40) 12 hypoxic situations. There were proved significantly worse trends of ICP and CPP in patients after hypoxia as well as the end result of the therapy. Relative risk index was 2.83.

CONCLUSION: The elective intubation in the case of GCS 8 points or less is the rational approach to the brain trauma patients.

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P021

EPIDURAL HAEMATOMA. A STUDY OF SEVENTY CASES

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A retrospective study of 70 children with the diagnosis of epidural hematoma was made during 1990-1995 period. Ages ranged between 7 days and 17 years (18% less than 1 year, 40% between 1 and 10 years, and 42% older than 10 years), 82% of them were admitted at the PICU. 51% of the cases were due to falls, 35% to road traffic accident and 14% to other causes. On admission GCS was less than 8 in 19% of the cases and more than 14 in 53%. Diagnosis was made during first 4 hours in 63% of patients and delayed more than 12 hours in 28% of them. Neurologic impairment was present at admission in 33% of patients, and delayed in 30%. Even so, 27% remained without impairment. Radiological findings at first CT were skull fracture (68%); epidural hematoma localization was: in the right side (63%), frontal area (24%), temporo-parietal (66%) and occipital (10%). Associated lesions were: several (13%) or unilateral (51%) cerebral contusions, diffuse brain oedema (10%), unilateral hemispheric oedema (14%) and 38% showed shifted middle line. Four patients died, half of them during the first 24 hours. 41 fully recovered (58.6%) and 25 have sequelae of different nature: 7 were left with severe motor disability (10%); at the follow-up 13 have some degree of neurodisability. Next data keep correlation with death or neurosurgical impairment: only were significative multiple cerebral contusion ($p=0.002$) and brain oedema ($p=0.05$), GCS less than 8 at the admission ($p=0.002$), shock ($p=0.003$) and remaining cerebral contusion in control CT correlated with death or disability at discharge. On the other hand, neither surgical drainage volume nor first or highest levels of ICP (12 cases), nor pupillary abnormalities (10 cases) correlated with worse prognosis.

Conclusion: GCS equal or less than 8 and shock are main factors related to worse prognosis, also multiple cerebral contusions in CT and diffuse brain oedema.

P022

ANTIEDEMA THERAPY WHEN THE CEREBRAL-BLOOD BARRIER HAS BEEN DAMAGED.

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Mannitol infusion has been extensively used as osmotic anti-cerebral edema medication in pediatric patients without renal insufficiency. In the presence of a cerebral-blood barrier rupture as in cerebral haemorrhage or after neurosurgical intervention, the osmotic drugs could worsened the edema recalling fluids locally. The Authors studied prospectively 33 children admitted to the PICU after neurosurgical removal of cerebral posterior fossa tumors. They were randomly assigned to two different anti-cerebral edema protocols: 15 received mannitol (1gr/kg/dose * 6) and 18 received furosemide(1-2 mg/kg). All the children received water restriction policy, dexamethasone therapy (0.5 mg/kg/die), a constant monitoring of heart rate, blood pressure, haemoglobin saturation, intracranial pressure, urine output, and hourly Glasgow score. The two groups of children didn't have statistical differences in age, need of mechanical ventilation, Glasgow score, presence of ventricle catheter, tumor histological characteristics, tumor extension and amount of tumor excision. During clinical course the group treated with mannitol has registered hypotension in 5 subject, intracranial hypertension in 3 subject and hyponatremia in 3 subject: the group which received furosemide has registered intracranial hypertension in only 2 subject. The mean days of permanence in PICU were 6 (range 2-22) for mannitol group and 5.3 (2-13) for furosemide group. None died. The authors suggest a more safety use of furosemide than mannitol as anti cerebral edema associated to corticosteroids in the absence of cerebral-blood barrier integrity.

P024

GLASGOW COMA SCALE (GCS) IN RELATION TO OUTCOME OF CHILDREN WITH HEAD INJURY

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The results of a modified GCS were compared to outcome and intensive therapy in 78 children (mean age $8,5 \pm 4,7$ years) with head and associated injuries (53,6% of all cases) of different causes (traffic accidents, falls). The GCS was regularly used inn the course of intensive therapy. According to our own and other experiences the GCS was divided in 3 stages: stage 1 (4-8 points), stage 2 (9-12 points) und stage 3 (13-19 points).

50% of the stage 1 patients died and the rest was in an intensive care unit (duration: $34,9 \pm 15,3$ days) and were ventilated $8,5 \pm 4,7$ days. The children with intracranial pressure values over 40 mm Hg did not survive. All patients had neuropsychical damages (decerebration, paresis, hydrocephalus, symptomatic epilepsy, different psychical disturbances). Associated injuries (fractures, lung contusion, abdominal trauma, burns) complicated the prognosis. At stage 2 the duration of intensive therapy ($15,2 \pm 6,2$ days) and of respirator treatment ($2,6 \pm 1,7$ days) decreased. The posttraumatic sequelae were observed only in 50% of the injured children. Stage 3 patients were treated $6,7 \pm 3,4$ days without ventilation with a good prognosis; only one patient had hearing disturbances.

The GCS allows an exact examination of head injury patients with resulting effective diagnostic and therapeutic measures. Stage 1 patients should be ventilated and an intracranial pressure monitoring is really necessary.

P023

THE STATE OF HEMATOENCEPHALITIC BARRIER IN CHILDREN WITH SURGICAL EMERGENT PATHOLOGY

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The impact of toxemia on the CNS state in children with acute surgical diseases is one of the least studied aspects in current reanumatology. Sensibilisation to the cerebral antigens was investigated in the immunodetoxikation test with the view of establishing the status of hemato-encephalitic barrier in children with surgical emergent pathology. The antigens of the whole brain along with those of the cerebellum and the hypothalamus were used. Blood samples were drawn within the 24-48 hours following operation, at 5-6 days and at the child's discharge from the intensive care unit. Homeostasis together with the level of the patients' toxemic markers was monitored. Cerebral blood flow was studied with the use of transcranial Dopplerography and transcranial angiography.

22 children were examined following surgical emergency for various disorders of the thoracic and abdominal cavity. In 13 subjects within the 24-48 hours' period after the operation the level of immunodetoxikation index did not exceed 0.1 (normal value 0.11). There was no evidence of pathology while studying cerebral blood flow. Subsequently, the state returned to normal limits, the postoperative being without complications.

A rise in the level of sensitization to the cerebral antigens up to 0.4-0.7 was noted in 9 patients. There was an increase in cerebral velocity, an elevation in peripheral resistance of the large cerebral vessels. Neurologic symptomatology (somnolency, muscular hypotonia, hyperreflexia) was observed in these patients on clinical grounds.

The present observations suggest that the study of the state of hemato-encephalitic barrier in children with surgical emergeny is of obvious necessity in correcting severe pathology immediately following the operation.

P025

THREE-DIMENSIONAL RECONSTRUCTION OF THE BRAIN WITH TRANSFONTANEL ULTRASONOGRAPHY IN NEONATES BEFORE AND AFTER CARDIAC SURGERY.

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Background: Reconstruction of the heart by three-dimensional (3D) echocardiography provided new information on anatomy of complex congenital heart defects. We assessed the utility of 3D ultrasound in detecting morphological changes in cerebral anatomy in newborns before and after cardiac surgery.

Methods: Transfontanel cross-sectional ultrasound scans were obtained in standardized coronal and median sagittal planes. Subsequently, rotational scanning was used to acquire the multiple sequential cross-sections of the brain. For rotational scanning, a conventional 5 MHz transducer was rotated 180 degrees. Scanning took less than one minute and required no sedation. Data was stored in the image processing computer which allowed for off-line three dimensional reconstruction of different brain regions. Twelve infants aged 3-21 (median 7) days were assessed before and after cardiac surgery.

Results: Cavity of lateral ventricle, choroid plexus and the periventricular brain parenchyma could be reconstructed in all. Accurate estimation of size and volume of lateral ventricle, aqueduct, and other ultrasonographic visible pathological brain lesions could be performed. Reconstruction of various brain areas was accomplished in 3-10 minutes. The localisation and extension of severe periventricular hemorrhage which was detected preoperatively in one infants was better visualized than in conventional ultrasonography. Epicortical and subarachnoidal space could be reconstructed in all and allowed detection of hemorrhage in one case which was not detected by conventional ultrasound.

Conclusion: 3D reconstruction of different areas of the brain may provide additional quantitative information on size and volume of the internal ventricle and choroid plexus, and better understanding of the topographical aspects and the extension of intra- and periventricular hemorrhage than conventional cross-sectional ultrasound.

P026**RELATIONSHIP BETWEEN THE SPECTROSCOPIC MEASUREMENT OF REGIONAL CEREBRAL HEMOGLOBIN SATURATION (rSO₂) BY NEAR INFRARED SPECTROSCOPY (NIRS) AND VENOUS BLOOD SATURATION IN THE JUGULAR BULB (SjO₂) IN INFANTS AND CHILDREN.**

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Introduction: Intracranial cerebral blood has been estimated to be 70% venous. The invasive measurement of venous blood saturation in the jugular bulb provides quantitative information on cerebral oxygen supply and consumption. However, routine oxymetric measurement of blood saturation in the jugular bulb by insertion of a catheter line into the internal jugular vein is an invasive procedure which has limited use especially in infants and young children. Thus the aim of this study was to investigate the correlation between the non-invasive spectroscopic measurement of rSO₂ and the oxymetric determination of the blood saturation in the jugular bulb in infants and children undergoing routine cardiac catheterization.

Methods: During routine cardiac catheterization 30 infants and children (age 5 day-16 year, median 4.5 year) the rSO₂ was measured continuously using a two channel cerebral oxymeter (INVOS 3100A). The sensor was placed in standardized location at the left temporal head side. After the routine oxymetric blood sampling in the superior vena cava the oxymetric catheter was manipulated into the left jugular bulb. After control of the catheter position simultaneous values of the rSO₂ were documented.

Results: Over a range of (33-87%) SjO₂, a significant linear correlation was found between the spectroscopic measurement of rSO₂ and the oxymetric determination of venous blood saturation in the jugular bulb ($r=0.83$, $p<0.001$) and the superior vena cava ($r=0.65$, $p<0.05$). No significant correlation was found between rSO₂ and the arterial blood saturation in the descending aorta and as well as to the standard hemodynamic parameters.

Conclusion: Measurement of rSO₂ by NIRS may provide continuous non-invasive information on cerebral venous blood saturation and thereby possibly on cerebral oxygen supply and consumption in infants and children. These may be of clinical value particularly during and immediately after heart surgery by means of non-pulsatile cardiopulmonary bypass.

P027**UNUSUAL PRESENTATION OF BRAIN ABSCESS: TETRALOGY OF FALLOT MODESTO V, IBIZA E, ABENGOCHEA A, ARAGO J, SANCHIS R, VARAS R, CALDERARO R, TOMAS J, GARCIA E.**

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CASE REPORT:

The patient was a 2-year-old girl diagnosed of Down's syndrome, Tetralogy of Fallot. (T.F.)

Before admission a vasovagal crisis after coughing and vomiting was seen, and she was taken to the emergency room. Mother said she had cyanosis in the mucous membranes of the mouth with exercise. On physical examination, she was afebrile, normal fundi and neurologic examination was normal. A harsh systolic murmur was heard, with decreased intensity during bradycardia. Chest RX disclosed a decreased pulmonary vascular markings. ECG: sinus rhythm, with bradycardia and nodal escape rhythms. She was transferred to our PICU because of severe hypertonic seizure, lost consciousness, and decerebrate posturing, without cyanosis. The episode lasted for several seconds, and ceased with diazepam.

On admission she was lethargy, and neurologic examination showed weakness of left leg without Babinski, and normal funduscopic. The patient had two episodes of bradycardia and isoproterenol was begun. During those episodes the patient was cyanotic, and the murmur was heard with the same intensity. A CT scan disclosed a right parieto-temporal abscess with midline shift. Immediately after the diagnostic CT, we administered antibiotics, antiedema treatment and it was drained. The abscess culture was negative. A CT control disclosed air and midline shift. During the next two days she had three episodes of hypoxia and cyanosis ceased with oxygen, morphine and propanolol.. The patient died during a fourth episode.

DISCUSSION:

Arrhythmias are uncommon in patients with Tetralogy of Fallot before surgery. In our case the first diagnosis was sick sinus syndrome vs bradycardia secondary to cyanotic episodes. The incidence of cerebral abscess in children with congenital heart disease (CHD) is approximately 5%. Tetralogy of Fallot is the most common associated lesion, and is unusual in children under 2 years of age.

CONCLUSION:

1) Brain abscess is a rare complication of patients with cyanotic CHD, but should be suggested in patients with "apparent" sick sinus syndrome.

2) In patients with Down's syndrome, T.F., with cyanotic episodes, and difficult neurologic exploration , a brain CT scan is recommended.

P028**REFRACTORY STATUS EPILEPTICUS IN CHILDREN AT CHANDIGARH, INDIA**

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Information on refractory status epilepticus (RSE) from developing countries is scarce. We analysed 43 cases of RSE admitted over last 2 yrs. The objective was to study etiology and evaluate efficacy of diazepam infusion. Median age of the patients was 1.25 years (range 1.5 months to 11.5 yrs); 70% were boys. Onset of seizures was 1-144 hours (median 24 hours) prior to hospitalisation. The Glasgow Coma Scale score ranged from 3-11 (mean + SD 5 + 2). The commonest underlying causes were acute CNS infections (26/43, 60%; bacterial meningitis, 16, encephalitis, 10) and epilepsy (8/43, 10%).

Diazepam infusion in incremental dose (range 0.01-0.025 mg/kg/min) was used in 38 patients over 3.4±2.1 days. Seizures were controlled n 31 (82%). Mechanical ventilation was required in 10 (26%) only, while none had hypotension; 84% patients survived. Thiopental infusion (bolus 5 mg/kg followed by 0.2 mg/kg/min, and increments of 0.1 mg/kg/min till seizure control) was used in 8 patients over 1.7±0.7 days; seizure were controlled in all, but five patients needed mechanical ventilation, six developed hypotension needing infusion of vasopressor drugs, 3 out of 8 (38%) died. Overall mortality was 26%, mainly due to acute CNS infections (n-8) and prolonged SE.

Conclusion: In developing countries like ours where acute CNS infections account for most of SE and intensive care facilities are scarce, diazepam infusion is an effective mode of therapy and may obviate the need for thiopental infusion, mechanical ventilation and vasopressors.

P029**TREATMENT OF GUILLAIN-BARRE SYNDROME IN CHILDREN, USING PLASMAPHERESIS.**

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Guillain-Barre syndrome (GBS) is an acute autoimmune reaction, directed primarily toward the myelin encasing the peripheral motor nerves. This reaction causes a delay or block in nerve conduction. The presentation often can be very subtle but is followed by rapid loss of neuromuscular power, leading to acute respiratory distress, resulting from weakness of muscles and aspiration pneumonia.

There were 3 boys - 4, 8, and 11 years old with GBS, treated in our ICU. Two of them due to the respiratory distress were intubated nasotracheally and ventilated mechanically with SERVO-900C (Siemens-Elema, Sweden) ventilator. Duration of ventilation was 11 and 34 days, respectively. Plasma exchange was performed in all cases. The numbers of plasma exchange sessions were 2-4 in each case. Mean amount of plasma exchanged per session was 28,24 ml/kg. Plasma was substituted with albumin, plasma or saline.

The most important aspect of the management of patients with GBS in the ICU involves the airway care, prevention and treatment of aspiration pneumonia and the mechanical ventilation if respiratory distress presents. Endotracheal intubation should be performed whenever there is evidence of retention of pulmonary secretions, refractory to chest physical therapy, weakness of protective reflexes of the airway, leading to aspiration pneumonia and (or) atelectasis. Cardiac arrhythmias too, is a main threat to the circulatory stability in GBS. Therapeutic plasmapheresis has been shown to be beneficial, reducing the time for weaning from the ventilator and for achieving independent ambulation. However, plasma exchange is expensive and not without significant risks for the patient. Some authors find that plasmapheresis is not effective for patients with fulminant course of GBS and blocking of nerve conduction. Recent studies have demonstrated that intravenous high-dose immunoglobulin can be equally effective.

There were no significant complications associated with plasma exchange. All presented patients survived without residual disability.

P030**Tetraparesis associated with long-term Pancuronium use in an infant.**

Bordet F, Berthier JC, Contamin B, Pondarre C, Rousson A.

Pancuronium is a muscle relaxant used in ventilatory management of patients with respiratory distress in intensive care unit. After the end of sedation some patients were found to have severe tetraparesis. Paresis was accompanied by complete areflexia and diffuse atrophy of all extremity muscles. This neuromuscular complication is caused by prolonged high-dosage pancuronium treatment. In the last 5 years, numerous reports have linked the use of pancuronium bromide with prolonged paralysis, disuse atrophy and areflexia. This side-effect is well known in adults patients but rare in a pediatric intensive care unit.

We describe one pediatric observation of tetraparesis after prolonged pancuronium treatment in a 9-month-old girl. This female infant developed respiratory distress syndrome and was intubated and mechanically ventilated. To decrease chest wall rigidity pancuronium bromide was administered during 11 days. (she received approximately 120 mg of pancuronium bromide). On day 12 the drug was discontinued and the patient had severe tetraplegia and areflexia with normal head movements. Electromyography showed absence of any disorder of neuromuscular transmission. This infant showed a recovery of muscles after 3 months. The other causes of peripheral neuropathies were eliminated. Electroencephalograms and head scans were normal. The recovery pattern observed in our patient correspond to the process of regeneration after axonal degeneration. It is suggested that these neuromuscular complications were caused by prolonged high-dosage pancuronium treatment (associated with corticoid and aminoglycosides).

P032**TITLE: "NEUROMUSCULAR DISORDERS IN I.C.U. CHILDREN"**

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Neuromuscular disorders (NMD) of Critical Illness Polyneuropathy syndrome in adult I.C.U. appeared in literature in 1984 and is extremely common in long stay cases. The etiology of these disorders remains elusive. It is tempting to ascribe them to administration of drugs (muscle relaxants, steroids, aminoglycosides), prolonged immobility, malnutrition, sepsis and ischemia associated with reperfusion injury. To our knowledge there is only one case report of similar condition in a children I.C.U.(Pascucci 1990)

We present a serie of 16 previously healthy children, aged 9 months to 13 years, who admitted in I.C.U with respiratory failure and who following weaning from M.V. remained in profound diffuse hypotonia with proximal and distal muscle weakness for various length of time. Recovery of muscle strength occurred in a week or months (the longest 10 months).

All children, except one, 3-4 days before admission developed symptoms of either respiratory or upper airway infection with fever. On admission viral and bacterial cultures were positive in 2 cases (Haemophilus influenzae, Herpes virus). During treatment 9 patients became septic.

Muscle histological and Neurophysiological investigations have not been done.

Considering the multifactorial nature of the acquired NMD in adult critically ill pts, is impossible to attribute the muscle weakness of our pts to any specific cause.

In conclusion, our findings suggest the need for further investigation of NMD in critically ill children treated in I.C.U.

P031**OUTCOME AFTER FEBRILE STATUS EPILEPTICUS.**

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Febrile Status Epilepticus (FSE) is a prolonged and serious febrile seizure. Little is known about the outcome of FSE in neurologically normal children. This survey involved patients between 6 months and 6 years of age who had visited due to their first FSE, the Sophia Children's Hospital during the period of January 1981 till December 1991. Patients with a history of neurologic disorders were excluded. 57 patients were identified, 65% were male. The cause of the fever remained unknown in 51% of the cases. In all case the FSE was generalized and it most frequently occurred at night (47%). The mean age at FSE was 1.6 years (0.5-4.7), the mean temperature 39.6°C (38.5-40°C). The mean follow up time was 1.7 year. Twelve children (21%) had neurologic sequelae. The neurologic sequelae varied from speech deficit (4 case mild, ½ - 1 year delayed; 4 case moderate > 1 year delayed) to severe retardation and epilepsy (4 cases). Speech deficit was detected after a mean period of 6 months (range 0-18). Age, gender, temperature, family history and time of onset were no significant risk factors for neurologic sequelae. Duration of seizure [RR 3.0 (0.8-11.3)] and more than two drugs to treat FSE (RR 5.2 (1.5-18.1) were related to neurologic sequelae. We recommend that FSE children should be followed for at least a year to detect possible speech disorders properly and start early intervention.

P033**UNUSUAL PRESENTATION OF MYASTHENIA GRAVIS**

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CASE REPORT: The patient was a 2-year-old girl transferred to our PIC because of severe respiratory failure. The patient, convalescent of chickenpox, came into contact with horse manure previous afternoon. In the morning, she was lethargic, and irritability, with poor feeding and suffered an episode of coughing, cyanosis and acute respiratory failure after mucous vomiting when she was drinking milk. On admission she had severe respiratory distress, respiratory acidosis, and the Sat O₂ was 86%. She was intubated without difficulty, and was transferred to our P.I.C.U. Physical examination reveals stable hemodynamics, pupils equal, round, reactive to light, normal fundi, and muscle relaxation. Crusted vesicles disseminated. Rhonchi over both lungs. Hepatomegaly (+) and splenomegaly (+). The urine, hematologic, and C.S.F. laboratory findings were normal. C.T. scan of the brain, E.E.G., and E.K.G. revealed no abnormalities. Rx chest disclosed a retrocardiac atelectasis. Specimens of stool and blood were obtained for cultures and study of *C. botulinum* toxins. Pending receipt of these results, a broad-spectrum antibiotic and acyclovir was begun. The initial differential diagnosis consisted of LARYNGOSPASM ASSOCIATED WITH ASPIRATION, botulism, and postinfectious varicella encephalitis. After 15 hours, weaning was begun. The neurologic examination showed a low Modified Glasgow Coma Scale (MGCS), generalized hypotonia and muscle weakness. These data suggested three diagnoses, postinfectious encephalitis, residual neuromuscular blockade, and excessive doses of sedative and analgesic drugs. After 20 hours she regained skeletal muscle power and sufficient respiratory effort, the MGCS was acceptable, and blood gases were normal. She was given neostigmine and atropine, and her trachea was extubated. An acute respiratory failure occurs 120 min. after. Chest radiograph disclosed a left inferior lobe atelectasis. After 20 hours weaning begun, and the same episode was seen. At this point her mother stated that the girl showed weakness of the eyelids or extraocular muscles. It suggested myasthenic syndrome vs Guillain-Barré syndrome. *C. botulinum* toxins were negative, cholinesterase level was normal. Edrofonium test was positive. Anti-acetylcholine receptor antibodies were negatives. E.M.G. confirmed MYASTHENIA GRAVIS (CONGENITAL vs JUVENILE seronegative). Pyridostigmine was begun and the trachea was extubated without complications.

CONCLUSION: 1)In the differential diagnosis of weaning failure we must consider myasthenic gravis. 2)Myasthenia Gravis could resemble encephalitis, because of low GCS, overall if is triggered by viral infection. 3)In some diseases (this case) GCS could not be an accurate index of mental state.

P034

Preterm Birth at 25 to 32 weeks'gestation : strabism of one-year-old infant is a good predictor of a poor neurological outcome at two years of age.

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Objective : to point out that strabism (S) of one-year-old premature is a good predictor of a poor neurological outcome at two years of age.

Design and setting : two-year prospective cohort study and geographically defined study (region of Franche-Comté, FRANCE).

Main outcome measures : neurological assessment was performed at one and two years of age (uncorrected for gestational age). A mailing questionnaire was sent to the family and full-filled by the family doctor (pediatrician or physician), or neonatologist of the ICU at tertiary center. S was diagnosed at one year of age by the examiner but S was not used to diagnose cerebral palsy (CP).

Sample : 161 of 171 survivors (94%) evaluated at one and two years of age.

Results : correlation of one and two years neurological evaluation is weak ($\kappa=0.5$). Correlation of S at one year and CP at two year is fair ($\kappa=0.72$).

		2 Years				2 Years			
		CP(+)	CP(-)			CP(+)	CP(-)		
1 Year	CP(+)	8	2	151	Strab.+	15	4	142	
	CP(-)	13	138		Strab.-	6	136		161
		21	140	161		21	140	161	

Discussion : In this population-based study, strabism at one year of age is a better predictor of CP at two years of age than neurological evaluation itself. Characteristics of S for the screening of CP are : sensitivity 71% (15/21), specificity 97% (136/140), positive predictive value 79% (15/19), negative P.V. 96% (136/142). When a trained neuropediatric team can't assume the entire follow-up of ancient prematures, examinators should be aware of the opportunity to refer the child affected by strabism to the neuropediatric team because of a high probability of CP.

P035

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ULTRASOUND APPEARANCE OF STRUCTURAL PLASTICITY OF THE HUMAN CEREBRAL CORTEX DURING PERINATAL AND EARLY POSTNATAL LIFE

The goal of this paper is to review evidence related to hypothesis that the "waiting" axons and cells of the transient subplate zone may participate in the structural plasticity of the human cerebral cortex after perinatal brain damage (Kostovic et al., Metabol Brain Res 4:17, 1989) and to correlate this phenomenon with different forms and mechanisms of structural plasticity. It is our basic assumption that all lesions occurring during cortical histogenesis will lead to more or less pronounced structural reorganization. Here we show that various components of the subplate zone participate in several forms of the structural "plastic" responses in the human cortex: modification of convolutional pattern, changes in size of cytoarchitectural areas, columnar reorganization, dendritic and synaptic plasticity. The etiological factors which induce lesions and subsequent plastic changes act via the following pathogenetic mechanisms:

- * disturbances of radial unit formation (Rakic);
- * changes in ingrowth of afferent fibres;
- * changes in the rate of normally occurring reorganisational events, depending on the critical period for a given histogenetic event.

In the present study developmental lesions (localized periventricular leukomalacia and haemorrhages) were demonstrated by ultrasound in live-born infants ranging between 26 to 40 weeks of gestation. In younger infants (24-34 w) who died shortly after birth, examination revealed lesions of the white matter with the preservation of the subplate zone. In infants who died one week or more after the lesion, we have observed localized micropolygyria, cavities, condensed layer VI - subplate zone, and columnations of the cortical plate. These changes are less prominent if the lesion occurs after diminishment of the subplate zone (after 34 w). Since in the fetal cortex the subplate zone serves as predominant source of growing fibers, transient neurons, trophic factors and contains cellular substrate for migration, this zone is the most likely candidate for major types of structural plasticity.

In conclusion, cerebral cortex of the low - birthweight infants is more susceptible to the various lesions but shows vigorous structural plasticity and conspicuous functional recovery due to the growing, transiently located neuron al elements.

Sepsis

P036

PROGNOSTIC FACTORS IN MENINGOCOCCAL INFECTION: PREDICTORS OF MORTALITY.

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The mortality due to meningococcal sepsis is high in spite of important progress in emergency and intensive care medicine. During the last decade multiple scoring-systems have been developed in order to establish a therapeutic approach and to evaluate the final outcome of a meningococcal infection. Different clinical and biological data (shock, ecchymosis, peripheral WBC and platelet count, coagulopathy, acidosis, meningism, etc) are taken into consideration and the importance given to these data depends on the scoring-system used. A review of the different scoring-systems is given and a clinical case is presented.

We report the case of a 4 year old male, who was transferred to our ICU 12 hours after onset of temperature and skin rash. The parents described a fast deterioration of his condition. The boy presented wide spread ecchymosis, high temperature, no signs of meningism, circulatory insufficiency and shock, coagulopathy and low peripheral WBC and platelet count. Disseminated intravascular coagulopathy developed promptly. The Glasgow Meningococcal Septicemia Prognostic Score (GMSS) was used and the obtained score reached the highest level (15/15). This corresponds to a 100% mortality. The patient required mechanical ventilation for 5 days. At admission he received human albumine, fresh frozen plasma, dexamethason, dopamine, dobutamine and a continuous infusion of adrenaline. Antibiotical treatment consisted of ceftriaxone. The evolution was favorable and the infant fully recovered.

Retrospectively the GMSS was compared to other meningococcal scoring scales which gave the same mortality (100%).

We conclude that the scoring-systems are important to evaluate the seriousness and to assess the therapeutic approach, but they should be used cautiously even when 100% mortality is predicted by several risk evaluations scoring-systems.

P037

HAEMODYNAMIC PRESENTATION AND MANAGEMENT OF 46 CASES OF PAEDIATRIC MENINGOCOCCAL INFECTION

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The aim of this study was to assess the haemodynamic status on admission and the critical care management of children presenting with meningococcal infection. This was a retrospective study of the charts of 46 consecutive admissions.

Mean age was 3.43 years (+/-3.46). The average duration of symptoms prior to admission was 20.4 hours (+/-14.09). On admission 17.4% were hypotensive, 45.6% had clinical signs of haemodynamic instability and 54.8% of cases that had a blood gas analysis on admission had a metabolic acidosis (Bases excess < -5.0). The mortality rate was 10.9%. 80% of patients that died were hypotensive on admission and all had a metabolic acidosis. Of the 41 survivors 9.7% were hypotensive on admission, 39% had clinical signs of haemodynamic instability, 25% required invasive pressure monitoring and 7.3% were ventilated and received inotropic support.

This study demonstrates that at the time of presentation with meningococcal infection children had a high incidence of established haemodynamic instability. Successful management of this infection is dependent on early presentation and initiation of therapy and on aggressive support of the cardiovascular and vital organ systems.

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P038

EXPERIENCES WITH PENTAGLOBIN IN THE THERAPY OF BURNT CHILDREN

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Immunosuppression and sepsis is a common consequence of burns in childhood. Current opinion favors the concept of downregulation of the immun reponse by mediators of the inflammatory reaction rather than intrinsic failure of immunocompetent cells. Highly developed antibiotics are available for therapy of bacterial infections. Nevertheless, bacteria and their toxins are becoming an increasing problem.

In our department 391 burnt patients were treated between 1990-1995. The age of patients was one month to 15 years. 52 patients showed clinical symptoms of septicaemia. 20 of them were treated with Pentaglobin / Ig M enriched Human iv, Immunoglobulin/. The dosage was 5ml/kg for 3 days. Pentaglobin was well tolerated by the patients, and clinical signs of sepsis improved. 4 children died. In two of them Pentaglobin administration was restarted, when they were already in hypodinamic phase of sepsis and then Pentaglobin showed to be ineffective. We can conclude, when started therapy in early phase of sepsis immunoglobulin specially Pentaglobin is useful in the therapy of burnt children.

P039

ARE THERE SPECIFIC HEMOSTATIC ABNORMALITIES IN CHILDREN SURVIVING SEVERE INFECTIOUS PURPURA (SIP) AND HAVING SKIN NECROSIS AND LIMB ISCHEMIA (SNLI) THAT NEED SKIN GRAFTS AND/OR AMPUTATIONS?

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More than 10% of children surviving SIP (defined as purpura with shock) have SNLI. **Objective.** To search for a specific hemostatic profile in children with SNLI. **Patients and methods.** Between May 1989 and March 1995, 34 children with SIP were admitted to our PICU : 6 (17.6%) died and 28 (82.4%) ranged in age from 1 to 185 months (mean : 29) survived, 5 of them (17.8%) with SNLI (defined as the need of a surgical procedure). In survivors, two hemostasis studies (between H0 and H12, and 24 H later) included the determination of coagulation factors (routine tests), protein C (PC : amidolytic activity, Biogenic), total protein S (PS : ELISA, Stago), C4b binding protein (C4bBP : Laurell's technique, Stago), antithrombin3 (AT3 : chromogenic test, Stago), and plasminogen activator inhibitor1 (PAI1 : chromogenic test, Biopool). Three severity scores were determined at admission : French Group of Pediatric Intensive Care, Gedde-Dahl, and CRP. Statistical analysis used the Wilcoxon's test. **Results.** At admission (1st sample) severity scores and AT3, PC, PS, C4bBP levels were not different between the group with SNLI and the group without SNLI ; Quick time ($22 \pm 5\%$ vs $35 \pm 14\%$; $p = .025$), VII+X ($20 \pm 3\%$ vs $30 \pm 10\%$; $p = .041$) and PAI1 (105 ± 157 UI/ml vs 580 ± 570 UI/ml; $p = .028$) were lower in the group with SNLI. On the 2nd sample there was no difference between the two groups. Kinetics of hemostatic abnormalities was not different between the two groups. **Conclusion.** In the literature, intravascular coagulation (DIC), low fibronectin and AT3 were identified as predictors of SNLI, and a negative correlation was found between the mean size of the skin lesions and PC activity, AT3, and total PS. In this series, apart from DIC, there were no specific hemostatic abnormalities that support the use of treatments such as PC, AT3, and PAI1 antibodies administration to prevent SNLI. Further studies including more children are needed.

P040

PENTAGLOBIN FOR THE TREATMENT OF SEPSIS SYNDROME

Borbála Mikos, Éva Biró

The aim of study was to investigate the efficacy of intravenous immunoglobulin with enriched IgM content Pentaglobin /Biotest/. In our pediatric intensive care unit ten septic children /group I/-their average age 2,6 years /SD:0,6/, 7 of them with Gramm negative and one with Gramm positive blood cultures, and two with unidentified bacteria- were treated with basic sepsis therapy and Pentaglobin. The application of Pentaglobin was as follows: 1,5 ml/kg loading dose for one hour, followed by a continuous intravenous infusion 0,1-0,4 ml/kg/hour depending on body temperature /Lanser scheme/ for 72-96 hours. Another ten septic patients /control-group II/ - the mean age 2,5 years/SD:0,65/, their blood cultures were Gramm negative bacteria 6, positive 2, and the bacteria was not identified in two cases - were treated with only the basic therapy.

Results: the duration of intensive treatment decreased from an average 22,7 days /SD:8, min 12-max 38 days/ to 19,5 days /SD:5,2 min 9-max 25 days/ in the group treated with Pentaglobin. The difference was significant / χ^2 p<0,01/. In the group I nobody died, but three in the group II.

Conclusion: the Pentaglobin therapy can improve the efficacy of the basic therapy of sepsis.

P042

POSTSEPSIS BRADYCARDIA IN A BOY WITH LEUKEMIA

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Sinus bradycardia after an episode of sepsis is a rare symptom complex described in children with hematologic malignancies. We present a case of postsepsis bradycardia following severe typhilitis and septic shock in a 12 year old boy with relapse common ALL. Blood and ascitic fluid specimen grew Clostridium species and Pseudomonas aeruginosa. At surgery there was a necrotic gangrenous terminal ileum and cecum, requiring ileocecal bowel resection with ileostoma. While clinically recovering from sepsis he developed bradycardia for 120 hours. Extensive diagnostic procedures were given and the heart rate slowly increased to normal range of age.

Postsepsis bradycardia in children with hematologic malignancies after an episode of sepsis is self-limiting and after careful differential diagnostics warrants an expectative attitude.

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P041

PUTATIVE PROGNOSTIC AND DIAGNOSTIC VALUE OF SERUM NITRATE IN NEONATAL SEPSIS.

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Nitrate level is known to be enhanced during sepsis. Serum nitrate is the stable metabolic end-product of endogenous nitric oxide generation. Nitric oxide has demonstrated to be a powerful anti microbial final mediator and also a key molecule driving to the lethality of one of the most common complication of sepsis; the endotoxic shock. Such facts prompted us to investigate the possible diagnostic and/or prognostic value of monitoring serum level in high risk, presumptive and confirmed sepsis patients. Additionally we have explored the usefulness of this mediator as index of therapeutic response. In our study it is demonstrated that there is an important relationship between nitrate level and the occurrence of neonatal sepsis. Septic newborn group showed 6 fold higher nitrate level than that of healthy control group. In addition, the group of patients with high risk of sepsis which finally became septic, exhibited 3 fold higher nitrate level at 24-72 hours before the first symptoms appeared, when compare with those who did not develop sepsis. However in the presumptive sepsis group, there was no difference between the patients which finally were considered septic and those which not. In all septic cases, after 7 days of a successful therapy with antibiotics, the level of nitrate diminish 3 fold. Our results suggest the utility of monitoring nitrate as index for the diagnosis of neonatal sepsis.

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P043

HAEMODYNAMIC IMPROVEMENT AFTER PLASMA EXCHANGE IN SEPTIC SHOCK

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The potential benefits of exchange transfusion, plasma exchange, and haemofiltration have all been described in children with overwhelming sepsis. However, little hard evidence exists to prove the benefits of any of these techniques.

I have treated five patients with plasma exchange (PE), having been asked to see all these patients at a point when it was felt death was inevitable. Two of the patients had staphylococcal, two meningococcal and one enterococcal septicaemia. All patients showed a dramatic haemodynamic improvement following PE with improvement in blood pressure, reduction in inotrope requirement and improvement in tissue perfusion. Three patients survived. One of the patients with staphylococcal sepsis and both of the patients with meningococcal sepsis had developing gangrene of the limbs which showed remarkable reperfusion with PE. In two of the patients measurements of cardiac output (CO) and systemic vascular resistance (SVR) showed a reduction in CO and a rise in SVR over the course of a PE despite the reduction or cessation of vasoconstricting inotropes.

Many believe haemofiltration is of value in septic shock. A trial with a no treatment limb is difficult to achieve. I believe we now have enough evidence to justify a controlled trial of haemofiltration versus plasma exchange in patients with septic shock and unstable haemodynamic status whilst on inotropic support.

P044**The Effectiveness of plasma exchange in neonatal sepsis with acute haemogenous osteomyelitis .**

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The plasma exchange /PE/ as immunotherapy has been used in the treatment in neonatal sepsis with acute haemogenous osteomyelitis . PE may improve outcome by reducing the plasma concentration antigens , immune complexes , bacterial toxins , inflammatory mediators . The replacement was 10% albumin and fresh frozen plasma /FFP/. It is used to provide immunoglobulins ,complement factors and fibronectin in the treatment of neonatal sepsis.

Methods: 20 newborns with sepsis with acute haemogenous osteomyelitis were admitted from Sep 1994 to Oct 1995 . 9of them were treated with PE . Another 11cases were in control group .Both groups received the same therapy expect PE . Through central vein catheter ,the PE was performed . Exchange volume was 160 - 215 ml .

Results: the mortality rate PE (1/9 , 11,1%) was much lower than (4/11 , 36,4%). The effectiveness of PE had relations with number of insufficient organs . The PE was determined that the decrease of endotoxicosis level , rate of large molecular weight substances and the reduction of immunodeficiency with normalization of T-helper and T-suppressor ratio took place . The activity of disseminated intravascular coagulation syndrome decreased . Further studies of PE effectiveness in the neonatal sepsis treatment should be done .

P046**A Bedside Hematologic and Clinical Scoring system for early Detection of Nosocomial Sepsis (NS) in Newborns.**

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Introduction

Delayed antibiotic treatment of neonates with nosocomial sepsis (NS) can cause unnecessary morbidity and even mortality. The risk of overtreatment is real since clinical symptoms and laboratory parameters for infection are specific. Therefore, as for each onset sepsis, there is need for a bedside scoring system using clinical symptoms, riskfactors as well as hematologic parameters of infection to identify sepsis in those neonates who become "septic" during hospitalization.

Aim of the study:

To identify hematologic markers, clinical symptoms and risk factors for infection significantly associated with NS in "septic neonates". To develop a bedside diagnostic scoring system which can be helpful in early diagnosis of NS in these hospitalized sick newborns.

Methods

Neonates admitted in the NICU between Oct 1993 and Nov 1995, who became "septic" after 2 days of hospitalization and who were treated with antibiotics after a sepsis workup were included in the study. Hematologic parameters (WBC count, I/T ratio, Platelet count and CRP), clinical signs (temp, respiratory, gastrointestinal and cardiorrespiratory symptoms) and risk factors (central catheter, duration of hospitalization, recent surgery, TPN, steroids, BPD) for infection were analysed by calculating the maximum likelihood estimated (MLE) odds ratio for each parameter for NS. Factors who were highly associated with NS ($P<0.10$) were used to develop a scoring system. The best cut-off value (highest sensitivity and specificity) of the hematologic-, clinical-, risk factor- and a cumulative global-score was used to compare the discriminative value of each scoring system.

Results

The incidence of NS was 7.7% (41/528). 110 sepsis workups were performed in 80 of 528 admitted neonates (20.8%). In 41.3% (45/104 episodes) NS was proven by positive bloodculture. The source of infection were: catheter related (69%), probable catheter related (7%), respiratory tract (14%), primary (7%), skin 5%, gastrointestinal (5%) and UTI (2%). Gram-positive organisms were most common (61%), especially coagulase negative staphylococci (60%) and *S. aureus* (14%).

Factors with strong association for NS ($P<0.10$), their odds ratio and the corresponding score are listed in the next table.

PARAMETER	(MLE) ODDS RATIO	95% C.I.	SCORE
Laboratory			
Leucopenia (<5,000/mm ³)	4.7	0.94 - 35.5	2
I/T ratio (>2x)	1.9	0.63 - 4.31	1
Thrombocytopenia (<150,000/mm ³)	1.9	0.63 - 4.31	1
CRP (>1.0 mg/dL)	4.0	1.59 - 11.17	2
Symptoms			
Hypothermia (T<36.5°)	1.9	0.83 - 4.31	1
Hypothermia (T<35.5°)	4.5	1.26 - 16.3	2
Risk factor			
Umbilical CVC*	7.1	1.05 - 168	3
Percutaneous CVC*	12.9	1.96 - 287	4
TPN	5.2	1.87 - 16.7	2
Duration of hospitalization >14d	3.6	1.6 - 8.47	1

*CVC = central vascular catheter

The best discriminative value of each scoring system and the global score (clinical-,+hematologic,- lab- score) are compared in the next table.

SCORE SYSTEM	SENSITIVITY (%)	SPECIFICITY (%)	+ PV* (%)	- PV* (%)
Lab score >=5	60.5	72.6	61.9	72.6
Clinical score >=2	69.7	39.4	44.8	64.9
Risk score >7	58.1	82.0	69.4	75.5
Global score >10	74.4	75.8	66.6	80.4

*PV = predictive value

Conclusion:

Hematologic parameters, especially: leucopenia (<5,000/mm³) and CRP (>1 mg/dL), clinical symptoms, hypothermia (>38.5°C), hypothermia (<36.5°C) and risk factors, the presence of a percutaneous CVC, TPN, prolonged hospitalization (>2w) are useful indicators of NS. A bedside global scoring system composed from clinical, hematological and risk factor parameters for infection, had the best sensitivity and specificity to detect NS in septic neonates.

P045**CENTRAL VENOUS CATHETER RELATED THROMBOSIS IN HEREDITARY PROTEIN C DEFICIENCY**

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Hereditary heterozygous protein C deficiency is one of several possible causes of unexpected thrombosis in childhood and adolescence. It is very important to make a complete diagnosis in such cases, concerning numerous consequences of impaired coagulation status.

A 7-year old boy was admitted at surgery department with deep vein thrombosis of the right leg, after a 7-day febrile illness. Thrombectomy of the right femoral vein and amputation of the right foreleg was performed. A central venous catheter (CVC) was placed after surgery.

During the next several days, cough and chest pain suggested pulmonary embolism confirmed by radiologic evaluation. Echocardiographic examination showed multiple thrombosis of the superior vena cava, right atrium and ventricle and pulmonary artery. Estimated protein C level was 50.7 % (normal range 70- 140%); identical deficiency was found in patient's mother and elder sister.

CVC was removed, and after 2-month Heparin therapy and substitution of protein C with fresh frozen plasma, there was almost complete thrombolysis of the great vessels and cardiac chambers.

We conclude that invasive diagnostic and therapeutic procedures in such patients may result in higher risk for severe thrombosis at unusual sites, and numerous further complications

Pulmonary

P047

BRONCHOPULMONARY DYSPLASIA (CHRONIC PULMONARY DISEASE)

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Bronchopulmonary dysplasia (BPD) is a chronic pulmonary disease of preterm and term babies treated with mechanical ventilation for respiratory problems of different origin and requiring oxygen therapy 28 days after birth. BPD is a disease affecting the growth and development of pulmonary tissue. Such pulmonary lesions heal by squamous metaplasia leading to scar formation and fibrous tissue ingrowth. The Pediatric Intensive Care Unit makes the survival of babies with very low birth weight (500 - 999 g) possible. With the increase in their survival, the number of complications in low birth weight babies increases as well. BDP is a very serious complication. Therefore the importance of early diagnosis and treatment of BDP must be stressed in order to reduce the consequences. Babies with BDP must be under medical surveillance for at least 3 years as the disease needs at least that long for complete resolution.

In the ICU of Pediatric Department at Maribor Teaching Hospital, during the past two years (1994-95) 154 newborns were treated with mechanical ventilation. The neonatal and postnatal death rate of all newborns admitted to our ICU was 7%. In the two years from 1994 to 1995, 16 newborns were admitted to our ICU (2% of all newborn babies at Maribor Teaching Hospital), with birth weight 500-999 g. In the ICU, the survival of these babies and parallel to it the number of complications is increasing.

During the mentioned 2-year period, 8 babies with very low birth weight (500-999 g) survived: 5 in 1994 and 3 in 1995. In 45-50 %, first or second stage BDP was treated; there was no case of third or fourth stage BDP.

The treatment consisted of early removal from mechanical ventilation, oxygen therapy, intensive treatment of infection, volume and caloric intake control, corticosteroid treatment through 6 weeks with decreasing doses, diuretic and antioxidant therapy. The children are to be reevaluated at the age of 3 and 6 months and again at 1 and 3 years.

P048

SHORT-TERM EFFECTS OF SYNCHRONIZED ASSISTED VENTILATION /SAVI/ - A NEW METHOD OF PATIENT TRIGGERED VENTILATION /PTV/ IN INFANTS WITH RESPIRATORY FAILURE.

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A prospective study was undertaken to assess circulatory and respiratory effects of SAVI in which mechanical breaths are initiated by infant's own inspiratory effort registered as the chest expansion by pulmonary impedance monitor.

Methods: 16 infants with mean weight 1996 g and postnatal age 12 days ventilated because of RDS, pneumonia, MAS, PDA or BPD were studied. After a 30 min period of observation on conventional ventilation /IMV/ they were switched over to SAVI with the settings unchanged, and observed for the next 30 min.

Results: Significant increase in ventilator rate and mean airway pressure was noticed after the change to SAVI. No differences in oxygenation, CO_2 partial pressure and systolic, diastolic or mean blood pressure between IMV and SAVI periods were noted. In 6 infants however an improvement in $\text{PaO}_2/\text{paCO}_2$ and decrease in PaCO_2 was observed after the switch to SAVI. These babies had a lower initial a/A oxygen tension ratio and required higher initial ventilator rate ($p < 0.05$) in comparison to the rest of the studied patients.

Conclusion: Infants with low a/A PO_2 ratio who need high initial ventilator rate are likely to obtain benefit from SAVI..

P049

HIGH FREQUENCY OSCILLATORY VENTILATION (HFO-V) IN A PEDIATRIC AIDS PATIENT WITH PNEUMOCYSTIS PNEUMONIA.

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Case Summary A 4½-month 6.5 kg girl of African origin was admitted to the Pediatric Intensive Care Unit with pneumonia and progressive respiratory insufficiency. She was intubated and ventilated by pressure regulated volume controlled ventilation (Servo 300c, Siemens, Solna, Sweden). Maximum conditions were inspiratory Minute Volume 3.2 l, PEEP 10 cm H₂O and 100% O₂. Chest X-ray showed bilateral interstitial consolidation. Material obtained by broncho-alveolar lavage showed Pneumocystis Carinii. HIV-serology (Elisa and Western blot) and p24-antigen were positive, confirming the diagnosis of pediatric AIDS. She was then treated with high dose Co-trimoxazole, Pentamidine, Zidovudine and steroids iv. Because of chest X-ray features, high need for O₂ (100%, paO_2 56 mm Hg), not responding to elevation of PEEP (max 10 cm H₂O) and $\text{PaO}_2/\text{FiO}_2 < 200$ (56).¹¹ Acute Respiratory Distress Syndrome (ARDS) was diagnosed. Because conventional ventilation (cv) failure, HFO-V (3100A, Sensor Medics, Yorba Linda, CA) was initiated. Starting Mean Airway Pressure (MAP) of 19 cm H₂O was based on MAP of the cv, oscillatory pressure amplitude (dp) of 47 was, at initial frequency of 7.5 Hz, adjusted until chest wall vibrations were visible. It was required to raise MAP to 26 cm H₂O and dp to 66 before optimal lung volume and ventilation were achieved and need for O₂ reduced within hours. This was monitored by frequent blood-gas analysis and chest X-rays. MAP and dp could slowly be reduced. After a good response the first day, gradually O₂-demand reduced and the patient could be weaned from the ventilation. MAP, dp, FiO₂ and Oxygenation Index (MAP x $\text{PaO}_2/\text{FiO}_2$) are shown in table 1. Chest X-ray follow-up showed gradually improving lung features, with marked improvement of aeration. After 10 days HFO-V she could be successfully extubated when a MAP of 10 cm H₂O was achieved.

HFO-V (days)	day 1	day 2	day 4	day 6	day 8	day 10
MAP (cm H ₂ O)	22	45	24	24.5	23.5	14
FiO ₂	1.0	0.75	0.35	0.35	0.25	0.21
OI	32.8	19.5	12.7	10.5	8.3	3.5

Conclusion: HFO-V proved to be an effective alternative in conventional ventilation failure in this pediatric patient.

11 Bernard GR et al. Report of the American-European concensus conference on ARDS. Intensive Care Med 1994;20:225-32.

P050

USE OF HEAT AND MOISTURE EXCHANGERS IN PEDIATRIC ICU

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Purpose: This study was made to find out whether the heat and moisture exchangers (HME) was effective enough to humidify in the respiratory management for children.

Patients: The study population consisted of 21 patients who were provided with artificial airway. They were divided into the two groups: 11 with heated humidifier (A) and 10 with HME (B).

Methods: HME could be used for those without pulmonary complication and with less leakage around the endotracheal tube. In both A and B groups, (1) we have measured relative humidity, temperature, and absolute humidity at the endotracheal tube connector. For these measurements, Humidity Sensor System was utilized. (2) Any troubles and complications caused by the artificial airway were investigated.

Results: (1) In Group A, we confirmed the mean values as the relative humidity of 96.5%, the temperature of 32.8°C, and the absolute humidity of 34.0mg/L. In Group B, they were 92.7%, 29.5°C, and 28.7mg/L respectively. No difference was noted between the two groups as to the relative humidity, but the temperature and absolute humidity were lower in Group B with a significant difference ($p < 0.0001$). (2) In neither of the groups, any respiratory complications such as obstruction or stenosis of the artificial airway were noted.

Conclusion: In pediatric ICU, HME can be used without any problems under given conditions.

P051

Titel: POSITIVE PRESSURE VENTILATION WITH FACE MASK IN CONGENITAL CENTRAL ALVEOLAR HYPOVENTILATION SYNDROME
Autoren: HM Grubbauer, R Kerbl, H Litscher, G Zobel, M Trop

Congenital central alveolar hypoventilation syndrome (CCHS) is a rare disorder with failure of chemoreceptor control of ventilation. Depending on the degree of severity children with CCHS need ventilatory support continuously or during sleep. Treatment modalities ranging from diaphragmatic pacing, negative pressure ventilation or positive pressure ventilation through a tracheostomy tube. To bypass the problems of an artificial airway only few experience with nose mask ventilation in older children have been made.

Case reports: We report our experience with face mask ventilation in two siblings with CCHS. The experiment to try a face mask ventilation for treatment of CCHS was done because the parents refused a tracheostomy in both of their children. The face masks were made by a medical bandagist. They are tightly fitting masks which are closing the mouth and applying the positive pressure ventilation through the nose. In the older boy face mask ventilation was started only at the age of four years due to a delayed diagnosis. Hypoventilation was present only during sleep and the patient is treated with nocturnal mechanical ventilation. The patient has now home ventilation since four years without major problems. His younger brother was diagnosed with CCHS much earlier at the age of 8 months. Since that time for now 12 months he is also ventilated via face mask during sleep at home. Both boys are on a volume cycled respirator (life care PLV100 respirator) under pulsoximetric monitoring and close medical observation.

Conclusion: In our experience face mask ventilation for CCHS is an efficient alternative even in the young child to bypass the complications of an artificial airway.

P053

THE USE OF A NEW DEVICE TO MEASURE AUTO-PEEP IN PEDIATRIC PATIENTS DURING MECHANICAL VENTILATION.
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Objective: evaluate the precision, reproducibility and applicability of a new device to measure auto-PEEP in pediatric patients during mechanical ventilation.

Material and Methods: it's an electronic-pneumatic controlled device with an occlusion valve and a pressure monitor installed between endotracheal canula and the ventilator circuit. The measurements were performed with a solenoid connected with to the ventilator to detect the end of inspiration phase and the activation of the occlusion valve. The signs of pressure and flow were monitored using a differential transducer and it was processed using a PC computer and a Pneumoview® software. The auto-PEEP also displayed in the ventilator pressure monitor.

Results: we submitted 17 children with neuromuscular disease or respiratory distress in this study. The incidence of auto-PEEP was 76%, with variability between 1,5 to 13 cmH₂O. All the measurements were performed 3 times to verify the precision and the reproducibility and evaluation of the pressure and flow curves.

Conclusion: the device is low cost, easy to use and can be used without the pneumotacograph. The auto-PEEP measurement can be done during mechanical ventilation with time cycled, pressure limited and continuous flow, the most common ventilator used in pediatric patient.

P052

Assessment of high-frequency neonatal ventilator performances. P. Jouvet*, P. Hubert*, D. Isabey*, D. Pingquier* E Dahan*, M. Clouet*, A. Harf*. #USIP, Hôpital Necker-E.M. Paris.

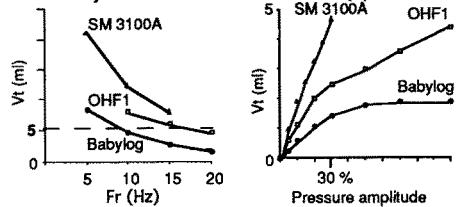
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High-frequency ventilation provides adequate ventilation in neonates at tidal volumes smaller than the anatomic dead space. High frequency ventilators available nowadays are widely used in neonatal intensive care units.

Aim of the study : To assess the performances of three high-frequency ventilators.

Methods HFV-Babylog 8000 (Dräger, Lubeck, Germany), OHF1 (Dufour, Villeneuve d'Asc, France) and SM 3100A (SensorMedics, Bilthoven, The Netherlands) were connected to a neonatal test-lung. Resistance was modeled by 3 endotracheal tube (ETT) sizes (2.5, 3, 3.5), and compliance by 2 test lungs (1 and 5 ml/cmH₂O). For each resistance - compliance arrangement, we measured tidal volume (V_t) at various frequencies, peak to peak (P-P) and mean airway pressures.

Results V_t increased when ETT size increased with all 3 ventilators in accordance with Fredberg results (JAP, 1987; 62: 2485-90). The maximum V_t delivered was smaller with the HFV-Babylog 8000 than with the OHF 1 or the SM 3100A at a given frequency (figure on the left). Increasing P-P resulted in a linear increase in V_t delivery in the 0-30% range of maximum P-P (figure on the right). HFV-Babylog 8000 didn't provide significant V_t increase when P-P was set above 50% and V_t delivery decreased when mean airway pressure decreased.



Conclusion OHF 1 and SM 3100A were able to deliver adequate V_t at the usual frequency of 15 Hz regardless of the endotracheal tube size and respiratory system mechanical properties.

P054

A NEW APPROACH TO ARTIFICIAL LUNG VENTILATION (ALV) IN NEWBORN INFANTS WITH ARF.

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A number of ventilatory parameters had been analyzed with Russia-produced monitor Humitemp HTM 902 (Servisinstrument J.-S. Co) in 24 newborn infants with RDSN of I-IV stages on CMV, CPPV, IMV, and CPAP steps using respirators of various kinds (Stephan-Staxel, Bear-2001, Newport Breeze, Sechrist). Parameters investigated were: temperature of inspired mixture (T), relative and absolute humidity (RH and AH, respectively), static compliance (C), expired tidal volume (V_t), expired minute volume of ventilation (MVE). The monitor read these parameters in following ranges: RH-from 10 to 100%; AH-up to 55mg/l; MVE-up to 3.0 l/min; V_t-from 3 to 130 ml; T-accurate to 3%; C-from 0.1 to 10 ml/cm H₂O. Continuous monitoring time ranged from 2 to 96 hours, it was noted, that during this time the monitor and transducers had no malfunctions, and it's using didn't require additional calibration. It was found, that humidifiers MR 498 and MR 410 (Fisher, Paykel) couldn't maintain parameters T and AH continuously (these values varied from 34.3 to 38.2 C and from 37.5 to 47.1 mg/l, respectively, when heating regulator position was unchanged).

Changes of parameters C depended clearly on CPPV conditions and RDSN severity (with RDSN of stages I-II C value ranged from 2.4 to 1.2 ml/cm H₂O; and with stages III-IV- from 0.3 to 1.1). In 6 newborn suffering from RDSN of stages II-III and III-IV with PIP>25 mbar, FiO₂>0.7, PEEP=4-7 mbar, C-from 0.3 to 1.2 ml/cm H₂O, effectivity of Exosurf Therapy was studied. In 4 newborns in 4-12 hours of therapy PIP decreased to 0.3-0.4, and C increased to 1.7-2.4 ml/cm H₂O. In 2 newborn infants with AaDO₂>500 mmHg and C from 0.3 to 0.8 ml/cm H₂O positive effects of Exosurf on lung compliance were not observed. In 3 newborns the monitor had revealed decreased of C (from 3.4-2.9 to 1.8-1.3 ml/cm H₂O), manifested clinically by pneumothorax. In general, monitor HTM 902 made possible: 1). to estimate the adequacy of CMV-parameters and regimes in newborn infants; 2). to select optimal T and AH values in the respiratory outline in dependence on lung damage severity and infused volume; 3). to reveal RDSN severity; 4). to optimize indications and adequacy of surfactant therapy; 5). to diagnosticate the air leakage syndrome; 6). to effects to some agents (broncholytics, spasmolytics); 7). to obtain objective indications for IMV/SIMV and CPAP regimes.

P055**HOME CARE FOR A BETTER QUALITY OF LIFE FOR VENTILATOR DEPENDENT CHILDREN.**

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Increased survival rates in chronic ventilator-assisted children has impulsed a search for new therapeutic approaches in order to improve their quality of life. As very few institutions can handle this patients, home care represents a promising alternative. We describe 2 patients with Spinal Muscular Atrophy, one type I (2 months old) and a 2 year-old boy with type II. Hospital stays were 130 and 176 days, respectively. Both were on permanent ventilatory support through an indwelling tracheostomy.

Looking for a better quality of life, a decision was made to continue their treatment in a home care basis. A multidisciplinary team, including intensive care physicians, physical therapists, nurses, nutritionists and a psychologist, developed a training program to instruct children's parents how to operate the ventilator and other ancillary monitoring devices as well as to perform some primary care techniques. (Suction procedures, set alarm thresholds, ventilatory support with an air bag, etc.). In addition to an equipment tailored to their needs, each patient received all the disposables and full support through scheduled control visits paid by physicians, a trained nurse and physical therapists and, if needed, home emergency assistance through a medical manned and fully equipped ambulance service.

So far, results are encouraging regarding children's reincorporation to family environment and recovery of the family organization, allowing one or both parents return to work. A decrease in infectious complications and a sensible reduction in costs (home care vs in-hospital care) are major advantages of this approach. We think home care could be an alternative approach in suitable cases, leading to a better quality of life for this chronically ventilated patients, compared to that offered by the traditional in-hospital care.

P056**SPEAKING AIDS IN CHRONICALLY VENTILATED CHILDREN**

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Communication is an important aspect of human development and existence, and an inability to vocalise can be a problem in ventilator-dependent patients. We present our experience with speaking aids as a means of enhancing verbal communication in four ventilator-dependent children in our Paediatric Intensive Care Unit.

The age of the children ranged from 7 months to 5 years, and the period of ventilation ranged from 3 months to 21 months via a tracheostomy. They require continuous flow generated pressure limited or control ventilation at rates of 13-20 bpm. The reasons for ventilation include tetraplegia following a shrapnel injury; tetraplegia following congenital cervical spine damage; tetraplegia following atlanto-axial subluxation; and critical illness polyneuropathy following adult respiratory distress syndrome from prolonged ventilation for a severe head injury.

The first three patients have Passy-Muir one-way speaking valves and the final patient has a Bivona foam cuffed tracheostomy tube with a talk attachment in view of recurrent aspiration. An improvement in quality of speech has been shown by independent assessment.

We will review the present literature on this subject and discuss the advantages and disadvantages of these two types of speaking aids in the light of our experience.

P057**USE OF NONINVASIVE VENTILATION DURING GASTROINTESTINAL ENDOSCOPY IN PATIENTS WITH NEUROMUSCULAR DISEASE.**

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Introduction: Patients with severe neuromuscular weakness hypoventilate and may require endotracheal intubation during procedures done under conscious or deep sedation. We describe the use of noninvasive nasal ventilation (NNV) with a pressure support device (BiPAP®) (Respirtronics, Murrysville PA, USA) during gastrointestinal endoscopy in patients (pts) with chronic respiratory failure (CRF). 3 procedures were performed in 2 pts with Duchenne's muscular dystrophy. All procedures were done in the pediatric intensive care unit with continuous pulse oximetry, ECG, and blood pressure monitoring.

Results:

Pt 1: 20 y.o. with severe dysphagia using chronic NNV for CRF; forced vital capacity (FVC) = 230 ml. Malnutrition necessitated gastrostomy placement. The gastrostomy was placed percutaneously with endoscopic guidance. Continuous NNV was used with nasal pillow® (Puritan-Bennett, Carlsbad, CA, USA) interface. BiPAP was in the spontaneous/timed (S/T) or timed (T) mode. Pressures, rate and FiO₂ were adjusted to maintain oxyhemoglobin saturations (SpO₂) 95-100%. The pt tolerated the procedure without complication.

Pt 2 (procedure 1): 17 y.o. male using nocturnal NNV for CRF (FVC = 750 ml). Endoscopic gastroduodenoscopy for suspected peptic ulcer disease. BiPAP in S/T or T mode with pressures, rate and FiO₂ adjusted to maintain SpO₂ 95-100%. Pt tolerated procedure well without adverse effect.

Pt 2 (procedure 2): Colonoscopy for hematochezia performed 1 month after procedure 1. BiPAP in S/T mode with pressures and FiO₂ adjusted to maintain SpO₂ 95-100%. Pt tolerated procedure well without complication.

Conclusion: NNV with BiPAP is an effective means of providing respiratory support during gastrointestinal endoscopy in pts with significant respiratory muscle weakness.

P058**EARLY PREDICTION OF PULMONARY HYPOPLASIA (PH) IN ANTE-NATALLY DIAGNOSED CONGENITAL DIAPHRAGMATIC HERNA (CDH). JE Germain, B Thebaud, C Farnoux, D Pinquier, A Cortez, O Sibony, F Beaufils**

The prognosis of antenatally diagnosed CDH is closely related to the degree of PH. There have been attempts to correlate antenatal or postnatal criteria to mortality: none have been demonstrated to be predictive of lethal PH. The aim of this retrospective study was to determine whether antenatal or early postnatal data could correlate with the findings of post-mortem examinations.

Patients and methods: Between July 1990 and July 1994, 32 CDH patients have been antenatally and postnatally managed at our institution. Twenty-three infants underwent a post-mortem examination. PH was assessed by using the lung weight to body weight ratio (LW/BW) and the radial alveolar count (RAC). **Antenatal results:** CDH diagnosis was made at 24 weeks of gestation (wg) (15-37). Twenty-eight patients had a left sided CDH, 3 had a right sided CDH, and one had a bilateral CDH. Herniated organs were stomach alone (n=21), or liver alone (n=4), or both stomach and liver (n=5). In 8 patients, echographic studies disclosed associated malformations. **Postnatal results:** Six patients survived and 26 died. Thirteen were treated by ECMO. Sixteen reached a PaO₂ ≥ 100 mmHg during conventional therapy, including the 6 survivors. Sixteen did not reach this PaO₂ level and none survived. **Correlations with post-mortem examinations:** Two patients had no PH (LW/BW > .018). Twenty-one patients had PH: 12 of them had obvious PH (LW/BW ratio < .009); in 9 patients, LW/BW ranged from .009 to .018, but the low RAC (< 3.1) confirmed PH. The term of diagnosis was positively correlated with LW/BW and RAC ($r^2=.40$, $p=.002$ and $r^2=.49$, $p=.0003$ respectively). Patients with PH had an earlier antenatal diagnosis (22 ± 3.6 vs 29.6 ± 4.3 wg, $p=.0004$), and a lower left to right ventricle ratio when measured between 36 and 40 wg ($.57 \pm .11$ vs $.87 \pm .15$, $p=.04$). All infants with a best PaO₂ < 100 mmHg had severe PH. Patients with a best PaO₂ ≥ 100 mmHg included 2 infants who died from complications without PH, 7 infants with PH, and the 6 survivors (necropsy was denied in one). **Conclusion:** 1) The term of diagnosis correlated with the severity of PH. In addition, low left to right ventricle ratio was also a good predictor of PH. 2) Permanent poor values of PaO₂ allowed to predict PH in all cases. This study suggest that such patients could probably be excluded from ECMO. 3) Adequate values of blood gases were associated with a good prognosis or with lethal PH. This condition probably justifies to start ECMO when conventional therapy fails.

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P059**OPPORTUNISTIC PNEUMONIA, AND ARDS MAJOR COMPLICATIONS AFTER RENAL TRANSPLANTATION.**

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CASE REPORT: The patient was a 3-year-old girl with chronic renal insufficiency secondary to renal dysplasia. Two months before admission a kidney transplant was performed. One month later she showed acute graft rejection with serum creatinine (Cr) level of 0.7 mg%. The rejection was unresponsive to an increased steroid dosage, and OKT3 was begun with resolution of the rejection. One week after, new rejection episode was seen unresponsive to an increased steroid dosage, and transplantectomy was performed five days before admission to our PICU. Hemodialysis and Peritoneal dialysis (P.D.) each other day, was indicated (G.R.F. < 10 ml/min). Four days before admission T_c rose to 38°C. The diagnosis of opportunistic pneumonia was made on the basis of tachypnea, hypoxia, and diffuse interstitial infiltrates. Serum IgM was positive for cytomegalovirus (CMV), and stool culture for *C. Albicans*. Pentamidine, ganciclovir (DHPG), anti-CMV gamma globulin, erythromicine and amphotericin B was administered. On admission in our PICU, trachea was intubated, (A-a) O₂ gradient was 600, PaO₂/FiO₂: 65, Lung Injury Score > 3 with PEEP level of 8 cm H₂O. She had normal liver function. During the next days she had fever and developed ARDS. BAL was negative. P.D. was of little efficiency. We adjusted pentamidine, and DHPG doses for severe renal failure, with supplements after hemodialysis, and after P.D.. During the next days she was afebrile, and the chest became radiologically normal. After ten days on Mechanical Ventilation (M.V.), the patient was extubated. Cr. level was 3.2 mg%, (A-a) O₂ gradient was 20, and PaO₂/FiO₂ was 375. The patient was discharged with chronic ambulatory P.D.

DISCUSSION: OPPORTUNISTIC PNEUMONIA is a major complication in immunocompromised children, specially after kidney transplantation. C.M.V. infection can result after OKT3 administration. In the treatment DHPG dose must be adapted to the degree of renal insufficiency, with supplements after hemodialysis, and after P.D. *Pneumocystis carinii* pneumonia is characterized by ventilation-perfusion mismatch, decreased pulmonary compliance, hypoxia and elevated (A-a) O₂ gradient, with diffuse interstitial infiltrates. In our case BAL was negative. Although we did not find the etiology the precocious combination of antimicrobial therapy, along with M.V., and supportive measures were the most effective treatment.

CONCLUSION: 1) In patients with severe renal failure and life-threatening infections, we must consider drug adjustments. 2) In our patient we gave DHPG supplements after P.D. with excellent results, although P.D. was of little efficiency.

P060**PNEUMONIA IN VENTILATED BABIES IN A DEVELOPING COUNTRY: CLINICAL FEATURES AND SHORTTERM OUTCOME**

S.Kling, RP Gie

Pneumonia is the second most important cause of death in young South African children. The clinical features, intensive care course and outcome of children being ventilated for pneumonia in the developing world is unreported.

AIM: To describe the clinical findings, aetiology and shortterm outcome of children younger than 6 months with pneumonia requiring ventilation.

METHOD: The data of all babies under the age of six months with a lower respiratory tract infection admitted to the Paediatric ICU for ventilation were prospectively collected over a period of 14 months. Tracheal aspirates and blood specimens were submitted for viral and bacterial cultures.

RESULTS: Forty-seven babies aged 14 to 174 days were ventilated for pneumonia. Twenty-six infants had been born prematurely; 12 had been ventilated during the neonatal period and 4 had BPD. The median duration of symptoms was 1 day, the most common being cough, tachypnoea, apnoea and cyanosis. Five babies (10%) died. The mean duration of ventilation was 8 days (range 1-85 days) and of ward stay after ICU discharge 19 days (range 1-161 days). Blood cultures were positive in 7 children (15%). Viruses were cultured in 14 children (30%).

CONCLUSION: 1) Fifty-five percent of children below 6 months requiring ventilation for pneumonia were premature infants, of whom 46% had been ventilated during the neonatal period. 2) The median duration of symptoms prior to admission was 1 day. 3) Ninety percent of the children survived and were discharged from hospital. 4) Viral pneumonia was responsible for 30% of the admissions.

P061**PREVALENCE OF OROPHARINGEAL ASPIRATION IN INTUBATED CHILDREN**

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Introduction: Endotracheal intubation and mechanical ventilation have become an important treatment for many diseases accompanied by respiratory failure. With the frequent use of this treatment modality, an increasing number of complications associated with endotracheal intubation have gained clinical significance.

Material and Methods: A transversal study was realized to find the prevalence of pulmonary aspiration with endotracheal tubes in 36 infants and children. Aspiration was assessed by applying two dyes (Evans Blue, Erytrosine Sodic) on the tongue and searching for the dye during suctioning in the endotracheal aspirate.

The factors, that potentially have influenced the aspiration, including weight, age, sex, cause of respiratory failure, main pressure airway (MAP), level of consciousness, presence of swallowing and body position were evaluated.

All the variables studied had their association with aspiration tested by chi-square Method with Relative Risk considering a Confidence Interval of 95%. The results were adjusted by multivariate analysis.

Results: The overall prevalence of aspiration was 36.1%. Among all children who aspirated, compared to those who did not, there was a statistically significant difference in the presence of swallowing ($p=0.005$). The odds ratio to aspiration in the presence of swallowing was 38.4 (1.75 - 100 C.I. 95%) and the relative risk 55.5. Aspiration was not significantly affected by sex, weight, age, cause of respiratory failure, MAP, level of consciousness and position of the body during the ventilation.

Conclusion: The endotracheal intubated children frequently aspirate as intubated adults and that preventive measures are ineffective. The presence of swallowing movements is the main risk factor to aspiration of oropharyngeal content in intubated patients.

P062**MECHANICAL VENTILATION AND ATRIAL Natriuretic Factor RELEASE**

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Mechanical ventilation effects on renal function decreased diuresis and natriuresis due several factors including ANF. Several studies have demonstrated ANF released due increasing pressure in right atrium. On the other hand, mechanical ventilation, overall PEEP modality, inhibits peptide release although CVP increased is found. This study was designed to demonstrate ANF stimulation is due right atrium stretch which be higher during mechanical ventilation instead of atrium pressure.

We design a prospective study including 14 patients, age range 16 months-13 years with congenital heart disease. All of them were admitted at Pediatric Intensive Care Unit after extracorporeal surgery and were assisted by mechanical ventilation. Hemodynamic state was stabilized in all patients and nor renal neither neurological diseases were found. After 24 hours with mechanical ventilation, plasmatic levels of ANF were measurement, PVC, pericardial pressure were assessment; all patient were sedated with midazolan and paralyzed with neuromuscular blocking agent; mechanical ventilation technique was as follow: IMV between 20 and 30, tidal volume and Fi O₂ enough to maintain respiratory parameters in normal range. Afterwards, at least twentyfour hours in spontaneous breathing, the study was made again in each patient. Atrial stretch was assessment according to following equation:

$$\text{Transmural pressure} = \text{CVP} - \text{Pericardial pressure}.$$

CVP were significantly higher with mechanical ventilation than when the patient was breathing by himself. (5.4 ± 2.2 vs 3.8 ± 1.8 mm Hg; $p < 0.01$). However, transmural pressure during mechanical ventilation were lower than during spontaneous breathing (8.92 ± 3.86 vs 11.76 ± 3.32 mm Hg; $p < 0.01$). Equal, plasmatic ANF levels were lower during mechanical ventilation (87.77 ± 46.55 vs 108.92 ± 49.06 pg/ml; $p < 0.01$).

In conclusion, ANF secretion decreases during mechanical ventilation, even with CVP higher. ANF release would depend on atrial stretch measured by transmural pressure, lower in patients with mechanical ventilation and it would not depend on atrial pressure.

P063EXPERIENCE WITH VENTILATION IN CHILDREN

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The Paediatric intensive care unit Shaikh Zayed Hospital, Lahore is an acute care area devoted to the care of critically sick children upto the age of 13 years. In a 6 bedded unit with limited equipment, constant care is ensured by the presence of at least one nurse and one doctor round the clock. In this setup we have the facility to ventilate 2-3 children at one time. Between Sep. 93 and Dec. 95, out of 885 patients admitted to ICU, 171 (19.32%) were below 1 yr of age, while 48 (28%) were below 1 month of age. Life support was discontinued in 17 (9.9%). Total mortality was 56 (32.7%). Major mortality was in 0-1 month age group 22 (12.8%), and 1 month to 6 month 15 (8.7%). Majority of the patients were of sepsis (36.2%), CNS disorder (22.2%) followed by respiratory problems (14.6%). It seems therefore that the major indication for ventilation was overwhelming septicemia leading to multiple organ failure, rather than purely respiratory problems.

P065

High frequency oscillation (HFO) in the therapy for ARDS in pediatric patients requiring aggressive conventional mechanical ventilation (CMV) - routine or experimental mode of pre ECMO therapy.
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Supported by Grant Agency of Health Ministry, Czech Republic, No 1451-3

Introduction: 9 pediatric patients (8 males, 1 female, average age 4.7 months, average body weight 5.8 kg) with severe ARDS ventilated with aggressive regimen of PCV or PRVC were connected to HFO (Sensormedics 3100) as the last "rescue" therapy due to uncontrollable respiratory failure before intended ECMO. In the course of HFO 2 of them were given NO in the concentrations of 5-80 p.p.m., 3 were subjected repeatedly to surfactant replacement therapy (Alveofact).

Results: ECMO was needed in no patient, 8 patients survived, 1 patient was disconnected from the ventilator because of brain death in spite of conspicuous improvement of oxygenation and other parameters. Some relevant parameters 48 hours before and 48 hours after starting HFO are given in table 1. In all the cases, the disconnection from HFO was carried out through the SIMV regimen, never directly to CPAP.

Table 1: The levels of blood gases, oxygenation index (OI), AaDO₂, MAP, FiO₂ and PaO₂/FiO₂ ratio 48 hours before and 48 hours after starting HFO.

Conclusion: Although none of the patient had to be subjected to pediatric ECMO, HFO should be carried out only in workplaces having the immediate possibility of using this method in the case of HFO failure.

Speculation: Should not HFO be used in pediatric patients with ARDS earlier than aggressive CMV? Can HFO be considered standard, not experimental method of therapy?

Table 1:

Parameter	before HFOV		during HFOV		signif.
	average	deviat.	average	deviat.	
pH I-J	7.357	± 0.066	7.412	± 0.054	n.s.
pO ₂ [torr]	66.050	± 13.683	88.760	± 34.102	n.s.
PCO ₂ [torr]	55.198	± 10.964	45.022	± 9.162	n.s.
OI I-J	19.848	± 12.177	9.684	± 5.886	<0.05
AaDO ₂ [torr]	392.217	± 113.994	213.509	± 174.224	<0.10
MAP [cmH2O]	14.017	± 4.337	13.948	± 4.361	n.s.
FiO ₂ [%]	74.352	± 13.909	49.019	± 22.136	<0.05
PO ₂ /FiO ₂ [torr]	101.216	± 27.383	296.030	± 199.757	<0.10

P064**RESCUE HFOV IN SEVERE RESPIRATORY HYPOXEMIC FAILURE IN A PREMATURE INFANT CANDIDATE TO ECMO.**

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Refractory hypoxemia in premature patients is characterized in a persistent elevation of pulmonary vascular resistance, with right to left shunt through the ductus arteriosus and/or foramen oval. We report the case of a VLBW patient (GA 27W, BW 1010g) who present a severe hypoxemia related to hyaline membrane disease and a pulmonary and systemic infection to group B streptococcus, refractory to conventional ventilatory support and surfactant therapy, associated to hemodynamic failure failing in ECMO criteria used for term infants. A rescue therapy with HFOV (Sensor Medics 3100A) is decided at 5 h of live. The table resume the patient's evolution before and after HFOV. At 36W of postgestational age the patient present a FiO₂ of 0.23 with a chest X ray compatible with a CLD type I. At discharge no oxygen requirements was needed and actually he's doing well.

CONCLUSION: HFOV, using an adequate alveolar recruitment strategy, was effective in the rescue of a severe hypoxic respiratory failure with a rapid off of ECMO criteria entry in our VLBW premature patient.

MODE	CMV	CMV	HFOV	HFOV	HFOV	HFOV
HOURS	-H5	-H2	+H1	+H3	+H5	+H9
FiO ₂	0.7	1.0	0.6	0.35	0.35	0.27
MAP	17	24	27	30	30	30
PaO ₂	43	38	50	55	58	68
PaCO ₂	39	35	49	31	35	31
AaO ₂	400	640	310	290	200	90
aAO ₂	0.09	0.04	0.13	0.25	0.28	0.4
OI	25	64	45	19	12	15
	mmHg					

P066**TREATMENT OF SEVERE ASTHMATIC ATTACK IN PICU FOR THE LAST TWO YEARS**

Z.ZIVKOVIC, S.MIHAILOVIC

During the United Nation's embargo against Yugoslavia the prevalence of the asthmatic attacks in children araised. The most common causes have been: dramatic worsening of life standard, economic disaster in global community, great number of refugees from the other parts of former Yugoslavia. It was obvious that socio-economical conditions took a part in the exacerbations of previously known childhood asthma, because of micro- and macroclimatic changes, psychosocial and emotional crises, lack of medicaments for prevention and therapy of acute asthmatic attacks. About 10% of children treated in our PICU for these years experienced severe attack for the first time in their lifes. It has been cured 1362 children in respiratory PICU of our Hospital. The acute severe attack (more than 50% of highest clinical score) was detected in 62% of all children admitted with respiratory problems. From the analyses we excluded: bronchiolitis, congenital anomalies, severe infections. Concerning our drug supplies (which were reduced), we started our therapy by administration of oxygen, beta2-agonist inhalations (but sometimes we had the solution for jet nebulizers only for one inhalation per patient), aminophyllin and methylprednisolone intravenously. 48% of these asthmatics needed repeated doses of aminophyllin parenterally, including the fluids. The bronchodilator response was poor and slow, hospital stay in PICU was for 4 days and for 14 days in other units afterwards. The maintenance of their stable condition was hard at home (or refugee camps), without prevention, so they came back to hospital for more than 3 times in 27% of cases. During these last months the situation improved, concerning the drugs supply for prevention, and we hope that these life-threatening conditions wouldn't repeat.

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Acute lung injury

P067

REPEATED INSTILLATION OF PORCINE SURFACTANT IN EARLY-STAGE ADULT RESPIRATORY SYNDROME IN A CHILD Olaf van Ditzhuyzen, Aladin Nasimi, Michel Berthier, Denis Oriot Department of Pediatrics, University Hospital of Poitiers, 86000 Poitiers, France

Surfactant replacement improves gas exchange in early-stage adult respiratory syndrome (ARDS) [1,2], but not in late-stage ARDS [3]. We report the first case of successfull treatment of ARDS after repeated instillation of surfactant.

A ten year old boy, weighing 32 kg, presented with hemorrhagic shock. Biphasic-Positive-Airways-Pressure ventilation was performed (Evita II, Dräger, Germany). He had received nine units of packed red blood cells and underwent surgical excision of two bleeding gastric ulcers. Post-operatively, a cardiac arrest required cardiopulmonary resuscitation for three minutes. Hemodynamic status was subsequently stabilized. The chest-radiograph showed infiltrates of both lungs without signs of cardiac failure. On the third day, the patient became severely hypoxic with a $\text{PaO}_2/\text{FiO}_2$ ratio of 30. Gas exchange was not improved by high ventilator settings. Peak inspiratory pressure (PIP) and ventilatory rates were 40 cmH_2O and 18 breaths/min respectively. Inspiratory:expiratory time was 1:1 and the positive end expiratory pressure (PEEP) 8 cmH_2O . After increasing the PEEP level to 11 cmH_2O , we instilled over 2 minutes, 80 mg/kg of porcine surfactant (Curosurf, Serono France), in two equal volumes in both main bronchi. The SpO_2 rose to 97% within 15 min, the FiO_2 could be reduced to 0.6. Twenty four hours later, gas exchange worsened again ($\text{PaO}_2/\text{FiO}_2$ ratio 90). We increased the PEEP from 8 to 11 cmH_2O , and instilled a second dose of surfactant (60 mg/kg). Again, FiO_2 could be reduced within 15 minutes (SpO_2 95; FiO_2 0.6). The patient was weaned from the ventilator and extubated on the tenth day. Follow-up at four month showed normal lung function.

We demonstrate improvement in oxygenation after repeated exogenous surfactant administrations. We assume that in early-stage ARDS, surfactant may potentiate shunt-reducing effect of PEEP as it has been demonstrated in experimental model of ARDS [4], and allow decrease in FiO_2 . In case of secondary deterioration, we think that a second dose of surfactant should be administered.

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P068

ARDS IN CHILDREN: COMPARISON OF TWO THERAPEUTIC PERIODS N.González Bravo, MJ.Ruiz López, E.Mora, A.Valdvielso, J.Casado Flores PICU. Hospital Niños Jesús. Autonoma University. Madrid. Spain

Introduction: The incidence of ARDS is increasing as survival of critically ill patients is higher. The application of new therapeutic modalities have increased the survival rates in (ARDS) adult patients.

Objective: To study the therapeutic efficacy of new treatments in children with ARDS

Material and methods: A retrospective study was conducted from 1990 to 1995. 17 children with severe ARDS, (lung severity score > 2,5) (R), aged 15 days to 16 years, were included. The diagnosis were as follows: 9 interstitial pneumonitis, 5 non interstitial lung infection, 2 with lung aspiration and 1 with clinical sepsis. 5 patients had different types of cancer and 4 to suffer immunodeficiency disease.

The first 8 subjects (Group I) were treated with conventional measures. From October of 1994 new therapeutic modalities were introduced, including: less aggressive ventilatory support, postural changes (prone to supine) in 9 subjects, administration of corticosteroids in 8 patients, nitric oxide in 3, permissive hypercapnia and administration of exogenous surfactant in one. $\text{PaO}_2/\text{FiO}_2$, $D(\text{A}-\text{a})\text{O}_2$, oxygenation index (OI) and the score of respiratory severity disease were similar in both groups. The two groups evolution was compared.

Results:

- Ten patients died, 6 from group I and 4 from group II (75% v.s. 44.4%, NS).
- The evolution time, either to exitus or weaning from ventilatory support was higher in group II (22.9 v.s. 13.6 days in group I, NS).
- The incidence of barotrauma was observed in 12 subjects (70.6%), 6 from group I and 6 from II. Of these patients 75% expired.
- During the course of the disease, 15 (88%) patients had more than one damaged organ. Only in one subject MOF was considered to be the main cause of death. The majority of the patients expired because of their respiratory disease, although, 80% of them met criteria of MOF.
- Fifty percent of the subjects were infected at the time of death.

Summary: a trend toward a higher survival rate is observed in the subjects receiving the new modalities therapeutic intervention (corticosteroids, postural changes and permissive hypercapnia). Our results are not significative, probably because of the small number of subjects studied.

P069

SURVIVAL OF NEONATAL AND PEDIATRIC PATIENTS WITH ACUTE HYPOXEMIC RESPIRATORY FAILURE (AHRF)

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Pediatric patients (pts) with AHRF have been reported to have a mortality rate of 43% (Ref). The aim of this study was to verify these data:

Patients/Methods: All pts admitted to our multidisciplinary NICU/PICU in 1995 were included if they were in respiratory failure requiring conventional mechanical ventilation (CMV) with $\text{PEEP} \geq 6$ and $\text{FiO}_2 \geq 50\%$ or high-frequency oscillation ventilation (HFO) with mean airway pressure $\geq 18 \text{ cm H}_2\text{O}$ for 12 or more hours. Diagnosis, maximal ventilatory parameters, barotrauma, organ/system failures, mechanism of death and Glasgow Outcome Scale (GOS) 1 and 6 months after study entry were prospectively collected.

Results: 685 patients were admitted to the unit, of whom 337 required mechanical ventilation for a mean duration of 4.0 days. Overall mortality was 5%. 22 patients fulfilled study criteria. 17 survivors had GOS 5, 2 pts with preexisting neurological impairment survived with GOS 3. Neonatal diseases included hyaline membrane disease (7), meconium aspiration syndrome (4) and cardiovascular surgery (1). Pediatric diseases included bacterial (1) and viral (5) pneumonia, aspiration (1) and cardiovascular surgery beyond the neonatal period (3).

1 Month follow-up	All pts	Pts fulfilling ref. criteria	Neonatal diseases	Pediatric diseases
Nonsurvivors	3	1	1	2
Survivors	19	4	11	8
HFO	11	-	9	2
Nitric Oxide	6	-	4	2
Surfactant	3	-	3	-
Duration of ventilation (d)	8.0	7.8	8.5	7.7

Conclusions: The present results might be superior to those of Timmons et al (Ref), however the number of pts is small, limiting firm conclusions. We are surprised by the scarcity of pts fulfilling study criteria.

Ref: Timmons OD, Havens PL, Fackler J. Predicting Death in Pediatric Patients With Acute Respiratory Failure. *Chest* 1995; 108: 789-797

P070

Double-lumen two-stage ET-tube improve CO_2 removal in rabbits with acute lung injury

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A new double-lumen two-stage ET-tube (DL-ETT) was designed and tested in the rabbits with acute lung injury under conventional mechanical ventilation. Ventilation efficiency of DL-ETT was compared with that of conventionally used single lumen ET-tube (SL-ETT).

Methods: DL-ETT was specially made out of two SL-ETT. Vertical cross-sections at the distal end of two ET-tube (ID 3.0 mm Portex) were adhered with each other to form a tracheal stage lumen with ID 3.0mm. The two remained uncut parts of the tubes constituted the oral stage with two separate lumens. DL-ETT and SL-ETT were randomly applied to five adult paralyzed rabbits with acute lung injury (by 0.1 ml/kg oleic acid, iv). A Bird inter 3 ventilator (Bird products corporation) was used for time-cycled pressure-limited ventilation at 40/min. of respiratory rate, 10 $\text{cm H}_2\text{O}$ of peak inspiratory pressure, 1:1 of I/E ratio, 6 l/min. of flow rate and 0.21 of FiO_2 . Peak inspiratory pressure, mean airway pressure, positive end-expiratory pressure at tip of ET-tube and hemodynamics were measured and recorded continuously. Arterial blood and expired gas were measured (by AVL 993 blood gas analyzer) after each stabilization period of 30 minutes. Analysis was by paired t test.

Results: DL-ETT acutely improve CO_2 removal at all animals. PaCO_2 was decreased by 10.6±1.5 (p<0.01) and physiologic dead space fraction (V_D/V_T) reduced by 22% ±1.8% (p<0.01), compared with DL-ETT. There were no significant change in arterial oxygenation.

Conclusion: The double-lumen two-stage ET-tube significantly increases ventilation efficiency with simple operation in rabbits with acute lung injury. Its availability may influence future clinical management of ventilated patients.

This study was funded by the Science and Technology Committee of Beijing Municipality.

P071

HEMOSTASIS DISORDERS IN CHILDREN WITH ARDS.

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Analis of hemostasis alterations on different coagulation cascades in 46 children with septic shock has shown that coagulation disorder character is dependent on lung affection rate. The initial manifestation of the respiratory distress-syndrome (RDS) are characterized by the obvious activation of blood thrombin potential, moderate coagulopathy and not sharply marked endoteliosis, the Willebrand's factor (WF) increase tot 140-220%. Progress in the clinical picture of "shock lung" leads to chronometric and structural hypocoagulation with potential hypercoagulation in "mix-test", high level of fibrin derivative, thrombocytopenia with thrombocytopathy and the WF increase to 210-315%.

Terminal stages of the RDS, as a rule, are characterized by potential hypercoagulation absense, depletion of AT-III and plasminogen, prevalence of antithrombin and antiaggregating activity, obvious endoteliosis (the WF to increase 250-540%). The arterio-venous difference according to index of the thromboelastography (TEG) in the RDS III-IV rates was 69,8% less than in the I-II rates. Disorder of lung filtering ability in severe RDS is confirmed also by minimal arterio-venous difference of activated euglobulin lyses (AEL) in children with the RDS III-IV rates is only 11,4%, while the patients whit RDS I-II rates have the AEL-activity in arterial blood 2,1 times as much than in venous blood. The use of then allows to determine the potential hypercoagulation rate, the AT-III level and fibrinogen quantity during the anticoagulant therapy and also the character of the X-factor activation and thrombocytic hemostasis. The effective therapy component of septic genesis RDS in children is the controled coagulation method with the use of the individual selected heparin doses in according to disagregants, kryoplasma, proteolysis inhibitors and trombolytics. It is necessary to avoid the heparin-therapy for children with the RDS complicated with producing coagulopathies and termal phases of blood disseminated intravascular coagulation (DIC).

Airway

P072

BRONCHOSCOPY FOR RESPIRATORY PROBLEMS IN PICU

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Bronchoscopy has been used for evaluation of the potential problems of the airways and for investigation the bronchial specimens for diagnostic purposes. Recent technical advances result in performing this procedure at the bedside manner and in critically ill patients.

We have performed 150 bronchoscopy during last three years on 1362 pediatric patients with respiratory problems. In 90% of cases the open-tube bronchoscopy was performed (for diagnostic as well as for therapeutic reasons) and collected secretions or bioptic material were examined. The indications were: acute upper respiratory problems, chronic wheezing, inspiratory stridor, tracheal or bronchial bleeding, chronic cough, retractable atelectasis, severe pulmonary infections, lymph node perforation in lung tuberculosis and sequelae like bronchiectasis and fibrosis. Our results were: anatomical malformations in 10%, mucosal oedema with chronic inflammation and thick secretions in 56%, caseous masses in 11%, granulation tissue and purulent secretions in foreign bodies and bronchiectasis in 16%, and only 7% of cases were normal finding. Our experiences pointed that this invasive procedure in carefully selected patients has important role in establishing the diagnosis and in therapeutic management of respiratory problems.

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P073

TRACHEOBRONCHOGRAM (TBG): A DIAGNOSTIC AND THERAPEUTIC GUIDE IN VENTILATOR-DEPENDENT PATIENTS

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Introduction: TBG has been a useful investigation in the management of ventilator-dependent infants in our experience. One ml of contrast was hand ventilated into the respiratory tree via their nasotracheal tubes and their anatomy and dynamics demonstrated on radiological screening.

Case Descriptions: Three infants who were difficult to ventilate requiring high airway pressures, high PEEP and a significant oxygen requirement had TBGs. The ages ranged from 3 to 9 months. Two cases were complicated by complex cardiac lesions. In all cases there were frequent episodes of desaturation, where hand ventilation proved difficult and various intermittent lobar collapses occurred. Microlaryngobronchoscopies (MLB) performed on the infants by experienced paediatric ENT surgeons failed to identify the airway problems. More than one MLB was frequently done. Concern about introducing contrast into the airways of infants with limited cardiorespiratory reserve combined with an uncertainty about how much extra information would be gained often led to a delay in investigation. When performed these fears proved groundless, the anatomy and pathology of the airways were demonstrated in full and the correct therapeutic plan started. In two cases tracheostomy and PEEP producing patency of bronchomalacic segments allowed weaning to low levels of ventilatory support. In one case tracheal reconstruction was undertaken and in the cardiac cases the respiratory component of the ventilatory dependence was fully assessed.

Conclusions:

1. Diagnostically excellent for upper airway pathology.
2. Performed early allows correct therapeutic plan to be established.
3. Can be used to assess the respiratory component to ventilator-dependence in complex cardiorespiratory cases.
4. Simple test even in cases with limited physiological reserves.

P074

TRACHEAL HOMOGRAFT TRANSPLANTATION IN A CHILD WITH LONG SEGMENT CONGENITAL TRACHEAL STENOSIS.

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At the age of 4 months, a baby boy with a history of minor respiratory problems, was admitted to hospital with an upper airway infection and severe dyspnoea. Shortly after arrival at the ICU he had a total airway obstruction. After intubation there were still difficulties to establish a normal gas exchange, and he was transferred to the regional PICU. CT scan and bronchoscopy verified a congenital tracheal stenosis affecting the whole trachea except the upper 15 mm below the vocal cords. The diameter was estimated to less than 2 mm.

An unsuccessful attempt was made to dilate the extremely rigid stenosis with a balloon. After the procedure he had a respiratory and circulatory arrest, and he was put on ECMO as a bridge to surgical correction. After 4 stable days on ECMO, surgery was performed during ECMO with a tracheal homograft transplantation. Immediately after surgery, ECMO was discontinued.

A silastic Dumont type stent was inserted inside the homograft, and a nasotracheal tube was placed inside the stent for assisted intermittent mechanical ventilation. Repeated bronchoscopies were performed to remove granulation tissue and secretions. At 9 months of age, the stent was removed with an endoscopic procedure. However, the trachea was still soft and collapsible, and another silicon stent was placed inside the trachea for another 4 months period.

After removal he had some respiratory problems and he was treated with nebulized salbutamol, racemic epinephrine and steroids. He was discharged from the hospital at 14 months of age and his condition is now stable.

This is the first procedure of its kind in Sweden. It was accomplished by international and multidisciplinary collaboration. ECMO may be a bridge to corrective surgery and long time stenting may be necessary in the postoperative period.

P075

A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED TRIAL OF INHALED L-EPINEPHRINE IN THE TREATMENT OF POST-INTUBATION LARYNGITIS.

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Post intubation Laryngitis (PIL) is still a frequent complication, occurring in 1 - 6 % of intubated patients. Inhaled racemic epinephrine has for long been used as an accepted therapy, but this drug is not always available. The authors undertook a randomized, double-blind, placebo-controlled trial to determine the efficacy of inhaled L-epinephrine(LE) in the treatment of PIL.

In the period between july/93 and may/95, 289 patients were submitted to endotracheal intubation for ventilatory support. After the extubation procedure patients were considered for enrollement if they met the following criteria: clinical signs of laryngeal stridor and a Downes and Rafaelli score for upper respiratory obstruction equal to or higher than 4. Patients with primary upper respiratory disease were excluded. All patients enrolled received either inhaled L-epinephrine 1% or normal saline. Dexametasona (0,6 mg/Kg/day) was given to all patients in both groups. After 2 inhalations, all patients were monitored for a period of 120 minutes and monitoring included cardiac and respiratory rate, mean arterial blood pressure, arterial blood gases and the Downes and Rafaelli score. Statistical analysis included, Qui-square with the Fisher correction test and the Z-test for paired variables.

Thirty eight patients (13,1 %) met the criteria for enrollment, 18 to the LE group and 20 to the placebo group. There were no significant differences in both groups in regard to age, sex, initial score (5,05 ± 5,1) and endotracheal tube diameter. The period of ventilatory support and tracheal intubation was significantly higher in the LE group (8,06 ± 4,54, p = 0,01). The follow-up score showed a significant drop only at 30 minutes after the inhalations (p = 0,03). Re-intubation due to laryngitis, occurred in 1 patient of the LE group and in 4 of the placebo group with no statistical significance (p = 0,2). No difference was observed on the monitored hemodynamic variables during the 120 minutes, except for the mean arterial pressure at 60 minutes, being higher on the placebo group (p = 0,05).

We concluded that, although the L-epinephrine group showed a trend in better scores post-inhalation and fewer re-intubations due to laryngitis, the results were not statistically significant. We speculate that the period of intubation may have affected our results. Similarly there were no differences in the incidence of adverse effects between both groups.

P076

ACUTE UPPER AIRWAY OBSTRUCTION IN CHILDREN WITH EPIGLOTTITIS OR CROUP:

COMPLICATIONS DUE TO ENDOTRACHEAL INTUBATION.

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Objectives: To evaluate the complications of endotracheal intubation in children with upper airway obstruction due to epiglottitis or croup.

Methods: During a 5 year period (1991 - 1995) all patients with epiglottitis or croup were reviewed to determine the complications of endotracheal intubation, especially upper airway obstruction due to granulomas.

Results: 33 Patients were reviewed. In 17 children (mean age 2.5 years) with epiglottitis the mean duration of intubation was 4.0 days (3 - 5). No complications were seen.

In 16 patients (mean age 2.3 years) with croup the mean duration of intubation until the first extubation was 8.1 days (1 - 15 days). Elective extubation was performed if an airleak was present or after 7 days without airleak but in the absence of fever and obvious secretion. Reintubation was not necessary in 10 children (62.5%). In this group the mean duration of intubation was 6.4 days (1 - 12). In 6 patients (37.5%) reintubation was necessary because of severe upper airway obstruction due to granulomas. Mean duration of intubation until the first extubation was 10.8 days (6-19). There seems to be a difference in duration of intubation between these two groups with croup, however it is not significant ($p > 0.1$). All the patients with granulomas could be successfully extubated after microlaryngeal surgery, with a mean intubation period of 35.3 days (21 - 47).

Conclusion: Endotracheal intubation in children with epiglottitis revealed no complications, whereas endotracheal intubation in children suffering from croup showed a high incidence (37.5%) of granulomas.

P078

OBSERVATION ON TIME LIMIT OF LONG TERM PERNASAL ENDOTRACHEAL CATHETER PLACEMENT

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Pernasal endotracheal catheterization was performed in 54 Patients with the placement for 7-61(20.5) days, 54 cases (51.8%) were found to have laryngeal obstruction(LO) 1° and 44 (81.5%) hoarseness, while 22 cases with catheter placement 3.0 days[average] were 3(13.6%) in LO 1° and 10(45.5%) in hoarseness, In the long term[average 385 days] laryngoscopic follow-up survey in 36 patients,8 were found to have thickening of the free borders of the bilateral vocal cords,insufficient closure of the vocal cords,thickening of the false vocal cords and other laryngeal complications. However, laryngeal stenosis and other serious complications were not seen. 3 patients (42 days averagely) was obviously seen in the peak zone of f1, f2 resonance and in the zone of high frequency in noise composition while 12 cases(3 days average) showed no abnormality both clinically and laryngoscopically. 7/10 patients with catheter placement for more than 5 weeks and 1/26 patients for less than 5 weeks had laryngeal abnormal change in their larynges. Abnormal changes of sound spectrogram were all seen in 3 patients with placement for more than 5 weeks. Our data suggest: (a) the complication of endotracheal intubation was increases with increasing length of time of catheter placement, but serious complication is rare; (b) the time limit of pernasal endotracheal catheter placement is 5 weeks within which the procedure is a comparatively safe and effective means for maintaining a long term artificial airway.

P077

TRACHEOBRONCHOMEGLY IN PRETERM INFANTS ON MECHANICAL VENTILATION

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In a 6-year period (1986-1992) we diagnosed TBM as an apparent dilatation of the trachea and main bronchi in four premature infants on continued MV for respiratory distress syndrome (RDS). The infants were three boys and one girl with gestational age (GA) 26-33 weeks and body weight (BW) 1100-1965 g. MV was provided by Bourns 2001 CUB time-cycled and pressure-limited ventilator to attain normal gas tensions. No jet ventilation was used.

Chest radiographs were reviewed for a complete evaluation, and for the evaluation of the airway. After the initial subjective diagnosis of TBM, the width of the tracheal and main bronchial air column was measured at the lower level of the first and the third thoracic vertebral body (T1, T3) and near the carina; the width of the main bronchi below the carina was also measured.

In all infants, TBM became apparent close to the 20th day, that is, after 2-3 weeks of MV. Therefore, for the time period from birth to the 20th day the following ventilatory parameters were reviewed and analyzed: (1) the percentage of total ventilation time when more than 40% O₂ concentration was required, (2) the peak inspiratory pressure, (3) the positive end-expiratory pressure, and (4) the duration of high frequency ventilation (80-160 breaths per minute).

Also noted were the Apgar scores (1 and 5 min after birth), the duration of hypotension (systolic BP below 40 mmHg) and circulatory instability, the presence of systemic or tracheal connatal or later infection, the duration of MV, and the final clinical outcome. The records were also reviewed for other possible pertinent data.

P079

RIGID RESPIRATORY ENDOSCOPY IN CHILDREN

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Introduction: The respiratory endoscopy is an important procedure to diagnose and treat many airway's diseases in children. Although have had advances in radiologic investigation exams and pulmonary function tests, the direct anatomic visualization of airway is important to the management of many respiratory problems.

Objective: Evaluation the respiratory endoscopies performed with a rigid bronchoscope in a pediatric reference hospital.

Material and Methods: We study the records of all children that were submitted to respiratory endoscopy under general anesthesia from March 1989 to March 1992. Age, sex, clinical to indicate the procedure, diagnosis and complications of endoscopy were registered.

Results: Three hundred and fifty six respiratory endoscopies were performed. The most common indications for endoscopy were stridor (52%), suspected foreign body (16%), atelectasis (16%) and difficult tracheal extubation (8%). The most frequent diagnosis were laryngomalacia (36%) and subglottic stenosis (6%) in the glottic and subglottic areas, and foreign body (9%) and tracheomalacia (7%) in the tracheobronchial area. Normal endoscopy was performed in 54 (21%) of the children. Only three slight complications of the endoscopy were observed. Two patients presented bradycardia during the exam, and the third need tracheal intubation due to post-endoscopic subglottic edema.

Conclusion: The rigid endoscopy in children is efficient and has no serious complications.

Cardiopulmonary resuscitation/Emergencies

P081

Near drowning; Indicators of acute and long term prognosis

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In this retrospective study factors that affect short and long term prognosis after submersion were analysed. All patients that were admitted to a tertiary pediatric ICU between january 1, 1986 and january 1, 1992 were included. Of 34 patients, aged 0-13 years, 8 died in the ICU, one after hospital discharge. Survivors and non-survivors showed significant differences with respect to central temperature, pupillary reactions, arterial pH, Pediatric Risk of Mortality (PRISM) score and Therapeutic Intervention Scoring System (TISS) upon admission ($p < 0.05$). Non-survivors more frequently required mechanical ventilation, bicarbonate administration and active reheating. ARDS was seen in 22 patients (65%), invariably within 6 hours after admission. No patients with cardiac arrest on admission survived without sequelae. Hypothermia appeared to have no protective effect on hypoxic damage. Survivors with persistent sequelae ≥ 6 months after discharge had significantly higher PRISM and TISS scores (mean 27 and 34, respectively) than those with complete recovery (mean 14 and 23, respectively). Long term cognitive problems were present in 7/25 survivors (28%) and emotional disturbances in 5/25 (20%).

In conclusion, a concise number of clinical and laboratory parameters, representing acute severity of illness, are important prognostic indicators for survival and health status of children after submersion.

P082

A CASE OF ORPHENADRINE POISONING.

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Orphenadrine is an anticholinergic drug mainly used to decrease symptoms of Parkinson disease. Orphenadrine has a peripheral and central effect and overdose can result in athetoid movements, convulsions, cyanosis, coma, arrhythmias, shock and cardiac arrest. Physostigmine is a specific antagonist of the peripheral and central effects and can be a useful antidote.

We report the case of a two and a half year old female who was transferred to our ICU for general convulsions. The little girl had, three hours before admission, accidentally ingested 400mg of orphenadrinehydrochloride (Disipal®), which was her grandmother's anti-parkinson medication. Three hours after ingestion she presented neurological signs: confusion, unstable walking, and periods of aggression. Generalized tonic-clonic seizures appeared who were rebel to administration of multiple anti epileptica but ceased after IV administration of diazepam and endotracheal intubation and ventilation. An episode of ventricular tachycardia responded well to the IV administration of lidocaine. The levels of orphenadrine in the serum were high at admission (3550µg/L) and were present in the blood up to 96 hours after ingestion. High serum levels are, in the literature, associated to a high mortality rate. Physostigmine was administered three times at a 0.02mg/kg dose in the first 24 hours. We describe the noted effects of physostigmine on the different symptoms. The patient survived and could leave the ICU after one week.

In conclusion: orphenadrine poisoning is a very complicated medical problem associated with high mortality. In severe intoxication, the benefit of physostigmine more than counterbalances its side effects.

P083

MANAGEMENT OF ACCIDENTALLY INGESTED FOREIGN BODIES IN CHILDHOOD

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We analyzed retrospectively the management of sixtyfive (65) accidental ingestions of foreign bodies in children. No child had ingested more than 1 foreign object. The majority of the ingested foreign bodies were : parts of food and coins. Children were seen at the emergency ward within a few hours after the accident. Chest and/or abdominal X-ray was performed as first-line investigation. The incidence of accidentally ingested foreign bodies was 1% during 30 months. 34 (52,3%) were boys, and 31 (47,7%) were girls. There were 59 (91%) bronchoscopies, and 6 (9%) were oesophagoscopies. The average age was 2,8 years for bronchoscopies, and 4 years for oesophagoscopies.

The outcome of the patients was good. No complications were observed. Extraction is recommended in every symptomatic patient.

P084

EPINEPHRINE PHARMACOKINETICS AND PHARMACODYNAMICS FOLLOWING ENDOTRACHEAL ADMINISTRATION IN DOGS: THE ROLE OF VOLUME OF DILUENT

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Objective: To define the optimal volume of dilution for endotracheal (ET) administration of epinephrine (EPI).

Design: Prospective, randomized, laboratory comparison of four different volumes of dilution of endotracheal epinephrine (1, 2, 5, and 10 ml of saline)

Setting: Large animal research facility of a university medical center.

Subjects and interventions: Epinephrine (0.02 mg/kg) diluted with four different volumes (1, 2, 5, and 10 ml) of normal saline was injected into the ET tube of five anesthetized dogs. Each dog served as its own control and received all four volumes in different sequences at least one week apart. Arterial blood samples for plasma epinephrine concentration and blood gases were collected before and 0.25, 0.5, 0.75, 1, 2, 3, 4, 5, 10, 15, 20, 25, 30, and 60 minutes after drug administration. Heart rate and arterial blood pressure were continuously monitored.

Measurements and Main Results: Higher volumes of diluent (5 and 10 ml) caused a significant decrease of PaO_2 , from 147 ± 8 torr to 106 ± 10 torr, compared to the lower volumes of diluent (1 and 2 ml), from 136 ± 10 torr to 135 ± 7 torr ($p < 0.05$). These effects persisted for over 30 minutes. Mean plasma epinephrine concentrations significantly increased within 15 seconds following administration for all the volumes of diluent. Mean plasma epinephrine concentrations, maximal epinephrine concentration (Cmax), and the coefficient of absorption (Ka) were higher in the 5 ml and 10 ml groups. The time interval to reach maximal concentration (Tmax) was shorter in the 5 ml and 10 ml groups. Yet these results were not significantly different. Heart rate, systolic and diastolic blood pressures did not differ significantly between the groups throughout the study.

Conclusions: Dilution of endotracheal epinephrine into a 5 ml volume with saline optimizes drug uptake and delivery without adversely affecting oxygenation and ventilation.

P085**PAEDIATRIC CARDIAC ARREST AND RESUSCITATION PROVIDED BY PHYSICIAN STAFFED EMERGENCY CARE UNITS**

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The aetiology and outcome of paediatric out-of-hospital cardiac arrest was studied during a 10-year period in Southern Finland served by physician staffed emergency care units. The files of 100 prehospital patients less than 16 years old without palpable pulse and spontaneous respiration were analysed retrospectively.

Fifty patients were declared dead on the scene (DOS) and resuscitation (CPR) was initiated in 50 patients. The sudden infant death syndrome was the most common cause of arrest (68%) in the DOS patients as well as in patients receiving CPR (36%). Asystole was the initial cardiac rhythm in 70% of the patients in whom CPR was attempted. Eight of the 13 hospitalised patients were discharged, 6 of them with mild or no disability, 1 with moderate disability and one in vegetative state. In multivariate analysis the short duration of CPR (<16 minutes) was the only factor significantly associated with better survival.

Due to various aetiologies the survival rate from prehospital paediatric cardiac arrest is quite low. On the other hand, hypothermic near-drowning victims seem to have a relatively good prognosis. Duration of CPR less than 16 minutes was the best predictor of intact survival. Our study supports the previous findings of the importance of early and effective resuscitation efforts for establishing ventilation and perfusion on the scene. In our system well trained physician staffed emergency care units are able to provide immediate and effective ALS on the scene. On the other hand, these units also appear to be able to refrain from resuscitation when the prognosis is pessimistic.

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Transplantation/Digestive tract

P086

ORTHOTOPIC LIVER TRANSPLANTATION [OLT] FOR FULMINANT WILSON'S DISEASE IN CHILDREN

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We report 5 children evaluated for fulminant Wilson's disease.

Patients: since 1985, 63 children (mean: 5.5 yr) with fulminant liver failure (FLF) were evaluated for OLT. Wilson's disease accounts for 8 % of the cases (n=5). **Results:** on admission all children (mean : 10 yrs) presented with grade 3 hepatic encephalopathy [HE], hepatomegaly and jaundice. The interval between jaundice and HE was 8 d (2-16 days). A Kayser-Fleicher ring was present in 4. Laboratory features were as following: ALT 893 ± 406 , IU/L, total bilirubin: 1069 ± 234 $\mu\text{mol}/\text{l}$, factor V: 20 ± 4 % of the normal, Creatininemia: 250 ± 50 mmol/l, ceruloplasmin: 00.7 ± 00.4 g/l. Hemolytic anemia was noted in all cases. Plasmapheresis were performed in all children prior to OLT: no improvement of HE and liver function tests were noted. All patients were registered on the emergency list of OLT. One died awaiting a graft, one died immediately after OLT (brain herniation ?), one died lately (severe neurological sequelae). Two patients are surviving, one after retransplantation for hepatic artery thrombosis. **Conclusion:** Wilson's disease may mimick fulminant hepatitis. Plasmapheresis does not modify the clinical course. The success of OLT in this situation is limited.

P087

Changes in serum aminoacid profile after liver transplantation in children.

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There is little information on the evolution of serum aminoacids in hepatic patients receiving an orthotopic liver transplantation (OLT).

Subjects. We have prospectively studied 32 OLT in 26 pediatric patients. We quantified in serum samples: total aminoacids (TAA), essential aminoacids (EAA), non essential aminoacids (NEAA), branched chain aminoacids (BCAA) and aromatic aminoacids (AAA). Serum samples were drawn: before surgery (PreTx), on admission to the PICU after OLT and subsequently on days 1 to 7 after OLT.

Results. TAA, EAA and NEAA are increased before OLT in relation to normal controls although the differences did not reach significance.

After OLT, TAA, EAA and NEAA decrease under normal levels on admission ($p < 0,0001$), day 1 ($p < 0,0001$), day 5 ($p < 0,0001$), day 6 ($(p < 0,0003)$ for TAA, ($p < 0,03$) for EAA and ($p < 0,0001$) for NEAA), and day 7 ($(p < 0,005$) for TAA, ($p < 0,002$) for EAA and ($p < 0,01$) for NEAA).

BCAA are decreased in hepatic patients before OLT, in relation to normal controls. The BCAA levels remain under normal values along the evolution, with statistical significance on admission ($p < 0,04$), day 1 ($p < 0,0001$), day 3 ($p < 0,0004$), day 5 ($p < 0,0001$) and day 7 ($p < 0,003$).

AAA levels are significantly increased before OLT ($p < 0,05$) and remain high on admission ($p < 0,04$).

Comments. The decrease in serum aminoacid levels we have found may suggest poor nutritional conditions in our patients. Thus, early parenteral support may play a role after OLT in children.

P088

GASTRIC INTRAMUCOSAL pH IN HEALTHY CHILDREN: REFERENCE VALUES

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Objective: To assess the normal gastric intramucosal pH (pHi) by tonometry in healthy children

Patients and methods: Twelve healthy children (6 males and 6 females) with age ranged from 6 months to 12 years scheduled for minor plastic or urologic surgery. Children were previously medicated with midazolam (0.25 mg/kg) and atropine (0.02 mg/kg) both i.m.. Anaesthetic induction was standardized with O_2 - N_2O (75%) administered via facial mask and increased halothane concentrations (up to 2%). All patients got an endotracheal tube after i.v. administration of fentanyl (2 mcg/kg) and vecuronium (0.1 mg/kg) or suxametonio (1 mg/kg). Anaesthesia was maintained with O_2 - N_2O (60-75%) and isoflurane (0.5-1%). During surgery, 8 children needed mechanical ventilation and the others maintained spontaneous breathing. EKG, heart rate, blood pressure, and pulse oximetry were monitorized. After anaesthesia, a sigmoid tonometry catheter (Tonometrics, Inc.) was inserted in the stomach of the patients by direct visualization with laryngoscope and Magill clamps. Children were all maintained normoventilated and with normal cardiorespiratory variables. Catheter's balloon was filled with 2.5 ml of saline. Thirty minutes after the insertion 1 ml was extracted and rejected, just afterwards the remanent 1.5 ml was extracted and immediately analyzed. Simultaneously an arterial gasometry by puncture was performed. Gastric pHi was calculated by the Henderson-Hasselbalch's equation using the pCO_2 obtained from the tonometry catheter and the bicarbonate value obtained from the arterial gasometry.

Results: Average gastric pHi was 7.34 ± 0.027 , range (7.29- 7.46).

Conclusions: Healthy children under normoventilation, and stable haemodynamic condition have gastric pHi values similar to those in adults

P089

GASTRIC MUCOSAL TONOMETRY ALTERATIONS IN THE POST OPERATIVE OF CONGENITAL HEART DISEASE DUE TO TRANSPORT.

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Objective: Demonstrating intramucosal pH (pHi) alterations during transport of patients from operative room to pediatric intensive care unit (PICU).

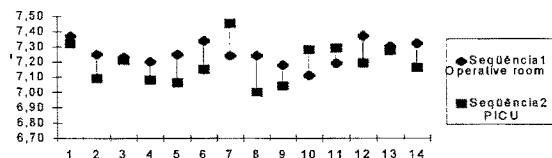
Material and methods: pHi measurements were performed with gastric tonometer catheter in 14 patients undergoing cardiac surgery with cardiopulmonary bypass (CPB). There was 9 male and 5 female, the average age= 3y10m, average weight= 12,5 kg, average time of CPB= 70 min. The measurements were made at the end of the surgery and when the patients had arrived in the PICU

Statistical analysis: Average and standard deviation and test "t" Student.

Results: The decrease of pHi was 7.26 ± 0.08 to 7.19 ± 0.13 when the patients had arrived in the PICU. 78,5% (11/14) of patients had decrease in pHi during transport.

Patients	time of	end of	PICU		time of	end of	PICU
	CPB	CPB			CPB	CPB	
1	105	7,37	7,32		8	128'	7,24
2	26'	7,25	7,09		9	38'	7,18
3	77	7,23	7,21		10	22'	7,11
4	90'	7,20	7,08		11	74'	7,19
5	86'	7,25	7,06		12	30'	7,37
6	52'	7,34			13	46'	7,30
7	101'	7,24	7,45		14	103'	7,32

ALTERATIONS OF pH DURING TRANSPORT



Conclusion: We noticed a decreased in the pHi after transport, however this data didn't achieve statistical significance.

P090**GASTRIC INTRAMUCOSAL PH AND ARTERIAL LACTATE LEVELS IN AN EXPERIMENTAL MODEL OF INTESTINAL ISCHEMIA.**

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Objetive: To asses the efficacy of gastric intramucosal pH (pHi) and arterial lactate levels to evaluate splanchnic tissular perfusion in an experimental model of intestinal ischemia.

Subjects and methods: twelve piglets weights 13-20 Kgs, undergoing orthotopic liver transplantation. The intestinal ischemia was induced by aortic clamping. Tonometry catheter (Tonometrics Inc.) was placed in the stomach after anaesthesia and OT intubation. pHi was determined 7 times and lactate levels was determined 6 times in 3 stages: I) Pre-Anhepatic stage (twice before surgery and before aortic clamping); II) End anhepatic stage (only pHi); III) Reperfusion stage (at 30, 90, 120 and 180 minutes). The pHi was derived from application of the Henderson-Hasselbach formula using the pCO_2 value from the tonometer and the arterial bicarbonate. All piglets received ranitidina before surgery. Values of pHi above 7,35 and lactate levels between 6 and 15 mg/dl were considered normal. The results were statistically analized with ANOVA and Bonferroni tests.

Results: The pHi was normal on pre-anhepatic stage ($> 7,35$) and lactate levels were slightly increased ($21,5 \pm 8,9$ and $19,5 \pm 5,9$ mg/dl, NS). In relation to pre-anhepatic values, pHi decreased significantly at the end of anhepatic stage ($7,39 \pm 0,14$ vs $6,94 \pm 0,1$ $p < 0,001$). pHi remain low in stage III, at 30 min ($6,86 \pm 0,12$ $p < 0,001$) and 90 min ($6,94 \pm 0,12$ $p < 0,001$).

Arterial lactate levels increased significantly in relation to levels in stage I, at 30 min ($63,6 \pm 9,7$ $p < 0,001$) and 90 min ($65,8 \pm 9,9$ $p < 0,001$) of reperfusion stage. There is a slight improvement on pHi and lactate levels at 120 and 180 min althought the differences did not reach significance.

Comments: pHi and arterial lactate levels propperly reflect hypoperfusion on the experimental model of acute intestinal ischemia.

(Supported in part by FISSS grant 93/0818 and 95/5504).

P091**NEUTROOPENIC ENTEROCOLITIS IN PATIENTS WITH THE III AND IV STAGES OF B-NON HODGKIN'S LYMPHOMA.**

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Progress in prognosis of pts with B-NHL had followed the use of multimodality chemotherapy (CT). With the prolonged survival, there are complications due to myelosuppression & disease process. The syndrome of Neutropenic Enterocolitis (NE) is one of the ominous problems because of pts increased susceptibility to infection & overwhelming sepsis. This material included 25 neutropenic pts (4-14 years) with the stages III & IV of B-NHL who were treated with the modified BFM-90 (MTX 1 g/m² in 24-h inf.); 22 males, 3 females. Seventeen episodes of NE were observed & only after the first 2 courses of CT (13 of 25 after 1st, 53%; 4 of 24 after 2nd, 17%). The symptoms existed 3 to 14 days. WBC ranged from 50 to 600 in 1µl (median, 100). The first signs of NE were directly correlated to the beginning of the neutropenia & the recovery of neutrophils led to the disappearance of abdominal recovery of neutrophils led to the disappearance of abdominal pain. The conservative treatment included gastrointestinal tract decompression, broad spectrum antibiotics initially, volume & electrolyte substitution, nutritional support, correction of acid-base balance, symptomatic treatment. Sixteen pts were treated nonoperatively, 1 died. On autopsy the transmural bowel necrosis due to thrombosis of branches of a.mes.sup. was found. The bowel perforation occurred in one patient, he was undergone laparotomy & hemicolonectomy & survived. We conclude that NE is a frequent complication in neutropenic pts with the st. III & IV of B-NHL. It occurs after the induction courses of CT. Close observation by surgeons, oncologists & pediatric intensivists is mandatory. Conservative treatment is effective & more preferable until leucopenia resolves. Operation is necessary only for those with perforation.

P092**ACUTE UNUSUAL GALLBLADDER DISEASE IN THE PREMATURELY BORN NEONATE : FOLLOW-UP OF 4 CASES**

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Background : The paediatric gallbladder diseases generally described are calculous cholecystitis, cystic duct obstruction, congenital anomaly of the biliary tract, and inflammation. In the neonatal period, nonlithogenic gallbladder disease could be also due to erythroblastosis or hyperalimentation.

Objective : We describe an other type of disease affecting the gallbladder in neonates thought to be related to their vascular vulnerability.

Methods : Four patients with abnormal gallbladder ultrasound not related to classical observations were included. We have studied and reviewed the biological and clinical data, the ultrasound findings and their evolutions.

Results : Four patients, 30 to 32 week-old neonates with a birthweight between 1,3 and 1,9 kg, were intubated and under total parenteral nutrition for 10 to 35 days. None of them were symptomatic on repeated clinical evaluations.

One newborn developed hypotension on umbilical bleeding at 3 hours of life. In two cases, signs of cholestasis were discovered : the total bilirubin level has risen to 5 mg/dl; the direct bilirubin level was 1,5 mg/dl while the urina were dark and the stools uncoloured. The complete serology as all the cultures remained negative. The ultrasound explorations were atypical : in the four cases, an initial increasing broad and thickness of the wall of the gallbladder with an hyperechogenic inside content, which was not sludge, was discovered. In three cases the images resolved in ten to fifteen days.

In one case, an asymptomatic thrombosis of the vena porta which remained patent was discovered. In this case, at one month, the ultrasound showed images encountered in chronic cholecystitis and, at one year, the gallbladder appeared atrophic. None of them underwent surgery.

Conclusion : The gallbladder diseases are multifactorial. Besides the prematurity, the infections, the total parenteral nutrition, the premature neonate is exposed to vascular vulnerability affecting also the gallbladder and this may explain our findings.

P093**Near Infrared Spectroscopy as a tool for evaluation of intestinal perfusion - presentation of an animal model.**

C. Scheibenpflug, P. Buxbaum and A.M. Rokitansky

The recent development of and investigations in the so called Near Infrared Spectroscopy (NIRS -- transcutaneous emission and simultaneous registration of intensity of spectral colours depending upon modulations of tissue perfusion) enable physicians to measure and qualify organ perfusion and nowadays is mainly used to control cerebral as well as skeleton muscular blood flow in trauma patients at intensive care units (ICU).

Today intestinal perfusion, hypoperfusion, cell damage caused by reperfusion injury, bacterial and toxin translocation are serious problems in critically ill patients at an ICU.

Paediatric intensive care physicians put major concern on intestinal perfusion, which for instance gains more and more importance, especially in the neonatal period for example as an etiologic factor for necrotizing enterocolitis. We established an animal model, in which we measured intestinal perfusion by NIRS under various invasive and noninvasive conditions.

Methods and results will be referred.

For preliminary conclusion we propose Near Infrared Spectroscopy (NIRS) also as a potent diagnostic tool to determine early intestinal malperfusion in order to prevent lethal outcome.

Further investigations in animals as well in paediatric intensive care patients should be done to estimate our efforts.

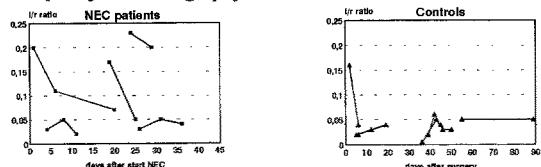
P094

CLINICAL MEASUREMENT OF ABNORMAL GUT PERMEABILITY IN PATIENTS WITH NEC AND CONTROLS WITH THE DOUBLE SUGAR TEST.

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Introduction: Following the acute phase of necrotising enterocolitis (NEC) starvation of the gut for a period up to 3 weeks is a generally accepted treatment modality in many centres. Objective criteria to refeed these patients are hardly available. Recently the double sugar test has become available as a parameter for (ab)normal gut permeability^{1,2}. **Aim of the study:** To evaluate the changes in permeability of the small bowel in patients with NEC and controls before introduction of enteral feeding.

Methods: A lactulose/ rhamnose (l/r) test was performed in two groups. Group 1 was studied 2-3 times within a 5-week period of starvation (n=5, mean gest. age 35, range 31-40 weeks). In group 2 seven different control patients were studied (mean gest. age 33, range 28-38 weeks). The test was performed by giving a patient after at least a 4 hour fast 1 ml/kg bodyweight l/r solution and determination of the l/r ratio in a 4-hour urine sample by chromatography. **Results:**



Conclusion: The double sugar test is a simple, noninvasive and reliable intestinal permeability test that can provide guidelines for the individual patient with NEC to restart enteral feeding at an earlier stage preventing TPN related morbidity.

¹ J Pediatr Gastroenterol Nutr 1995;20:184-8.

² Lancet 1993;341:1363-5.

Nitric oxide

P095

Accuracy in dosage and dose monitoring of nitric oxide in high frequency oscillatory ventilation.

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Introduction: Nitric oxide inhalational therapy requires a dosage unit, consisting of flow controllers for bias and NO flow as well as NO and NO₂ monitoring devices.

Aim of the study: We examined the accuracy of each component as well as the accuracy of the complete system in combination with a high frequency oscillatory ventilator (HFO-V).

Materials and methods: We compared accuracy of digital mass flow controllers (MFC) (Bronkhurst Hi-Tec, Veenendaal, The Netherlands) versus conventional analog flow controllers (Brooks Europe, Veenendaal, The Netherlands) for NO and biasflow control. NO and NO₂ concentrations were measured with chemiluminescence (CLD 700, EcoPhysics, Dürnten, Switzerland) in dry gas containing 21% oxygen. Furthermore accuracy of NO measurement in clinical conditions was assessed, with NO and bias flow MFC controlled. NO and NO₂ concentrations were measured using both chemiluminescence (CLD 700) and electrochemical analysers (SensorNOx, Sensor Medics Europe, Bilthoven, The Netherlands). The HFO-V ventilator used was a Sensor Medics 3100-A (Sensor Medics, Yorba Linda, Ca).

Results: We found major influences of used flow controllers, humidification, and measurement method used. Data are presented in the table as mean (95%CI limits) of the ratio of pre-calculated to measured NO value.

	2 MFC	0.99 (0.983-0.998)
Dosage accuracy (chemiluminescence)	3100 A biasflow, MFC (NO)	0.856 (0.835-0.877)
	3100 A biasflow, rotameter (NO)	1.175 (0.793-1.74)
Measurement accuracy (2 MFC)	electrochemical, dry gas	1.017 (1.006-1.029)
	electrochemical, humid gas	1.131 (1.089-1.175)
	chemiluminescence, humid gas	1.136 (1.126-1.136)

Conclusions: We conclude, that a system consisting of one MFC for NO dosage, rotameter for biasflow control and electrochemical NO and NO₂ analyser has adequate accuracy for clinical use during HFO-V. Our electrochemical analyser uses a cell, with limited sensitivity to high oxygen levels, sampled gas was dried via peraparure tubing and pressure swings were not allowed to reach the analyser.

P096

Occupational exposure levels by nitric oxide inhalational therapy in a pediatric intensive care setting.

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Aim of the study: To determine the amount of occupational exposure of nitric oxide (NO) and nitrogen dioxide (NO₂) during NO inhalational therapy.

Materials and methods: In a standard pediatric intensive care room, NO 800 parts per million (ppm) was delivered to a high frequency oscillator (3100-A, SensorMedics, Yorba Linda, Ca) and mixed with 100% O₂ to obtain 20 ppm NO in the inspiratory gas flow. Room air NO and NO₂ concentrations were measured using a chemiluminescence analyzer. NO flow and flow of the air-oxygen mixture were regulated with the use of a two channel mass flow controller (accuracy 1% FS) (Bronkhurst Hi-Tec, Veenendaal, The Netherlands, SensorMedics, Bilthoven, The Netherlands). Air samples were taken continuously from a height of 150 cm at a horizontal distance of 65 cm from the ventilator in a non ventilated intensive care room, as well as in a well ventilated room with and without an expiratory gas exhaust under normal intensive care environmental conditions.

Results: Maximal concentrations of NO and NO₂ were reached after four hours of NO use. Data are summarised in the table.

	maximal room air NO concentration (ppm)	maximal room air NO ₂ concentration (ppm)
background	0.002	0.028
no airco, no exhaust	0.462	0.064
exhaust, no airco	0.176	0.044
airco, no exhaust	0.075	0.034
airco and exhaust	0.035	0.030

Conclusion: We conclude that the use of 20 ppm NO, even under minimal room ventilation conditions, did not lead to room air levels of NO or NO₂, that should be considered toxic to adjacent intensive care patients or intensive care staff. Slight increases of NO and NO₂ concentrations were measurable but remained well within occupational safety limits. The use of an exhaust system and normal room ventilation further lowers NO and NO₂ concentrations almost to background levels.

P097

PROGNOSTIC FACTORS IN RESPONSE TO NITRIC OXIDE IN CHILDREN

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Objective: To evaluate the prognostic factors in the response to nitric oxide (NO) in children with Acute Respiratory Distress Syndrome (ARDS) and/or pulmonary hypertension (PHT). **Patients and methods:** 23 critically ill children received NO inhaled for ARDS and/or PHT treatment. 14 patient before and after cardiac surgery (2 cardiac transplants), 5 with bronchopneumonia, 2 multiple trauma, 1 sepsis and 1 cardiorespiratory arrest. 15 patients showed ARDS and 8 PHT, in 4 with associated ARDS. We analyzed age, sex, diagnosis, PaO₂, PaO₂/FiO₂, Oxygenation Index, PHT, shock, and sepsis as prognostic factors and response factors to NO.

Results : After NO administration oxygenation did not improve in 2 patients (8.6 %) and PHT did not diminish in one children (12 %). 12 patients survived (52 %), 8/15 (53.3 % with ARDS) and 4 / 8 (50 %) with PHT. The four patients with isolated PHT survived, and the 4 patients with PHT and ARDS dead. Patients after cardiac surgery presented less mortality (35.7 %) than the rest of patients (66.6 %). Patients with shock presented higher mortality (64.2 %) than the rest of patients (22.2 %). There are no differences in response to NO in respect of sex, age, diagnosis, shock, and sepsis. Survivors showed higher increase of PaO₂/FiO₂ 64.3 ± 58.4 to NO than non-survivors 48.4 ± 51.1 (N.S.). Patients with PHT showed higher increase in PaO₂/FiO₂ to NO administration (88 ± 47.1) than patients with ARDS (43.4 ± 50.8), (N.S.), but patients with ARDS showed a higher increase in OI, 15 ± 6.7, than patients with PHT 4.8 ± 4 (p < 0.05). Patients with PaO₂/FiO₂ < 100 showed less increase in PaO₂/FiO₂, 47.8 ± 46.3, than the rest of patients 82.8 ± 65.5 (N.S.)

Conclusions: 1. Mortality of isolated PHT treated with NO is less than patients with ARDS. Patients with shock and those with PHT and ARDS showed higher mortality.
 2. We have not found any clinical or analytical factor to predict clinical response to NO administration.

P098

NITRIC OXIDE ADMINISTRATION IN PULMONARY HYPERTENSION AND ACUTE RESPIRATORY DISTRESS SYNDROME IN CHILDREN

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Objectives: To analyze the effect of nitric oxide (NO) on pulmonary pressure and oxygenation in children with pulmonary hypertension (PHT) and/or with Acute Respiratory Distress Syndrome (ARDS).

Patients and methods: We administered NO inhaled between 1.5 and 45 ppm to 23 children aged between 15 days and 16 years (14 boys and 3 girls). 14 patients showed ARDS, and 9 severe PHT after cardiovascular surgery, in 5 with associated ARDS. We registered respiratory assistance, blood gases, PaO₂/FiO₂, the oxygenation index (OI), and mean pulmonary pressure/ mean systemic pressure (PAP/SAP) before and after NO inhalation. We measured continuous concentration of NO and NO₂ by electrochemical method (NoxBox, Bedfont, Airliquide).

Results: NO administration improved oxygenation mean PaO₂ from 74 ± 17 mmHg to 119 ± 54 mmHg (p < 0.01), mean PaO₂/FiO₂ from 83 ± 30 to 135± 72 (p < 0.01) and OI from 28 ± 14 to 20 ± 12 (p < 0.01). 2 patients did not improve with NO administration. The oxygenation improved in the first five minutes and the best oxygenation was achieved with 5 -15 ppm. There is no significant change in PaCO₂.

PAP/SAP diminished from 62 ± 17 % to 42 ± 9 % (p < 0.05). In one patient there is no response. The NO administration was maintained between 45 minutes to 47 days. The effect of NO on pulmonary pressure and oxygenation was maintained without change during all the time it was administrated. NO₂ concentration were always less than 2 ppm y metahemoglobinemia less than 3.5 %. There are no side effects secondary to NO administration. 12 patients survived (52 %).

Conclusions: 1. Administration of NO improves oxygenation in children with ARDS and diminishes PHT after cardiac surgery. 2. NO effect is fast and maintained during the evolution.

P099

High Frequency Oscillatory Ventilation in Combination with Inhaled Nitric Oxide
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Background:

For many years severely sick infants with congenital heart malformations or acute lung disorders have died due to pulmonary hypertension, hypoxia and multiple organ failure. Today there are several therapeutic facilities coming up for these infants. ECMO programmes have been introduced in several centres as well as improved ventilatory techniques, as high frequency oscillatory ventilation (HFOV), which provides adequate ventilation with less risk for lung injury.

In 1987, the endothelium derived relaxing factor was identified as nitric oxide (NO), and extensive studies have shown that inhaled NO reduces pulmonary vascular resistance and improves oxygenation in hypoxic infants with pulmonary hypertension.

Material:

From July 1994 to January 1996, we have treated 13 severely hypoxic children with combined HFOV-NO. Seven were newborn, 3 with CDH, one with MAS, one with IRDS, one with paediatric ARDS due to RSV infection and one with poor oxygenation after open heart surgery. 6 were between 1 month and 9 years and all had ARDS of different origin but one who was hypoxic after open heart surgery.

Method:

HFOV was given by means of SensorMedics 3100A oscillatory ventilator to 12 patients, and Dräger Babylog 8000 was used in one case. Mean airway pressures varied from 10-34 cm H₂O. Oscillatory pressures varied from 25-85 cm H₂O and ventilatory rates from 6-15 Hz. F_iO₂ varied from 0,21 - 1,0. NO was administered by NOMICUS classic. NO and NO₂ was measured in the inspiratory limb with an electrochemical device. NO-concentration varied from 2 to 20 ppm and the NO₂-concentration between 0,0-2 ppm. Methemoglobin was never more than 3,7 % (average 1,7). Duration of treatment varied from 1 to 20 days.

Results:

Combined treatment with HFOV and inhaled NO improved oxygenation and carbon dioxide elimination in 12 out of 13 treated children. 5 patients died, 3 due to their underlying congenital heart disease, one of asphyxia due to RSV-infection and one of CDH with progressive hypoxia and multiple organ failure.

Conclusion:

Combined treatment with HFOV and inhaled NO improves oxygenation in severely hypoxic children. Treatment should be started early to reduce the risk for chronic lung injury following barotrauma and high oxygen concentrations. We speculate that the combined HFOV-NO may reduce the use of ECMO, and that it may improve outcome in centres where ECMO programmes are not introduced.

P100**TITLE: SUCCESFULL TREATMENT OF PEDIATRIC ARDS WITH SURFACTANT COMBINED WITH HFO AND NO**

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Abstract. Objective: To report the first case of Acute Respiratory Disease Syndrome (ARDS) in children treated with surfactant combined with High Frequency Oscillation (HFO) and Nitric Oxyde.

Methods: A former premature infant developed ARDS related to Respiratory Syncytial Virus (RSV) infection. NO was delivered in the ventilatory circuit of a HFO ventilator (Dufour). As the patient was threatened by hypoxia (SaO₂:71%) in spite of HFO and NO combination with high pressures using 100% FiO₂, we decided to perform rescue surfactant treatment. The patient received 200 mg/kg exogenous surfactant (Curosurf®).

Results: Following surfactant instillation, marked improvement of oxygenation and ventilatory requirements was observed. FiO₂ could be dramatically reduced from 100% to 40%. Oxygenation index decreased from 35 to 12.5. After a second injection 12 hours after the first one, oxygenation index decreased to 5.

Conclusion: This children met the US criteria for ECLS. We conclude that surfactant could be an alternative to ECLS for children with ARDS after failure of HFO and NO. The choice between surfactant and ECLS should be considered carefully after the morbidity of the procedures, the duration of the therapy and the cost have been weighed. Waiting for a future study comparing these two techniques, surfactant could probably be used in rescue before ECLS after failure of HFO and NO.

P101**NITRIC OXIDE (NO) IN CONCENTRATIONS USED DURING INHALATIVE NO THERAPY AND ITS EFFECT UPON BACTERIAL GROWTH**

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Apart from its vasodilative properties nitric oxide appears to act also in physiologic immune defense. Intracellular concentrations of NO synthesized by macrophages are in the range of 10³ above those produced by vascular endothelium. We investigated the bacteriostatic effect of nitric oxide at concentrations used during inhaled therapy for pulmonary vasodilation in neonates. Ten different strains of five species were used (Staph. aureus, Staph. epidermidis, Strep. group B [GBS], E. coli and Pseudomonas aeruginosa), which are the most often tracheally isolated bacteria in mechanically ventilated premature infants and neonates. We compared bacterial growth of cultures applying three different concentrations of nitric oxide (40 ppm, 80 ppm, 120 ppm) to the growth of the same strains in room air for a duration of 24 hours.

No bacteriostatic effect was demonstrable at NO concentrations of 40 ppm. E. coli showed decreased bacterial growth at 80 ppm and 120 ppm, however without reaching statistical significance ($p=0.058$). At nitric oxide concentrations of 120 ppm Staph. epidermidis and GBS grew significantly less as compared to colonies of the same strains in room air. No effects were found regarding the growth of Staph. aureus and Pseudomonas aeruginosa.

We conclude that nitric oxide has a selective bacteriostatic effect on some of the most often tracheally isolated bacteria in premature infants and neonates. This effect appears to be dose-dependant and occurs in the upper range of dosages used with inhaled NO therapy. Further research is required in order to examine the mechanisms of action as well as specific interactions between different strains of bacteria and nitric oxide.

P102**SENSITIVITY OF THE BEDFONT NO-MONITOR TO AIRWAY PRESSURE AND SAMPLE LOCATION**

H.R. van Genderingen, D.G. Markhorst, H.N. Lafeber

The NoBox monitor (Bedfont, Kent, UK) is used to monitor nitric oxide (NO) and nitric dioxide (NO₂) during NO administration in ventilated neonates. According to the manufacturers specifications the monitor can be applied in cases where airway pressures range from 5 to 50 mbar. We investigated in-vitro the accuracy of the NO monitor in a range of ventilatory conditions.

Using a Dräger Babylog 8000 we ventilated an artificial lung. NO was administered (800 ppm NO in 100% nitrogen) with a mass flow controller to the inspiratory tube, at a distance of 20 cm from the Y-piece. The NO target value was set to 10 ppm. The ventilator was operated in both CPAP and IPPV modes at different settings. The NO sampling tube was placed on two different locations; in the inspiratory tube close to the Y-piece; in the expiratory tube half way between the Y-piece and the ventilator. The NO-monitor was calibrated with 84 ppm NO at 30 mbar.

Fig. 1 and 2 show the sensitivity of the NO-monitor for respectively static pressure (CPAP) and pulsatile pressure (IPPV) with the sampling tube located in the inspiratory tube. Fig. 3 shows the result for pulsatile pressure with sampling in the expiratory tube. We conclude that the accuracy of the Bedfont NO-monitor is dependent upon airway pressure and sampling site, the latter possibly caused by incomplete mixing. Pressure and NO are linearly related when sampling occurred further away from the administration site. Based on this study we suggest to place the sampling tube in the expiratory tube. During neonatal care the clinician should be aware of varying inaccuracies depending on the respiratory pressures.

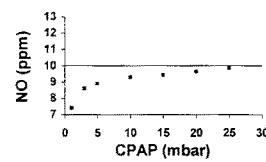


Fig. 1: static pressure (CPAP)

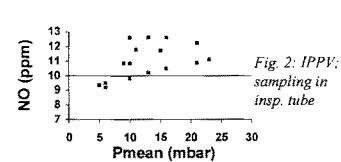


Fig. 2: IPPV;
sampling in
insp. tube

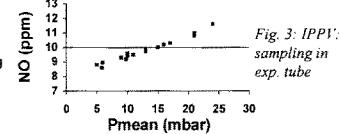


Fig. 3: IPPV;
sampling in
exp. tube

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P 103

Availability of Nitric Oxide Inhalation Therapy Reduces Use of Extracorporeal Membrane Oxygenation (ECMO) as Therapy for Severe Neonatal Respiratory Failure

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Hypothesis: Availability of therapy with inhaled nitric oxide (iNO) decreases ECMO use in patients referred to a tertiary care hospital for treatment of respiratory failure unresponsive to conventional therapies.

Background: At Children's Hospital of Wisconsin (CHW) treatment for patients who have failed conventional treatment for respiratory failure, sometimes called "rescue" therapy, has included ECMO since 1986 and high frequency oscillatory ventilation since 1992. iNO has been in experimental use at CHW since May of 1994 and has resulted in the perception of a decreased need for ECMO therapy in those patients referred for rescue therapy. This study was designed to test the validity of that perception.

Study Type: Retrospective cohort.

Methods: The medical records of all 105 patients referred to CHW from 1/1/93 to 4/1/95 for rescue therapy for severe respiratory failure were included in the chart review. Data were collected regarding diagnoses, illness severity, hospital course including interventions and complications, and outcomes. Exclusion criteria were the finding of structural heart disease or congenital diaphragmatic hernia as the basis for hypoxemia. Qualification for iNO treatment included an $A-aDO_2 \geq 600$ or $OI \geq 40$ for two hours or ≥ 25 for twelve hours and echocardiographic demonstration of persistent pulmonary hypertension of the newborn. Patients were classified into two groups based on the availability of iNO at the time of their hospitalization.

Results: In the time period of the study, 105 patients were referred for possible ECMO therapy. Twelve patients greater than 4 weeks old, 31 with congenital diaphragmatic hernia and 12 with congenital heart disease were excluded from this analysis, leaving 50 patients for study. iNO availability reduced ECMO use from 16 of 34 (47%) patients in the "iNO unavailable" group to 2 out of 16 (12.5%) patients in the "iNO available" group, $p=0.026$ by Fisher's exact test. The fact that the two groups were composed of patients of similar severity of illness is reflected by comparable rates of ECMO and iNO rescue therapy (47% vs. 56%).

Conclusion: By providing an alternative rescue therapy, iNO has reduced the need for ECMO in this group of neonates referred for respiratory failure.

Renal

P 104

ACUTE RENAL FAILURE DUE TO URINARY TRACT
INFECTION - CANDIDA ALBICANS IN TWO INFANTS. CASE
REPORTS.

Mária PISARČÍKOVÁ, Martin UHER, Jozef FILKA, Milan KURÁK,
Ladislav SOKOL

Two infants with Candida albicans urinary tract infection and acute renal failure due to mechanical obstruction are presented. They were treated with antimycotic drugs. The first girl was successfully treated with peritoneal dialysis. The second baby had undergone percutaneous bilateral nephrostomy (12 days). She had also signs of liver and heart affection. Ultrasound examination of kidneys revealed homogenic masses in the pelvic areas. On the 14th and 17th hospital days she urinated this masses (approximately 10mm resp. 5 mm in diameter).

P 105

COMBINATION OF PERITONEAL DIALYSIS AND CAVH IN THE TREATMENT OF ACUTE RENAL FAILURE DUE TO HEMOLYTIC-UREMIC SYNDROME. CASE REPORT

Martin UHER, Mária PISARČÍKOVÁ, Jozef FILKA, Miroslav ŠAŠINKA

12-month-old white girl with acute renal failure due to hemolytic-uremic syndrome and neurologic involvement (GCS 5) was indicated for peritoneal dialysis. The levels of urea and creatinin gradually decreased. Overhydratation with life-threatening pulmonary and cerebral edema was indication for CAVH on 10-th hospital day. Duration of CAVH was 144 hours. Peritoneal dialysis was performed for 20 days. Her renal functions improved 3 months later with mild proteinuria and renal tubular acidosis. She was left with statomotoric and mental developmental impairment.

Until now in the available literature we haven't read about using this two replacement methods together in the treatment of acute renal failure.

P 106

THE HEPATORENAL SYNDROME IN PEDIATRIC INTENSIVE CARE
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Introduction: true hepatorenal syndrome (HRS) is defined as acute renal failure (ARF) in the presence of severe liver disease without other known causes of renal failure. HRS is frequently seen in the course of hepatic cirrhosis. In children, cirrhosis is rare; however, ARF can be seen in combination with ascites and liver dysfunction. We describe 3 patients with hepatic dysfunction and ascites in combination with ARF and abnormal sodium-water handling, leading to the diagnosis of HRS.

Pathophysiology: three factors are considered in the pathogenesis of HRS: 1) hepatic dysfunction, 2) deranged hemodynamics, including abnormal blood pressure, reduced effective arterial blood volume and abnormal blood flow distribution, and 3) neuro-humoral dysregulation, including elevated levels of aldosteron, renin, angiotensin-II, ADH, vasodilating nitric oxide and vasoconstrictor peptide endothelin-I. The main pathogenetic feature is decreased cortical renal blood flow, decrease of glomerular filtration rate (GFR), vastly increased sodium retention, oliguria, and azotemia.

Treatment: therapy is based on counteracting sodium and fluid retention by high-dose aldosteron antagonists and loop diuretics, improving renal perfusion by low-dose dopamine, and strict restriction of fluid and sodium. Interventions as paracentesis of ascites or a peritoneo-systemic shunt are associated with high morbidity and poor outcome in children. Reversal of HRS by conservative measures can only be attained at early stages of HRS. Liver transplantation is the only definitive treatment that can reverse HRS at advanced stages.

Patients: the described patients developed severe ascites with insidious renal dysfunction and abnormal sodium-water handling during admission at PICU and fulfilled clinical criteria for HRS. Treated according to the cited principles, all patients showed improvement of GFR, with increased natriuresis and gradual decrease of ascites. Eventually, renal function normalised completely.

Conclusion: HRS deserves greater recognition in the PICU population; diagnosis can be suspected on clinical criteria. With this increased awareness, therapy can be instituted at an early phase, with better prospects for recovery. Positive outcome of HRS depends on early recognition of the clinical picture, understanding of the pathophysiology, and early institution of consistent treatment.

P 107

Methotrexate (MTX) intoxication treated by continuous arteriovenous hemofiltration (CAVH) : two cases report.

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MTX is an antimetabolite widely used as chemotherapeutic agents. High dose MTX (1 to 30g/m²) administered as a prolonged intravenous infusion (over 4-42 hours), is often used to treat malignant paediatric diseases. Major complications of this treatment are myelosuppression, orointestinal mucositis, dermatitis and impairment of renal function. We report two cases of MTX over dosage occurred in two children (5-year-old, 14 month-old) treated for acute lymphoblastic leukaemia. They were treated by CAVH and the MTX blood levels rapidly decreased avoiding multisystemic involvement.

Establishment of alkaline diuresis and monitoring of plasma MTX levels during treatment is essential to prevent nephrotoxicity. However, leucovorin rescue may not prevent the development of potentially lethal toxicities in patients with MTX concentrations persistently exceeding 10mM. In these cases, early treatment of MTX intoxication may prevent myelosuppression and reduce renal damage. The goal is to lower the concentration to below 10 mmol/L, at which time rescue agents alone would be expected to be effective.

Respective indications of these removal methods are still discussed: Haemodialysis and charcoal haemoperfusion should be proposed for massive and acute intoxication. However, rebound has been reported after combined hemodialysis and hemoperfusion. Exchange-transfusion may be proposed as a treatment for prolonged and moderate intoxication. Peritoneal dialysis is an ineffective method for removal of MTX. CAVH was used in our ICU.

CAVH is a simple method for blood purification and body fluid control. Use of CAVH was never be reported in this indication to our knowledge. Simplicity, rapid application and good clinical tolerance are the main advantages of this technique. The technique presents special advantages in terms of low priming volume of extracorporeal circuit, low blood flow, low rate heparinisation. Our results show a decrease of plasma MTX concentration and a rapid reduction of half-life of elimination (15 hours over the period of CAVH). Moreover, we didn't detected rebound after stopping procedure. Small size of the patients may present sometime special problems, but these technical problems can be overcome. No severe complication (bleeding, infection) were observed during filtration.

In summary, aggressive intravenous fluid hydration and alkalinization of the urine coupled with careful monitoring of renal function and plasma MTX concentrations during and after infusion along with leucovorin rescue has reduced the incidence of life-threatening toxicity after high-dose MTX. However, some MTX intoxication still occurred, leading to severe toxicity, particularly nephrotoxicity. In these cases, we think that CAVH (or CAVHD) is a reliable, rapid method without rebound increase in plasma MTX concentration or important adverse effects compared to other procedure removal.

P108

**REMOVAL OF BRANCHED-CHAIN AMINO ACIDS (BCAA)
AND α -KETO-ISOCAPROATE BY HEMOFILTRATION AND
HEMODIAFILTRATION**

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Preliminary limited data suggested that hemofiltration and hemodiafiltration may be valuable in some neonates with decompensation of maple syrup urine disease (MSUD). Venovenous hemofiltration (VVHF) and hemodiafiltration (VVHDF) were performed with a new neonatal hemo(dia)filter (Miniflow 10, Hospal) on 8 anesthetized rabbits infused with branched-chain amino acids (leucine, isoleucine and valine) and α -keto-isocaproate. The BCAA and α -keto-isocaproate blood levels were close to those previously observed in neonates with MSUD when extracorporeal blood purification was required. VVHF and VVHDF performances were assessed with two different blood flows ($Q_b = 8.3$ and 16.6 mL/min). VVHDF was performed with 4 dialysate flow rates ($Q_d = 0.5, 1.0, 2.0$ and 3.0 L/h). Thus, each animal was submitted to 10 successive procedures.

Within each studied period, clearances of the 3 BCAA were strictly similar. BCAA clearances obtained by VVHF were similar to ultrafiltrate rates (respectively, 0.78 ± 0.14 and $1.79 \pm 0.28 \text{ mL/min}$ at high and low Q_b ; $p < 0.05$). The α -keto-isocaproate clearances obtained by VVHF were 0.39 ± 0.17 and $0.92 \pm 0.43 \text{ mL/min}$ at low and high Q_b (not significantly different). Whatever Q_d value, the VVHDF procedures always allowed higher BCAA and α -keto-isocaproate clearances as compared with the corresponding VVHF period with similar Q_b . BCAA clearances obtained by VVHDF with a 0.5 L/h dialysate flow, were $4.1 \pm 0.5 \text{ mL/min}$ and $5.4 \pm 0.5 \text{ mL/min}$ at low and high Q_b , respectively. The concurrent α -keto-isocaproate clearances were $2.5 \pm 0.8 \text{ mL/min}$ and $2.9 \pm 1.0 \text{ mL/min}$.

At both Q_b regimens, BCAA clearances provided by VVHDF were markedly higher than values previously obtained with peritoneal dialysis in human neonates with MSUD.

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P109

PUMPED HAEMOFILTRATION IN SMALL/PRETERM INFANTS

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The management of renal failure in the newborn is difficult. When dialysis is instituted peritoneal dialysis (PD) is usually the technique of choice. This can be problematic and impossible in some patients with pre-existing intra-abdominal pathology. Continuous arterio-venous haemofiltration (CAVH) has been described in infants but sick preterm infants are not able to support the circuit. I have devised a means of having pumped haemofiltration in small/preterm infants (PHIS/PI) and describe its use in nine patients ranging in size from 750 to 3000gms for periods of 1 to 7 days.

Vascular access was achieved through 24 or 22 gauge cannulae in either a peripheral artery and a central vein or through two central veins. Blood was pumped out using an IVAC 572 infusion pump and through a Gambro FH22 haemofilter. A second IVAC pump was used to remove haemofiltrate from the filter and a third to infuse replacement solution. Removal rate was set to give a clearance of $15 \text{ mls/min}/1.73 \text{ sq.m}$ and blood flow rate set to between 5 and 10 times the removal rate. Heparin was infused into the circuit to prevent clotting of the filter.

Biochemical and fluid balance control was achieved in all infants. Guaranteed fluid removal allowed the administration of full nutritional support. Four patients died when treatment was withdrawn because of an untreatable underlying problem. One recovered renal function but died some weeks later from unrelated problems, three survived and recovered renal function and one patient is still on treatment.

This system allows a secure means of achieving fluid and electrolyte control in the preterm infant. The use of this technique may allow haemofiltration to become as applicable to preterm infants as it is to older children and adults.

P110

ACUTE RENAL FAILURE DUE TO FUNGAL URINARY TRACT INFECTION

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Systemic candidiasis is very serious illness in newborns and infants. Fungal pyonephrosis is thought to be very rare condition in this age.

The authors describe diagnostic and therapeutic procedures and course of acute renal failure due to *Candida albicans* pyonephrosis in three infants. Ultrasonography and percutaneous nephrostomy is stressed in the successful management of this condition besides the antifungal drugs administration in all our patients.

Pain/Sedation

P111

NOVALGIN INJECTION - EFFICACY, SAFETY AND SIDE EFFECTS IN THE MANAGEMENT OF ACUTE PAIN IN CHILDREN

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P.GAŠPAREC, K.KAFKOVÁ

INTRODUCTION: Unfortunately, children often receive no treatment, or inadequate treatment for pain and painful procedures. This prospective, multicentric study focuses on the efficacy, safety and side effects of Novalgin (Metamizol sodium) for this indication.

PATIENTS AND METHOD: Novalgin was administered to 56 children, aged between 6-16 years, with acute, postoperative or procedural pain. Novalgin (10-15 mg/kg) was given 6-8 hourly IV or IM respectively, in some cases (15) in combination with opioids (Tramadol 10, Piracetam 3, Butorphanol 2). The pain relief was assessed by six-step Verbal Rating Scale (VRS) from 0 to 5. Vital signs were monitored, the side effects, that occurred were recorded.

RESULTS: Pain relief was good (VRS less 2) in 53 children - 94.6 % of study patients. Novalgin was very well tolerated, only one patient had adverse reaction - hyperpyrexia following intravenous application of the drug.

DISCUSSION: Novalgin (Metamizol sodium) is safe and effective drug in the management of acute pain in children with low incidence of side effects.

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P112

The application of local and intravenous morphine infusion after surgery of urinary tract

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Introduction: Continuous analgesia with morphine may be regarded as a safe and effective method of pain relief during postoperative period.

Subjects and methods: 24 children /mean age 2.3 years/ underwent elective ureteroneoimplantation were randomly selected to receive either morphine intravenously of 10 ug/kg/h /Group One/ or bladder morphine infusion 50 ug/kg/h /Group Two/ after surgery.

All patients were prospectively evaluated during their stay in the postanaesthetic care unit.

Cardiac and respiratory rates, blood pressure, SaO₂ %, degree of alertness, pain perception and complaints of the patients were recorded hourly. Pruritus, nausea and vomiting, voiding difficulties, sedation, dysphoria were systematically sought and quoted. Statistical analysis was performed by chi square test.

Results: Postoperative analgesia was the same in the two groups, but side effects were less in the bladder morphine group, because of the lower serum morphine concentration. The differences weren't significant in two groups.

Conclusions: The administration of bladder morphine infusion is a safe and effective method in children.

P113

A comparison between two sedation scales (COMFORT and HARTWIG) in mechanically ventilated pediatric critical care patients

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Objective: a prospective study comparing simultaneous, independent ratings conducted by intensivists using an american (COMFORT) and an european (HARTWIG) sedation scale for mechanically ventilated pediatric patients.

Measurements and results: the study comprised 30 observations in 18 mechanically ventilated pediatric patients (aged 16 days to 5 years) in a pediatric intensive care unit (from March 1995 to January 1996). Each patient was sedated by his/her managing physician with opiates, benzodiazepines, barbiturates, used isolated or in combination. Each observation consisted of a 3-min period of observation of the patient in his or her pediatric ICU bed. After each observation, the COMFORT (analyses 3 dimensional physiologic and behavioral subscores - range 8 to 40 points) and HARTWIG (analyses 4 dimensional behavioral subscores - range 8 to 25 points) were performed by the intensivist. We established the COMFORT scores¹ corresponding to adequate (range 17 to 26), excessive (range 8 to 16), and inadequate (range 27 to 40) sedation; and, HARTWIG scores² corresponding to adequate (range 15 to 18), excessive (range 8 to 14), and inadequate (range 19 to 25). Statistical analysis³: agreement rate (kappa) and p < .01 was considered significant.

score	adequately sedated	inadequately sedated	too sedated
COMFORT	18 (60.9%)	2 (6.6%)	10 (33.4%)
HARTWIG	17 (56.6%)	7 (23.4%)	6 (20.0%)

To the COMFORT score, the average for adequately sedated, inadequately sedated, and too sedated was 20.28±2.78, 27.5±0.70, and 15.1±1.10, respectively. And to the HARTWIG score, the average for adequately sedated, inadequately sedated, and too sedated was 16.35±0.77, 20.85±1.57, and 13.0±0.89, respectively.

Table 1. Agreement analysis between COMFORT and HARTWIG scores.

HARTWIG/COMFORT	TS	AS	IS	Total
too sedated (TS)	5	3	0	8
adequately sedated (AS)	5	12	0	17
inadequately sedated (IS)	0	3	2	5
Total	10	18	2	30

agreement observed: 63%; p = 0.006; waiting chance for agreement: 44%; Kappa coefficient: 0.345238; z = 2.49

Conclusion: in our study there were no significantly statistical difference when you apply a more complex scale (COMFORT) or a less complex scale (HARTWIG) to assess the sedation of mechanically ventilated pediatric patients.

¹ Marx C, Smith PG, Lowrie LH, et al. Crit Care Med. 1994; 22: 163-170.

² Hartwig S, Roth B, Theison M, et al. Eur J Pediatr. 1991; 150: 784 - 788.

³ Fleiss JL. In: Statistical methods for rates and proportions, 2nd ed., Ed. John Wiley & Sons. 1981, 212 - 225.

P114

SEDATION IN PEDIATRIC INTENSIVE CARE UNIT: COMPARISON BETWEEN TWO SCALES MADE BY PHYSICIANS AND NURSES.

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Objetive: compare the evaluations of sedation level made by physicians and nurses with the Visual Analog Scale (VAS) and the COMFORT Scale (CS) in pediatrics patients receiving different modes of intravenous sedation.

Material & Method: the evaluations were made by an attending physician and nurse with the VAS and by another physician (always the same) using the CS.

The observations were divided following the sedation mode: one drug (Fentanyl or Midazolan), two continuous drugs, one continuous and one intermittent drug and two intermittent drug (Fentanyl and Midazolan).

The groups were compared using the t-Student test. The groups also were compared between the percentual of agreement of the evaluations of sedation level made by physicians and nurses with the CS and VAS using the χ^2 .

Results: we didn't find any statistical difference between the observations made by physicians and nurses with the VAS in the different modes of intravenous sedation.

The average of the observations using the CS between one drug and two drugs modes didn't exhibit also statistical difference.

The observations made by physicians and nurses using the VAS when compared with the CS didn't show statistical difference between the sedation level.

We found statistical difference only in percentual of concordance of sedation level between physicians and nurses when compared the one and two drugs modes of sedation.

Conclusion: we didn't find differences in the observations made by physicians and nurses in the sedation level, only in concordance percentual of observations when compared two modes of sedation. The observations using the CS (more complex) didn't show differences when compared with the VAS.

Pharmacology

P115

ANALYSIS OF THE VARIABILITY IN THE PHARMACOKINETICS (PK) AND PHARMACODYNAMICS(PD) OF BUMETANIDE(B) IN CRITICALLY ILL INFANTS. J.E.Sullivan MD, M.K.Witte MD, T.S Yamashita PhD, C.Myers PhD, J.L.Blumer PhD,MD, CWRU, RainbowBabies&ChildrensHosp,Dept.of Pediatrics,Cleveland, OH.

Effects of age, concurrent administration of other pharmacologic agents, and disease [cardiac(n=31) & pulmonary(n=22)] on the PK & PD of B were evaluated in volume overloaded infants aged 4 days-6 mo (n=53). Single doses of 0.005,0.01,0.015,0.02,0.025, 0.03, 0.035,0.05 & 0.10 mg/kg IV were given over 1-2 min after baseline evaluation. Age was used as a continuous variable to determine its effects on the variability in the PK & PD of B. Values for PK parameters were compared between patients in cardiac and pulmonary disease groups. Hierarchical multiple regression analyses were used to determine the effects of age, disease and other pharmacologic agents on the variability of bumetanide excretion rate (BER) and PD responses, e.g. urine flow rate (UFR) & electrolyte excretion. Cl_t , Cl_r & Cl_{nr} increased with age ($p<0.05$) while $t_{1/2}$ decreased markedly in the first month of life ($p<0.05$). BER normalized for dose increased with increasing age. Patients with pulmonary disease exhibited significantly greater clearance and shorter $t_{1/2}$ ($p<0.05$) than those with cardiac disease whereas V_{dss} was similar in both groups. The administered dose of B was the primary determinant of BER but increasing age also contributed. Penicillin antibiotics decreased BER. Dose response curves for UFR and electrolyte excretion were similar between disease groups. More of the variability in BER and PD responses could be accounted for in the pulmonary group than the cardiac group but this was not statistically significant. Conclusion: The PK of bumetanide were influenced significantly by age and disease. Differences in PK between patients with pulmonary and cardiac disease were primarily due to differences in total clearance. Age and the administered dose of B were positive determinants of BER and PD responses while penicillin antibiotics had a negative impact on both. Once B reached its site of action, no differences in PD responses were detected between disease groups.

P116

DOSE-RANGING EVALUATION OF BUMETANIDE PHARMACODYNAMICS IN CRITICALLY ILL INFANTS. J.E.Sullivan MD, M.K.Witte MD, T.S Yamashita PhD, C.Myers PhD, J.L.Blumer PhD, MD, CWRU, Rainbow Babies & Childrens Hospital, Dept. of Pediatrics, Cleveland, OH.

The pharmacodynamic effects of bumetanide were evaluated in volume overloaded infants (n=56) aged 4 days-6 months. Single doses of 0.005, 0.01, 0.015, 0.02, 0.025, 0.03, 0.035, 0.05 & 0.10 mg/kg IV were given over 1-2 min. Bumetanide concentration in blood (n=10) & urine (n=6) samples were quantified by HPLC. Baseline urine samples were collected over 2-4 hours prior to drug administration. Determinations of urine volume, electrolytes (Na^+ , K^+ , Cl^- , Ca^{++} and Mg^{++}), creatinine and osmolality were performed before and at 0-1, 1-2, 2-3, 3-4, 4-6 and 6-12 hours after bumetanide dosing. Changes in urine flow rate and electrolyte excretion were plotted as a function of bumetanide excretion rate which was considered the effective dose of the drug. Peak bumetanide excretion rate increased linearly with increasing doses of drug and showed no evidence of approaching a maximum. Time course patterns for urine flow rate and electrolyte excretion were similar for all dosage groups. Urine flow rate and electrolyte excretion increased linearly up to a bumetanide excretion rate of approximately 7 $\mu\text{g}/\text{kg}/\text{hr}$ and either plateaued (urine flow rate) or declined at bumetanide excretion rates > 10 $\mu\text{g}/\text{kg}/\text{hr}$. Bumetanide had no detectable effect on serum electrolyte concentrations.

Conclusion: Maximal diuretic responses occurred at a bumetanide excretion rate of about 7 $\mu\text{g}/\text{kg}/\text{hr}$. Higher bumetanide excretion rates produced no increased diuretic effect. Peak bumetanide excretion rate of about 7 $\mu\text{g}/\text{kg}/\text{hr}$ corresponded to bumetanide doses of 0.035-0.050 mg/kg.

P117

PHARMACOKINETICS OF BUMETANIDE IN CRITICALLY ILL INFANTS. J.E.Sullivan MD, M.K.Witte MD, T.S Yamashita PhD, C.Myers PhD, J.L.Blumer PhD, MD, CWRU, Rainbow Babies & Childrens Hospital, Dept. of Pediatrics, Cleveland, OH.

The pharmacokinetics of bumetanide were evaluated in volume overloaded infants (n=58) aged 4 days-6 mo. Single doses of 0.005, 0.01, 0.015, 0.02, 0.025, 0.03, 0.035, 0.05 & 0.10 mg/kg IV were given over 1-2 min after baseline evaluation (hematologic and serum chemistry studies). Bumetanide concentration in blood (n=10) & urine (n=6) samples were quantified by HPLC. Noncompartmental pharmacokinetics revealed:

$V_{dss}(\text{L/kg})$	$V_{dss}(\text{L/kg})$	$Cl_t(\text{ml}/\text{min}/\text{kg})$	$Cl_r(\text{ml}/\text{min}/\text{kg})$	$t_{1/2}(\text{hrs})$
0.39 ± 0.21	0.29 ± 0.12	2.74 ± 1.95	1.10 ± 0.86	2.34 ± 1.41

Peak serum concentrations occurred at the first post-dose sample (5 minutes) following bumetanide administration in most patients. AUC and peak serum bumetanide concentrations showed linear increases over the 20-fold dose range whereas V_{dss} , V_{dss} , Cl_t , Cl_r and $t_{1/2}$ were independent of dose. Peak urinary excretion rates of bumetanide increased linearly with increasing doses. The mean percent of bumetanide recovered in the urine from 0-12 hrs was $40 \pm 15\%$.

Conclusion: Distribution and elimination kinetics were similar in all patients. Elimination kinetics were first-order over the dose range of 0.005-0.10 mg/kg. Pharmacokinetic parameter estimates (V_{dss} , V_{dss} , Cl_t , Cl_r , and $t_{1/2}$) were independent of the dose of bumetanide administered. Single doses of bumetanide up to 0.10 mg/kg appear to be well tolerated in acutely ill volume-overloaded infants aged 0-6 months.

P118

TITLE: Evaluation of Different Methods of Teicoplanine (Teico) Infusion In Neonates Using An Electrical Syringe-Pump.

authors: Tréluyer J.M., Sertin A., Bastard V., Settegrana, C., Bourget P., Hubert P.

Background and objective: many problems can be observed with drug administration by i.v. route, especially in neonates. So we evaluate different protocols of Teico delivery using an electrical syringe-pump.

Methods: we simulate infusion of Teico with a syringe-pump (Pilot C, Becton & Dickinson Lab.) trough a standart neonatal I.V. system. For 2 weights (1 or 3 kg) we used 2 doses of Teico (8 mg and 16 mg/kg) and a dose volume ≤ 4.2 mL. Our goal was to perform a complete infusion in 10 minutes. The infusion system consisted of an Life Care 4 infusion pump (ABBOTT Lab.) with its I.V. set for maintenance intravenous fluid (flow ≤ 6 mL/h) connected to a 3-way stopcock. An 1 meter extension tubing was placed between the stopcock and a neonatal catheter. An another 1 meter tubing (injection tubing) connected the Teicoplanine syringe to the stopcock. The volume of the injection circuit (from the syringe to the distal part of the catheter was 2.6 mL. 4 methods of injections were assessed: A: Injection of the predetermined volume of Teico in 10 minutes with no wash out. B: Idem as A but the Teico was injected in 5 minutes, followed by a wash out (5 ml / 5 minutes). C: Twice the required volume was introduced in the syringe and the volume to infuse was programmed in 5 minutes, followed by a wash out (5 ml / 5 minutes). D: Idem as C but a priming was performed before connecting the Teico syringe to the tubing. During each run, serial samples were collected every ten minutes over a one hour period. The samples were assessed using HPLC method.

Results: the amount of drug delivered at 10 minutes were calculated. The results are a mean of 2 to 6 runs and expressed as the percentage of the total amount of Teico prescribed.

	1 Kg	3 Kg
A	2,8 %	6,4 %
B	47 %	62,3 %
C	82,4 %	86,8 %
D	94,2 %	95 %

Conclusion: for accurate and reliable intermittent drug infusion with a syringe pump it is mandatory to use a precise protocol of administration and to take in account 1) a priming (for immediate starting of infusion), 2) a drug volume greater than the dose prescribed and a programmed volume injected, 3) a wash out of the tubing (with a volume $\geq 1,5 \times$ volume of tubing injection)

P119

THE PHARMACOKINETICS OF CEFTAZIDIME (CAZ) DURING THE THIRD WEEK OF LIFE IN THE PRETERM INFANT.
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Introduction

CAZ is an antibiotic with activity against the major pathogens responsible for neonatal bacterial infections. We previously reported the pharmacokinetics of CAZ in 136 preterm infants on day 3 of life which showed that the clearance of CAZ increased with increasing gestational age (GA). Mean serum half-life of infants with GAs < 32 wks was 8.7 h. We wanted to investigate the effect of postnatal age on CAZ pharmacokinetics.

Methods

We therefore studied CAZ pharmacokinetics on day 19-21 of life in 10 preterm infants with GAs < 32 wks. CAZ (25 mg/kg) was administered as an intravenous bolus injection. Blood samples were collected before ($t=0$), and 0.5,1,2,4,8 and 12 h after the CAZ dose and analyzed by HPLC-assay. The pharmacokinetics of CAZ followed a one-compartment open model.

Results: mean \pm SD

Gestational age (wks)	28.8 \pm 2.3
Study weight (g)	1304 \pm 386
Serum half-life (h)	3.61 \pm 0.65
Volume of distribution (ml)	434 \pm 194
Total body clearance (ml/h)	86.4 \pm 44.0

Conclusions

- Mean serum half-life of CAZ decreased from 8.7 h to 3.6 h between day 3 and day 19-21 of life.
- This rapid postnatal decrease in serum half-life is not dependent on gestational age.
- This rapid decrease in serum half-life enables a dosing frequency of twice daily in preterm infants with GAs < 32 wks during the third week of life.

P120

SINGLE DOSE PHARMACOKINETICS OF MEROPENEM (MEM) IN PRETERM INFANTS.
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Introduction

MEM is a recently developed carbapenem antibiotic with broad spectrum activity against many Gram-positive and Gram-negative bacteria. Despite the introduction of MEM in neonatal intensive care units studies in newborns have previously not been performed.

Methods

We therefore studied the pharmacokinetics of MEM in 24 preterm infants (gestational ages 32.2 \pm 2.2 wks, postnatal ages 10.9 \pm 7.9 days). MEM (10, 20 or 40 mg/kg) was administered as a 30-minute intravenous infusion. Blood samples were collected before ($t=0$) and 0.25, 0.5, 0.75, 1, 2, 4, 8, 12 and 24 h after the MEM dose and analyzed by reversed phase HPLC using UV detection. Pharmacokinetic parameters were calculated by noncompartmental methods.

Results: mean \pm SD

Serum half-life (h)	2.95 \pm 0.78
Volume of distribution (ml/kg)	440 \pm 139
Total body clearance (ml/h/kg)	119 \pm 42

Conclusions

- Preterm infants have lower clearances, increased volumes of distribution, and longer serum half-lives compared to children and adults, which is in agreement with the known physiological status of preterm infants.
- Preterm infants need a less frequent dosing regimen of MEM than children and adults based on these pharmacokinetic data. Twice daily dosing (3-4 times the serum half-life) seems appropriate.

P121

ONCE-DAILY DOSING OF GENTAMICIN IN CRITICALLY ILL PEDIATRIC PATIENTS.
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Objective: to examine a once-daily dosing regimen of gentamicin in critically ill children in relation to serum levels.

Design and setting: open, prospective study on 50 antibiotic courses with gentamicin in 46 critically ill children, hospitalized in a multidisciplinary pediatric intensive care unit. For combined empiric antibiotic therapy

(aminoglycoside and beta-lactam) gentamicin was given intravenously over 30 min once every 24 hours. The dose ranged from 3.0 - 5.0 mg/kg, depending upon gestational and postnatal age. Peak levels were determined by immuno assay 30 min after the second dose and trough levels 1 hour before the third dose.

Results: 32 of 34 peak levels (94%) were clearly above 5 μ g/ml (mean 8.2, range 4.3 - 16.1 μ g/ml), two peak levels were subtherapeutic in conjunction with extreme capillary leak. 48 of 50 trough levels (96%) were within desired limits (< 2 μ g/ml) 2 were above 2 μ mol/l in conjunction with impaired renal function.

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Cardiac surgery

P122

Outcomes after Delayed Sternal Closure in Pediatric Heart Surgery

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One hundred and fifty consecutive cases of delayed sternal closure after cardiac surgery in infants and children between 1986 and 1995 were retrospectively reviewed. Diagnoses included Transposition of the Great Arteries (66), Total Anomalous Pulmonary Venous Drainage (11), Complete Atrio-Ventricular Septal Defects (10), Truncus Arteriosus (9), and other cardiac lesions (54). Age at surgery was 229 +/- 51 days (mean +/- Standard Error of the Mean), median age was 21 days. Weight at surgery was 4.8 +/- 0.3 kg (mean +/- SEM), median weight was 3.5 kg. Five of these patients required ECMO. 133 patients (88%) survived and were discharged from the hospital. The sternum was left open 3.86 +/- 0.29 days (mean +/- SEM; range = 1-33 days). Days of ventilation after sternal closure was 6.2 +/- 1.0 (mean +/- SEM). Stay in hospital after sternal closure was 17.6 days +/- 1.7 days (mean +/- SEM). Fifteen patients had minor wound infections requiring antibiotics. No patient required reexploration for mediastinitis. We conclude that delayed sternal closure with stenting of the sternum and silastic membrane skin closure is a safe and useful procedure, particularly in sick infants with compromised cardiac output after repair of complex congenital cardiac defects.

P123

PALLIATIVE SURGICAL REPAIR IN NEWBORNS WITH FUNCTIONAL SINGLE VENTRICLE - ASPECTS OF PERIOPERATIVE MANAGEMENT. Thul J., Wippermann F., Huth R., Michel-Behnke I., Schmid FX., Schranz D.

During 1995 11 newborns with complex congenital heart defects requiring either HTX or palliative staged single ventricle repair were admitted to our hospital: HLH n=8, unbalanced CAVSD, TGA with hypopl. RV and hypoplastic AOA. TGA with hypopl. RV, SAS and dextrocardia.

8/11 children had been admitted with cardiogenic shock and multiorgan failure due to intermittent closure of Ductus arteriosus; in 3/8 stabilization failed.

Parents were informed about the known and unknown risks of the always palliative surgery; in 2 cases parents denied further therapy.

One patient with HLH underwent orthotopic HTX at the age of 5 month after the Ductus art. had been stented in the newborn period. 9 month later he is still in favourable condition and without any sign of acute organ rejection.

5/11 underwent first stage of palliative single ventricle repair: Norwood - Op. (3) (n=3), Damus-Kaye-Stansel - Procedure (2). The clue to adequate postoperative management was to achieve a balanced distribution of flow to systemic and pulm. circulation, that is to protect the single ventricle from volume overload and to guarantee sufficient oxygenation and pulmonary development as well. With the centralvenous SatO₂ at about 50% provided maintaining the arterial SatO₂ at about 75±5% is corresponding with a Qp/Qs of 1:1. Using modified BT- shunts of 3.5mm resp. a central aortopulm. shunt of 4mm in one case (severe pulm. hypertension, surgery at 6 weeks of age) there was no excessive pulm. blood flow and no need to increase PVR with inspired CO₂. One child (Norwood at 5 weeks , preexisting pulm. edema) developed severe pulm. hypertension and parenchymal pulm. dysfunction after prolonged bypass and multiple transfusions due to intraoperative bleeding; hypoxemia could be managed successfully by implanting a second shunt of 4mm 18hh later and temporarily using Prostacyclin and NO; at sternum closure 6 dd later the second shunt was banded to 3mm. Follow up ranges 1-5 month: all 5 children are at home being assigned for second stage operation at about 6 month of age.

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P124

LENGTH OF MECHANICAL VENTILATION AND ICU LENGTH OF STAY FOR CHILDREN FOLLOWING CARDIOTHORACIC SURGERY FOR CONGENITAL HEART DISEASE. N.R. Patel and C.J.L. Newth, Childrens Hospital Los Angeles, Division of Pediatric Critical Care, Los Angeles CA, USA, 90027

Establishing clinical practice guidelines has become increasingly important in the current health care environment. Significant effort has been focused upon development of post-operative critical care pathways. However, benchmark data upon which such pathways should be based has not been well reported. Length of mechanical ventilation (LMV) and length of stay (LOS) for children following cardiac surgery, for example, is poorly described. We prospectively recorded the LMV and LOS in 168 patients who underwent cardiothoracic surgery between 9/1/93 to 6/30/95. Only patients who belonged in any one of five categories of congenital heart disease (ventricular septal defect +/- other septal defects (VSD), atrioventricular (AV) canal, Tetralogy of Fallot (TOF), transposition of great arteries (TGA), and single ventricle physiology (Fontan)) were included. Eight non-survivors were excluded from the analysis. All patients were admitted to an Intensive Care Unit (ICU) post-operatively where mechanical ventilation was managed by 4 pediatric intensivists. LMV was defined as the period from post-operative admission to planned extubation. Length of stay (LOS) was defined to be from day of surgery to day of discharge from the ICU.

Type of Repair	No. of Cases	Mean Age	Mean LMV		Mean LOS
		mos +/- SEM	hrs +/- SEM	days +/- SEM	days +/- SEM
VSD	77	29 +/- 5	26 +/- 3	1.1 +/- 0.1	2.8 +/- 0.3
AV Canal	19	6 +/- 1	70 +/- 17	2.9 +/- 0.7	5.1 +/- 0.8
TOF	30	26 +/- 6	41 +/- 7	1.7 +/- 0.3	3.2 +/- 0.4
TGA	22	<1	117 +/- 14	4.9 +/- 0.6	6.9 +/- 0.8
Fontan	12	73 +/- 12	79 +/- 31	3.3 +/- 1.3	7.6 +/- 2.5

11 of 160 patients had an extubation failure (reintubation required within 12 hours of extubation). There were no unplanned extubations.

Conclusion: Documentation of actual medical practice is essential for the establishment of appropriate benchmarks in critical care upon which clinical practice guidelines can be rationally developed.

P125

Cytokine patterns during and after cardiac surgery in young children.

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Especially in children, cardiac surgery with cardiopulmonary bypass (CPB) can cause a systemic inflammatory response. This process is thought to be mainly a result of inflammation induced by surgery and exposure of blood to an artificial surface, and of reperfusion injury during weaning of bypass. Complement activation, degranulation of granulocytes, induction of free oxygen radicals, endotoxemia and release of cytokines, are important contributing factors. We studied cytokine patterns before, during and after CPB in young children admitted for complex surgery or for septal defect correction. In the first group, significant amounts of IL-6 and IL-1ra could be detected preoperatively. These findings could reflect the already existing hemodynamic dysregulation. In both groups, CPB procedure upregulated the circulating pro-inflammatory cytokines IL-6/8, but not IL-18. At the same time, IL-1ra became detectable. Therefore, we suggest that in these patients the production of the anti-inflammatory cytokine IL-1ra was not induced by the preceding activity of pro-inflammatory cytokines. During CPB, we noticed a sharp decline in the capacity of the leucocytes to secrete IL-6/8. The ex-vivo production of IL-1ra however, was only slightly attenuated. We conclude that there is a differential regulatory pathway for the induction of IL-6/8 and IL-1ra. In addition, we studied the influence of dexamethasone administration on the cytokine pattern. Administration delayed the appearance of IL-6/8 and IL-1ra in the plasma. Interestingly, it did only interfere with the ex-vivo production of pro-inflammatory cytokines. The latter supports our hypothesis that production of IL-6/8 and of IL-1ra is regulated by two independent pathways.

P126**METABOLIC ALKALOSIS IN CHILDREN FOLLOWING CARDIAC SURGERY WITH CARDIOPULMONARY BYPASS**

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Our anecdotal experience has been that children undergoing open-heart surgery often develop metabolic alkalosis in the postoperative period. Their risk factors include diuretic use, exposure to citrated blood products, and cardiopulmonary bypass. This retrospective and prospective study was designed to evaluate the frequency and pathogenesis of postoperative metabolic alkalosis in children undergoing open-heart surgery.

Patients: Retrospective: 43 patients (age: 22 pts. < 12 and 21 pts. > 12 months); Prospective: 30 patients (age: 12 pts < 12 and 18 pts. > 12 months).

Results: I. retrospective study: Metabolic alkalosis occurred in 26 pts. (60%) of 43 pts. 82% of pts < 12 months of age developed metabolic alkalosis as compared with 38% of pts > 12 months of age. The infants with metabolic alkalosis received more citrated blood products and furosemide. Following cardiac pulmonary bypass the highest pH-values and BE-values were observed 24-48 hours and 48-72 hours, respectively.

II. prospective study: Metabolic alkalosis was registered in 21 children (70%), 8 of those <12 month (75%) developed metabolic alkalosis and 67% of those older than 12 months. During the postoperative course patients younger than 12 months developed the highest pH- and base excess values after 102 and 105 hours, in the subset of the older patients maximum pH and base excess was found after 48 and 81 hours, respectively. In one case the top level of pH-value exceeded 7.6, the base excess +20 mval/l.

Conclusion: Children undergoing cardiac surgery with cardiopulmonary bypass often develop metabolic alkalosis. In contrast to previous reports, we did not observe an association between metabolic alkalosis and mortality, nor greater frequency of cardiac arrhythmias or prolonged mechanical ventilation. In context with decreasing serum lactate levels, our data show positive correlation of metabolic alkalosis with postoperative improvement of liver function.

P127**TRANSAMINASE HEPATIC ALTERATIONS AFTER CARDIAC SURGERY IN CHILDREN**

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Objective: To analyse the incidence, risk factors and repercussion of transaminase hepatic alterations in children after cardiac surgery.

Patients and methods: We have studied prospectively 201 children, (112 boys and 89 girls), aged between 3 days and 17 years (mean 3.4 years, after cardiac surgery. Operations were 137 (68 %) cardiopulmonary bypass procedures and 64 (32 %) without cardiopulmonary bypass. We defined transaminase hepatic alteration (THA) as ALT > 100 U/L. Shock was defined as severe hypotension that need volume expansion and inotropic drugs (dopamine < 20 mcg/kg/min and/or adrenaline > 0.3 mcg/kg/min). Acute Renal Failure was defined as creatinine twice normal values and/or to need dialysis techniques.

Results: 20 children (10%) showed ALT > 100 U/L (range 100 - 3320 U/L), eight (12.5 %) of patients without cardiopulmonary bypass, and 12 (8.8 %) with bypass (non significant). 44 patients presented shock (22 %). 23 % of patients with shock showed THA, and only 6 % of patients without shock ($p < 0.01$). 33 patients (16.5 %) presented acute renal failure (ARF). 27 % of children with ARF showed THA and only a 6 % of patients without renal failure ($p < 0.01$). Total mortality was 9.4 % (19/201). The mortality in patients with THA was 35 % and 6.5 % in the rest of patients ($p < 0.01$).

Conclusions: 1. Transaminase hepatic alteration is frequent after cardiac surgery in children.
2. THA is related with shock and renal failure.
3. THA can be a marker of potential clinical importance after cardiac surgery in children.

P128**Respiratory mechanics and weaning outcome in children undergoing cardiovascular surgery**

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Mechanical ventilation (MV) and acute respiratory failure are common events in children undergoing cardiovascular surgery (CVS). The development of new techniques helped to measure some of the main respiratory mechanics (RM) in a non invasive fashion. Our goal was to evaluate the predictive value of these measurements in weaning (W) outcome in these patients.

Patients and methods: we prospectively evaluated children considered clinically to be ready for W with < 20 kg and > 24 hs MV. Patients with diaphragm paralysis and those who failed W because of upper airway obstruction were excluded. Before patient extubation the following measurements were recorded during spontaneous ventilation (CPAP/T piece) using the CP 100 Neonatal Pulmonary Monitor BICOIRE (Irvine, CA): total respiratory system static compliance (CSSR) and resistance (RTS), rapid shallow breathing index (RSBI). Maximal inspiratory negative pressure (Pi max) was measured using an unidirectional expiratory valve. Threshold values predicting W success (Ws) were: CSSR > 0.5 ml/cm H₂O, RTS < 75 cm H₂O /L/sec, RSBI 160 and Pi max > -30 cm H₂O. W failures (WF) = patient reintubation within the following 48 hs. These values were compared between W success and failures using Fisher exact test. An *a priori* level of statistical significance was chosen at $p < 0.05$.

Results:

n	age(m)	weight	MV (hs)	CSSR	RTS	Primax	RSV/kg	p	
Ws 25	18.4±28	7±3.7	144±159	0.72±0.3	93±96	54.4±16	529±460	NS	
WF 4	10.2±13	4±1.4	570±830	0.5	59	44±31	7	584±843	NS

* Not all predictors were measured in all the patients.

Conclusions: These respiratory RM measurements were not useful in predicting W success in these patients. Using our clinical criteria a low number of children failed extubation. The small number of patients in each group (n estimated 134) may bias our results.

P129**SERUM TUMOR NECROSIS FACTOR IN CHILDREN AFTER CARDIOPULMONARY BYPASS**

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Introduction: Cardiopulmonary Bypass (CPB) induces a whole body inflammatory response which has been associated with postoperative organic dysfunction and may contribute to the high morbidity found in these patients. Tumor necrosis factor alpha (TNF- α) has been implicated in this mechanism.

Patients and methods: We investigated serum TNF- α levels from 20 children with congenital heart disease (10 boys and 10 girls), aged from 7 days to 14 years, undergoing open heart surgery. Serum TNF- α levels were measured before CPB (A), upon arrival to the PICU (pediatric intensive care unit) (B), 24 hours after CPB (C) and 72 hours after CPB (D). Patients were divided in 3 groups: group I: n=6, age < 1 month (mean 0.46±0.26 months); group II: n=8, age from 4.5 to 40 months (mean 19.8±15 months); group III: n=6, age from 50 to 170 months (mean 98.0±47.9 months). Serum specimens were frozen and TNF- α values were determined by ELISA in simultaneous assay.

Results: Serum TNF- α levels in the different moments and groups were:

Group	A	B	C	D
I	7.05±4.4	10.83±3.54	8.06±1.92	12.79±5.24
II	6.85±2.29	9.83±3.63	6.03±1.89	5.26±1.75
III	6.43±3.41	8.72±3.25	4.82±2.76	4.04±1.13
Total	6.77±3.1	9.8±3.41	6.28±2.44	7.15±4.82

Globally considered, an increase in TNF- α levels is observed after cardiac surgery ($p < 0.001$) with a return to previous values after 24 hours ($p < 0.005$). 72 hours after CPB, similar values are observed in groups II and III, but there is a further increase in serum TNF- α levels in group I when compared with both other groups ($p < 0.03$). We found no statistically differences in any other moment. There was a significant correlation between serum TNF- α levels determined 72 hours after surgery and CPB duration ($p < 0.003$).

Conclusions: CPB in childhood provokes a significant increase in serum TNF- α levels. In newborns the inflammatory response is maintained 72 hours after surgery. This enhancement of serum TNF- α levels indicates the existence of a relevant inflammatory response in these patients.

P130**DISSOCIATED BEHAVIOUR OF IL-1 β AND IL-6 AFTER CARDIAC SURGERY IN CHILDREN.**

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Introduction: Cardiac surgery appears to induce a systemic inflammatory response. We have investigated the behaviour of IL-1 β and IL-6 before and after cardiac surgery.

Patients and methods: We studied serum IL-1 β and IL-6 levels from 20 children with congenital heart disease (10 boys and 10 girls), aged from 7 days to 14 years, undergoing open heart surgery, before CPB (D). Patients were divided in 3 groups: group I: n=6, age < 1 month (mean 0.46 ± 0.26 months); group II: n=8, age from 4.5 to 40 months (mean 19.8 ± 15 months); group III: n=6, age from 50 to 170 months (mean 98.0 ± 47.9 months).

Results: Serum IL-1 β and IL-6 levels (pg/ml) were:

		A	B	C	D
I	IL-1 IL-6	1.13 ± 0.91 21.8 ± 22.3	2.28 ± 2.09 237.8 ± 86.7	0.95 ± 0.5 226.6 ± 90.2	0.79 ± 0.5 70.5 ± 31.5
II	IL-1 IL-6	0.83 ± 0.43 1.6 ± 2.4	2.21 ± 2.08 203.5 ± 66.2	2.1 ± 1.59 173.4 ± 96.6	1.87 ± 1.22 46.5 ± 23.9
III	IL-1 IL-6	2.73 ± 3.42 0.01 ± 0	1.98 ± 2.14 170.1 ± 95.4	1.38 ± 1.57 95.6 ± 81.0	1.37 ± 1.56 34.61 ± 31.9
Tot	IL-1 IL-6	1.5 ± 2.06 6.4 ± 14.2	2.16 ± 1.99 203.7 ± 81.9	1.54 ± 1.38 166 ± 100.3	1.39 ± 1.21 50.21 ± 30.9

We found no statistically differences in the IL-1 levels in the different groups and moments. There is a significant increase in IL-6 immediately after surgery ($p < 0.01$) with similar levels 24 hours after CPB and a significant decrease ($p < 0.01$) 72 hours after CPB. Preoperative IL-6 levels were higher in the groups I and II than in group III ($p < 0.05$). 24 hours after CPB serum IL-6 levels in group I were significantly higher when compared with group III ($p < 0.05$).

Conclusions: CPB in childhood induces a significant transient increase in serum IL-6 levels, strongly relevant in newborns. CPB was not associated to a significant modification in serum IL-1 β levels. Thus, CPB in childhood induces a dissociated behaviour in the proinflammatory IL-6 and IL-1 β pathways.

Neonatology

P 131

EFFECTS OF ANTENATAL MATERNAL GLUCOCORTICOIDS (AMG) ON IMMATURE OUTBORN NEONATES

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Objective. To evaluate the effects of AMG receipt on the clinical condition during the first 12 hours after birth (¹²), the morbidity and mortality in immature outborn neonates.

Methods. We studied 44 outborn neonates with GA 26 to 29 wks, admitted during the years 1993 to 1995. Eighteen neonates exposed to AMG (GA:27.6±1wks, BW: 1066±195g) and 26 neonates did not (GA: 27.7±1wks, BW: 1042±187g).

Results. AMG-exposed neonates compared to those not exposed had lower incidence of Apgar score at 5 min ≤ 3 (6% vs 35%, p<.05), lower incidence of PH¹² <7.20 (11% vs 48%, p<.05), decrease need of bicarbonate¹² (22% vs 54%, p<.05), lower FiO₂¹² (FiO₂^{12min}>40: 17% vs 48%, p<.05 and FiO₂^{12max} >80: 17% vs 52%, p<.05), lower incidence of intubation (67% vs 92%, p<.05), lower requirements of surfactant (50% vs 79%, p<.05) and lower mortality (11% vs 50% p<.01). There were no differences between the two groups for the following parameters: type of delivery, hypothermia hypoglycemia and anemia during admission, hypernatremia, hypotension¹² (MAP<30mmHg), need of dopamine and or plasma¹², incidences of PTX PDA sepsis NEC severe ROP major IVH (plus PVL) and BPD and duration of intubation.

Conclusions. The main beneficial effects of AMG receipt on the immature outborn neonates were the decrease of mortality and the decrease of surfactant need. There was no effect of AMG receipt upon other severe morbidity in this high risk group of neonates.

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INFANTILE INTRACRANIAL HEMORRHAGE - LATE HEMORRHAGIC DISEASE OF THE NEWBORN

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Infantile intracranial hemorrhage is the most frequent and serious manifestation of late hemorrhagic disease of the newborn caused by vitamin K deficiency in early infancy.

In the last two years, we recorded five cases of infantile intracranial hemorrhage due to vitamin K deficiency, despite routine prophylaxis (intramuscular Vitamin K, 1 mg), with typical clinical presentation: age was 18 - 65 days (average 40 days); vomiting, poor feeding, lethargy/irritability, palor, bulging fontanelle and convulsions were present in most cases. Two patients developed signs of hemorrhagic shock, with hemoglobin level less than 70 g/l. In 3.5 F VII level was less than 30 % of predicted value. There was no evidence of head trauma or liver disease in none of patients. Four infants were breast fed, while one, who had diarrheal disease, was on adapted milk formula.

Routine therapy was given (including Vitamin K and fresh frozen plasma). Two patients were discharged with no sequelae, one developed posthemorrhagic hydrocephalus as a complication and two patients died.

Late hemorrhagic disease of the newborn is still a significant cause of morbidity and mortality in early infancy, despite different approaches to prophylaxis developed in recent years.

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Department of Gynecology and Obstetrics - Skopje, Macedonia HAEMORRHAGIO INTRACRANIALIS AND PREMATURITY

Elizabeta Zisovska, J.Vragotero

Premature babies are very sensitive on homeostatic disturbances, and often develop intracranial haemorrhage (ICH). Ultrasound scan of the brain shows four grades of ICH:

- Grade I - only periventricular hyperechogenic areas
- Grade II - haemorrhage into the lateral ventricles
- Grade III - dilated lateral ventricles
- Grade IV - intracerebral haemorrhage.

The purposes of this study were:

1. To show the incidence of ICH in premature babies and its correlation with the gestational age,
2. To determine the severity of ICH
3. To present the outcome of those babies.

In the study were included 393 premature babies successively born at the Department of Gynecology and Obstetrics before 37 gestational week (g.w.) and grouped in three groups: less than 28 g.w., 28-32 g.w., 33-36 g.w. To all of them was performed ultrasound scan of the brain.

Results :

1. The incidence of ICH in premature babies is 49 % and there is high level of correlation with the gestational age:

- Babies born before 28th g.w. have 100% incidence of ICH and graduated : I grade - 5%, II grade - 65%, III grade - 25%, IV grade - 5%
- Babies old between 28-32 g.w. have incidence of 61% : I grade - 24%, II grade - 62%, III grade - 14%.
- Babies older than 32 g.w. have incidence of 33%: I grade - 46%, II grade 48%, III grade - 6%

2. Sixty of 393 premature babies have died and it is 15.2% lethality. In all died infant was confirmed the grade of ICH diagnosed by ultrasound scan of the brain.

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NEONATAL HEARING SCREENING IN AT RISK NEWBORNS.

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Background: Neonatal hearing screening in at risk newborns can detect 50% of the children with a congenital hearing loss. Automated ABR hearing screening (ALGO-1) has been introduced for healthy newborns. The aim of this study is to test the validity of this ALGO-1 screener in at risk newborns in a neonatal intensive care unit.

Subjects: 250 at risk newborns (median gest.age: 30.0 wks, median birthweight 1350 g) selected according to the criteria of the American Joint Committee on Infant Hearing.

Interventions: ALGO-1 automated ABR-hearing screening at a level of 35 dB was performed in the neonatal intensive care unit. When bilaterally referred, further audiology screening and/or therapeutic intervention took place. When passed uni- or bilaterally, children enrolled in a) a nation wide screening programme (EWING) at the age of 9 months and b) in a half yearly follow-up programme in which hearing and speech-and language development were observed according to Egan an Illingworth.

Results: Screening without disturbance from ambient noise or from routine technical equipment was possible in the incubator, even during nasal CPAP therapy. 245 (98%) Newborns passed ALGO-1 screening. 5 (2%) did not pass bilaterally. 1 of 5 with a congenital rubella died shortly after screening. In 4 of 5 bilateral congenital hearing loss of ≥35 dB was confirmed. 235 of the newborns passed were still alive at the age of 1 year. Ewing screening was performed in 183 of 235 (77,9%). 161/183 passed, 15 of 183 had progressive conductive hearing loss, in 7/183 no further investigation was performed. All 235 children enrolled in the 1/2 yearly follow-up programme had normal speech-and language development. In this study all 4 at risk newborns with bilateral congenital hearing loss were detected with ALGO-1 screening. Screening results showed no false negatives at follow-up.

Conclusion: The ALGO-1 infant hearing screener can be used as an valid automated ABR-screener to detect hearing loss in at risk newborns in a neonatal intensive care unit.

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AXILARY AND RADIAL ARTERY CANNULATION IN NEONATAL SURGICAL INTENSIVE CARE

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A prospective comparative survey of 20 axillary and 20 radial artery cannulations in paediatric intensive care admission at The Clinic for Paediatric Surgery, Novi Sad, over a period one year has been carried out. The incidence of vascular or other complications was carried out. All patients were in neonatal surgical intensive care units, 1 to 15 days of age, weight range from 1700 to 3500 gr. Arterial lines were used for direct blood pressure measurement and blood gas sampling. In this study we had no significant vascular or neurological complications. We found, number of punctures before successful higher and number of days the cannula remained in situ smaller, vice versa. We conclude that the axillary artery provides a valuable alternative site for cannulation in sick and small babies.

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IATROGENIC ESOPHAGEAL PERFORATION: A RARE AND SEVERE COMPLICATION OF ENDOTRACHEAL INTUBATION IN NEWBORNS

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Iatrogenic esophageal perforations (IEP) in preterm and term infants are seldom reported in literature, in association with difficult endotracheal (ET) intubation (with or without stylets), insertion of gastric tube, and pharyngeal suctioning with stiff catheters. Cricopharyngeal muscle spasm caused by instrumentation may also lead to a narrowing of lumen, with increased risk of local injury. We report 4 IEP observed in intubated, mechanically ventilated newborn infants (2 male, 2 female, all outborn). A common feature of IEP was inability to pass a nasogastric (NG) tube into the stomach, mimicking esophageal atresia. Case 1: birth weight (BW) 1850 g, gestational age (GA) 37 wk, sepsis. Before admission to NICU, the baby underwent multiple ET intubations, because of inappropriate securing of ET tube. Bloody secretions in pharynx were observed. The endoscopy showed a large lesion at the end of proximal third of the esophagus. Case 2: BW 1080 g, GA 32 wk, RDS. Chest X-ray (CXR) showed a retrosternal air leak; the NG tube was stopped between D8 and D9 and soluble contrast was seen in upper mediastinum. Case 3: BW 760 g, GA 26 wk, RDS. The endoscopy showed an esophageal lesion. CXR showed a paravertebral route of NG tube and a right pneumothorax. Case 4: BW 1020 g, GA 32 wk, RDS. Bloody secretions in pharynx. CXR shows contrast in the upper mediastinum and abnormal route of NG tube through a false passage. Surgical intervention is needed in case of mediastinitis or mediastinal abscess; conservative management included broad spectrum antibiotics, total parenteral nutrition, antireflux therapy and, if necessary, drainage of air leaks. Enteral feeding has been stopped for 15 days and cautiously resumed after radiographic study. Local sequelae and death are uncommon, but IEP occur in newborns with high risk of death due to prematurity and other diseases. In our patients, ET intubation has been performed by experienced personnel: therefore the lack of skills in resuscitative procedures is not always the main factor of IEP. Prevention of IEP requires appropriate materials (ET tubes, laryngoscope blades, suction catheters), and procedures (positioning of the infant with correct neck extension, firm ET placement). Sedation and pain control may help to prevent the muscle spasm.

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EXTREMELY LOW BIRTH WEIGHT NEONATES AND VASCULAR IATROGENIC INJURIES

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Aggressive treatment has improved the long-term outcome of extremely low birth weight neonates (ELBW) but it has also increased the chances of iatrogenic lesions. Reviewing the charts of our neonates we observed a high number of vascular injuries. From 1987 to 1994, 2898 neonates were admitted to the neonatal intensive care unit (NICU); 335 of them were ELBW (11.5%). Studying the charts of these ELBW we observed 9 cases (4 M - 5 F) with vascular lesions (2.6%). Mean gestational age of these patients was 28.7 weeks (min 24-max33). Mean weight at birth was 880g (590-1450). Mean weight at diagnosis was 1825g (1230-2700). In the same period 10 patients with vascular injuries were reported in the 2563 neonates over 1500g (0.3%). The injuries observed in ELBW group were: 6 arteriovenous fistula (2 bilateral) at femoral level, 1 carotid lesion and 2 limb ischemic lesions. Aetiology was in 7 cases by venipuncture, in one case umbilical catheter and in the case of carotid lesion a wrong surgical maneuver. No general symptoms were observed. The vessels were repaired with microsurgical technique in six cases: the carotid lesion and five arteriovenous fistula; one case was solved with thrombolitic drugs; an amputation at knee level was required in one case after a long period of medical treatment. The last neonate with an arteriovenous fistula was only observed for parent's will. At follow-up (clinical and by ecodoppler) 7 out of 9 neonates presented normal vascular function without sequelae. From our experience ELBW neonates have more chances than older neonates to develop iatrogenic vascular lesions. We advocate an aggressive microsurgery and/or medical treatment to obtain good results and prevent late sequelae.

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A RETROSPECTIVE COMPARISON BETWEEN 2 NATURAL SURFACTANTS

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Aim: Retrospective comparison of Alveofact (in 1993) versus Survanta (in 1994) as rescue treatment for neonatal respiratory distress syndrome (RDS).

Methods: Both surfactants were given at an initial dose of 100 mg/kg (except for Alveofact 50 mg/kg for mild RDS grade I-II). Repeat doses were allowed (Survanta 100 mg/kg, Alveofact 50 mg/kg) up to a maximum of 200 mg/kg. All parameters and outcome criteria were strictly defined beforehand. The initial response (good,mild,no response,relapse) to surfactant therapy was defined on the basis of the decrease in FiO₂. **Results:** There were no significant differences in patient population and initial parameters: GA (29.9±2.2 vs 29.1±2.6 wks), birth weight (1332±431 vs 1227±444 g), severity of RDS (grade III-IV: 78.6% vs 80.3%), Apgar scores, cord blood gases, initial ventilatory settings. In '93 however, the initial surfactant dose was administered earlier than in '94 (14.4±17.4 vs 6.5±7.8 hrs postpartum, p=0.025). Although the average total cumulative dose was equal in '93 and '94 (169.3±65.8 vs 167.4±69.4 mg/kg), more doses of Alveofact were given compared to Survanta (2.3±1.1 vs 1.7±0.6, p=0.001) and more patients in '93 received more than two doses than in '94 (46% vs 18 % of patients). There was no difference in the incidence of non-pulmonary complications.

	Alveofact(n=46)	Survanta(n=74)	p
good + mild response	34+7=41%	57+14=71%	0.018
no response + relapse	16+43=59%	9+20=29%	0.018
mortality (%)	23.9 %	18.4 %	NS
BPD 28d/36w (%)	47% / 36%	43% / 25%	NS
ventilation (d)	40.1±63.6	30.5±39.4	NS
duration O ₂ (d)	18.2±29.3	11.5±14.5	NS
<1250 g	ventilation 33.9±33.5	17.0±16.0	0.011
	duration O ₂ (d) 69.6±68.9	47.0±44.4	0.168
≥1250 g	ventilation 3.8±2.5	3.7±6.8	NS
	duration O ₂ (d) 15.6±7.8	7.8±7.2	0.002

Conclusions: There was a better initial response to Survanta and a better respiratory outcome in 1994: in the group <1250g the duration of ventilation was half in 1994, and in the group ≥1250g the duration of extra O₂ need was half in 1994 as compared to 1993. We speculate that the main reason for this difference is the earlier and initially higher dosing used with Survanta compared to that used with Alveofact which was given in the same total cumulative dose but over a larger time span.

P 139**RESPONSE TO DOPEXAMINE AND DOBUTAMINE IN THE PRETERM INFANTS WITH CIRCULATORY AND RESPIRATORY FAILURE**

Paweł Kawczyński, Andrzej Piotrowski

To compare influence of dopexamine and dobutamine infusion on blood pressure and urine output in preterm infants we enrolled 37 neonates in our study. Inclusion criteria required hypotension, oliguria, metabolic acidosis and failure for volume loading. Studied drug infusion were initiated at 5mcg/kg/min for dobutamine and 2 mcg/kg/min for dopexamine and then increased in increments of 5 or 2mcg/kg/min for dobutamine and dopexamine respectively at 30 min intervals until mean arterial pressure /MAP/ was achieved or a maximum dose of 20/dobutamine/ or 8 mcg/kg/min /dopexamine/ was reached without improvement of MAP.

No infants in dopexamine group had a treatment failure, 4 neonates of 20 failed to maximal dose of dobutamine. Among those treated successfully, MAP increased significantly in both group of studied infants / $p<0.05$ / . Urine output rose significantly in dopexamine treated neonates / $p<0.01$ / but remained unchanged during dobutamine infusion.

We conclude that dopexamine could be more effective than dobutamine for the treatment of hypotension in preterm infants. Only dopexamine has specific renal-vasodilating effects which can produce improvement in urine output.

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Infectious complications during the therapy of respiratory insufficiency in neonates with birth weight less than 1500 g in the course of 3 years - retrospective study.

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179 Neonates with birth weight less than 1500 g were treated with the diagnosis of respiratory insufficiency (CPAP, IMV, IPPV) in the course of 3 years. 166 Neonates were included in the investigated group without clinical symptoms and laboratory parameters of infection (CRP, blood count, microbial cultures, haemoculture) at the beginning of the therapy. Pulmonary radiograph did not show any signs of pneumonia at the time. The treatment of neonates in this group (73/166 = 43,9%) was complicated by the development of pneumonia and in 14 by sepsis at the same time. The infection started approximately 109 hours after the beginning of the treatment. The diagnosis was established on the basis of positive cultures from bronchoalveolaire lavages (BALs), increased CRP, white blood cell count and pulmonary radiograph. As the most frequent pathogens from BALs enterococcus, pseudomonas spp. and klebsiella were cultivated. Because of the clinical deterioration the more aggressive ventilation parameters were necessary. Infectious complications extended the period of treatment of respiratory insufficiency in comparison with the group without infection (273 adverse 217 hours).

Conclusion:

Daily BALs and CRP monitoring gave a good account for early diagnosis of infectious complications.

The risk of infectious complications increases with the extended time of ventilation. Sepsis was developed in 19% of neonates.

The reintubation increases significantly the risk of infectious complications. The unfavourable epidemiologic situation at the NICU is an important risk factor for the development of pneumonia.

P 141**SURFACTANT TREATMENT IN PRETERM INFANTS - OUR EXPERIENCE**

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Background: Exogenous surfactant replacement treatment has become routine in the treatment of respiratory distress syndrome (RDS) of prematures, whereas its efficacy in other respiratory diseases is still being under investigation.

Objective: The primary interest is to report our results of prospective, non-randomized "rescue" study of surfactant replacement in outborn premature infants with RDS requiring mechanical ventilation (MV).

Patients and methods: From July 1993 to June 1995, 18/58; (31%) outborn premature infants, at a mean age of 22 ± 2.7 hours (13 boys, 5 girls; mean gestational age 32 ± 2.8 weeks, mean birth weight 1846 ± 544 g, Apgar 7.2 ± 1.7 at 5 minutes) with RDS, requiring MV, received bovine-surfactant (Survanta, Ross/Abbott, Laboratories Columbus, Ohio) endotracheally, as was recommended by manufacturer. As the control group 19 outborn premature infants (out of 49; 39%, admitted with RDS from July 1991 to June 1991) were selected and who did not receive surfactant. Compared with surfactant group they were admitted for treatment earlier after delivery (at the age 6.4 ± 2.2 hours vs. 11.7 ± 13 hours), but they did not differ in other baseline characteristics at admission. Entry criteria for surfactant application were fractional inspiratory oxygen requirements - $\text{FiO}_2 > 0.50 - 0.60$, ratio arterial to alveolar oxygen pressure - $\text{paO}_2/\text{FiO}_2 < 2.0$ and oxygenation index - $\text{OI} > 10$. Primary outcomes were determined by changes in oxygenation and ventilation in the following variables: (1) fraction of inspired oxygen (FiO_2), (2) mean airway pressure (MAP) (3) $\text{paO}_2/\text{paCO}_2$ ratio, (4) oxygenation index (OI). Common complications of prematurity and control mechanical ventilation (patent ductus arteriosus, intracranial hemorrhage, air leak, bronchopulmonary dysplasia and death) were regarded as secondary outcomes.

Results: In surfactant group we observed significant improvement ($p < 0.05$) in oxygenation and ventilation at 24 hours after entry into the study in comparison to nonsurfactant group. Comparison of secondary outcomes in infants with RDS shows Table 1.

Table 1: Comparison of secondary outcomes in infants with RDS, in Survanta and nonSurvanta receiving groups

Diagnoses	RDS - Survanta	RDS - nonSurvanta
Patent ductus arteriosus	7 (38.8%)	5 (26.3%)
Intracranial hemorrhage-total	6 (33.3%)	4 (21.0%)
Grade I - II	3	0
Grade III - IV	3	4
Pneumothorax	3 (16.6%)	11 (57.8%)*
Pulmonary interstitial emphysema	3 (16.6%)	4 (21.0%)
Pulmonary haemorrhage	2 (11.1%)	3 (15.8%)
Bronchopulmonary dysplasia	3 (16.6%)	2 (10.5%)
Death	2 (11.1%)	6 (31.6%)**

* $p < 0.01$, ** $p < 0.05$

We did not observe any major acute life threatening complications in surfactant group immediately after surfactant replacement therapy. The duration of mechanical ventilation and oxygen treatment in survivors of both groups did not differ significantly from each other.

Conclusion: In premature infants with RDS treated with surfactant replacement therapy we observed decrease in incidence of pneumothoraces and death ($p < 0.01$ and $p < 0.05$), whereas in other observed variables there was no significant difference.

P 142**CLINICAL APPLICATION OF EXOSURF NEONATAL IN NEWBORN INFANTS WITH RDS.**

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Effectivity of EXOSURF NEONATAL was analized in 37 newborn infants (body wt.- from 950 to 1990g, mean- 1400.7; gestation time - 30.2 ± 0.2 weeks) with RDSN of severe degrees (degree II-III - 15, III-IV - 18, and III-IV - 4 infants). Infants on CMV, CPPV, and IMV were administered EXOSURF in dose of 50-60 mg/kg twice endotracheally (see Table).

Parameter	Before administration	After administration			
		6 hours	1 day	2 days	4 days
PIP, mbar	24.3 ± 0.8	20.2 ± 0.3	16.4 ± 0.5	15.6 ± 0.4	13.9 ± 0.3
PEEP, mbar	4.1 ± 0.1	3.4 ± 0.1	2.3 ± 0.1	2.1 ± 0.1	2.1 ± 0.2
F, b/min	55.1 ± 1.4	44.4 ± 1.4	42.8 ± 1.3	41.4 ± 1.3	40.1 ± 1.4
FiO ₂ %	91.3 ± 2.4	63.2 ± 1.8	51.6 ± 2.1	45.2 ± 1.9	38.2 ± 1.7
SaO ₂ %	87.8 ± 4.1	92.7 ± 2.3	94.1 ± 1.2	$95. \pm 1.2$	95.3 ± 0.8
pH	7.2 ± 0.06	-	7.3 ± 0.05	-	-
PaO ₂ , mmHg	44.5 ± 3.9	-	75.4 ± 2.5	-	-
PaCO ₂ , mmHg	58.3 ± 2.1	-	36.3 ± 1.8	-	-
AaDO ₂ , mmHg	mean 486.2	338.3	240.4	172.7	115.9
AaDO ₂ , mmHg	mean 24.9	17.2	13.2	9.2	6.9
Qs/Qt%					

In 32 newborns (86.4%) 2 hours after surfactant administration FiO_2 value decreased by 20.8%, and after 6 hours - by 28.1% compared with initial value; PIP and PEEP values decreased by 3-5 cm H2O and 1-2 cm H2O after 6 hours, and by 4-7 cm H2O and 2-3 cm H2O after 1 day, respectively accompanied by mean decrease of AaDO₂ from 486.2 to 240.2 mmHg, Qs/Qt decrease from 24.9 to 13.2% (see Table). Mean time of CMV, CPPV was 7.8 days, IMV- 14-36 hours, CPAP - 10-24 hours. Respiratory therapy in 5 newborns (13.5%) was complicated by pneumothorax (bilateral - in 2 infants). In 1 newborn infant with RDSN of degree III and in 4 infants with RDSN of degree III-IV EXOSURF NEONATAL wasn't effective with AaDO₂ > 500 mmHg, Qs/Qt > 27.4%, lethal outcome occurred in 2-3 days (13.5%). Lethality level was 29.7% (under 7 days of age- 16.2%), including 45.5% - caused by RDSN, 36.4% - caused by sepsis, and 18.1% caused by intraventricular hemorrhage.

Results obtained suggest that EXOSURF NEONATAL therapy is not effective in newborn infants with RDSN of degree III-IV; and that in such situations it's necessary to use nitrogen oxide (NO) inhalations and/or ECMO.

P143**HYPERTENSION AS A COMPLICATION OF CHORIOANGIOMA**

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Chorioangioma is a relatively rare placental malformation associated with considerable mortality and morbidity. A chorioangioma can be regarded as an arterio-venous shunt in the circulatory system of the fetus. This causes volume loading eventually resulting in cardiomegaly and high output cardiac failure.

A female neonate (gest age 40 wk, birth weight 2290 g, -2.6 SD) was born with an apgar score of 4 and 7 after 1 and 5 min respectively. The placenta showed multiple chorioangioma. Ultrasound of the heart showed a hypertrophic cardiomyopathy. She developed severe hypertension (100/70 mm Hg), treated with nitroglycerine and nifedipine. Finally blood pressure decreased when enalaprilic acid was given (0.15 mg.kg⁻¹). We measured the activity of the renin-angiotensin system.

Results:

		reference
renin activity (ng.ml ⁻¹ .hr ⁻¹)	11	0.3 - 3.5
angiotensin I (ng.L ⁻¹)	125	11 - 88
angiotensin II (ng.L ⁻¹)	127	< 100

¹)Schilder et al. Acta Pediatr. 1995;84:1426-8

Conclusion: An elevation in renin-angiotensin system is shown probably to compensate for the low resistance circulation before birth.

Hypothesis: The instantaneous cut off of a large arteriovenous shunt did not result in a fast downregulation of the renin-angiotensin system resulting in hypertension.

Hypertension should be added to the list of complications of chorioangioma of the placenta.

Infectious disease

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SEPTICEMIA DUE TO STAPHYLOCOCCUS IN CHILDREN : CLINICAL STUDY AND PROGNOSIS

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The authors studied 75 cases of children's septicemia with blood culture yielding *Staphylococcus aureus*. The age of patients varied from 2 months to 15 years (51,3% from 3 years downward), 74% of the children caught their disease in the hot season (May to October). The deaths also occurred in this season: 87,5% (21/24). Following were the anatomo-clinical lesions.

- Skin 42%, muscle 60,0%, bone 21,3%, Joint 9,3%.
- Viscera : lung 50%, heart 33,3%, cerebrum 22,6%, kidney 60,6%, liver 17,3%.
- Simple lesion skin-muscle-bone joint: 12%, no death in this group.
- The concomitant lesions of the soft tissue, bone-joint and viscera : 34% with one viscera, 26% with two viscera, 18% with three viscera and 9% with four viscera.
- Bone lesion : Mainly on the long bones (50% on the tibia, 25% on the femur, the remainder being the mandible (3) and the humerus), inflammation of the hip joint was the main one.
- Lung lesion had forms pneumatocele (4 cases), bronchopneumonia (6 cases), pleural effusion (7 cases), multmicroabcess bursting into the pleura (8 cases), most multmicroabcesses were lethal : 20/22 (90,9%).
- Heart: all the three layers got lesions, 20% had 2 or 3 layers affected and death ensued.
- Cerebrum : the meninges had three forms of lesions purulent meningitis (13 cases), obturating embolus of brain vessels (2 cases) and cerebral abcess (one case). The characteristic clinical sign was paralysis and meningismus, phlebothrombosis of cavernous sinus (13 cases) was usually the result of a boil which burst. There were 6 cases of death with lesion of the meninges and 2 cases of obturating embolus of brain vessels.
- The main sign of lesion of the kidney was a change in the components of urine: 60% got proteinuria, 75% had leucocytes in their urine, 42% had erythrocytes in their urine, the urea in their blood increased (over 60mg%) in 21,4% of cases. The lesion of the kidney seemingly had little relation to death. Seven cases of icterus due to an increase of direct bilirubinemia and a decrease of blood-albumin.
- The biological characteristics of the pathogen staphylococci showed that all the 75 isolated specimens had positive coagulaza ; the specimens from the dead patients were less sensitive to, and multiresistant to antibiotics. Overall death rate was 34,7% (24/75).

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TREATMENT OF CEREBROSPINAL FLUID SHUNT INFECTIONS IN CHILDREN WITH FLUOROQUINOLONES

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Abstract

The main purpose of this retrospective study was to evaluate the efficacy and safety of quinolones in the pediatric patients. A total of 15 children aged from 2 to 51 months (mean 14.6 months) with cerebrospinal fluid shunt infections were treated with fluoroquinolones. Drugs were administered intravenously, the mean dosage was 29.6 mg/kg/day. The mean duration of treatment was 12.3 days. Cure rate was 86.7%. *Staphylococcus aureus* was the most frequently isolated pathogen (33%). There were no side effects associated with quinolone treatment in this study. Finally, potential indications for fluoroquinolones in children are discussed.

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PIPERACILIN + AMINOGLYCOSIDE VERSUS PIPERACILIN + III. GENERATION CEPHALOSPORIN IN THE TREATMENT OF SEVERE INFECTION IN CHILDHOOD

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INTRODUCTION: Gram - bacteria are the major causative organisms of severe infections in pediatric and neonatal ICUs. Broad-spectrum bactericidal ATB and their combinations are usually used in the treatment of this infections.

PATIENTS AND METHOD: We evaluate efficacy and safety of combination of antibiotics: Pip. + Aminoglycoside (Group I) and Pip. + III. generation Cephalosporin (Group II) in the treatment of life-threatening infections in childhood. 35 children aged from 1 day to 15 years were included to the study - 19 in Group I and 16 in Group II. Both Groups were homogenous for age, sex, weight and type of infection. All patients were treated in the pediatric ICU, 20 of them required artificial ventilation. The most frequent isolated microorganism was *Pseudomonas aeruginosa*.

RESULTS: 85.7 % patients (30) of the study Groups were successfully cured (16 in Group I and 14 in Group II), further infection occurred in 2 patients in Group I and death occurred in 3 patients (1 in Group I and 2 in Group II) - no statistic significant. No adverse reactions were noted.

DISCUSSION: Both ATB combinations are very effective in the treatment of severe infections in childhood. The "Group II" combination is very safe, mainly in the neonates and in the patients with acute renal failure.

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FIVE YEARS EXPERIENCE WITH CEFOTAXIM IN CHILDHOOD

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INTRODUCTION: The authors present results of treatment of severe infections in 378 children aged from 1 month to 15 years admitted to pediatric clinic during 5 years (1990 - 1994).

PATIENTS AND METHODS: Cefotaxim was used as a prophylactic agent in 43 patients in life threatening situations (e.g. multitrauma, neurosurgery etc.). More than 85 % children required Cefotaxim for the treatment of severe infections (epiglottitis, meningitis, sepsis, pneumonia - mainly in immunodeficient and neutropenic patients) in monotherapy or in the combination with the other antimicrobial agents.

RESULTS: Cefotaxim as a prophylactic drug was successful in all 43 cases (100 %). The effectiveness of treatment of infections was 82.8 % (313 patients). The change of antibiotic therapy required 9 patients (2.4 %). 40 patients (10.6 %) died, but only in 12 of them (3.2 %) the obduction confirmed infection.

CONCLUSION: We conclude that Cefotaxim is very effective and safe antibiotic and represents "golden standard" in the treatment of severe infections in childhood.

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P148**PAEDIATRIC INTENSIVE CARE UNIT-ACQUIRED INFECTIONS AND COLONIZATION**

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The purpose of our study was to evaluate the clinical and laboratory findings of infection and colonization of patients in a PICU. During a one year period, 195 children aged 15 days to 14 years were admitted in our PICU. Only 126 of them who remained >48 hours were included in the study. Fifteen patients (11.9%) had at least one PICU-acquired infection in a total of 22 infections and 17 were only colonized in the PICU. The types of infection were pneumonia (27.4%), bloodstream infection (63.6%) and urinary tract infection (9%). The microorganisms that were isolated were *Pseudomonas* (40.9%), *Enterobacteriaceae* (31.8%), Gram positive (18.2%) and fungi (9.1%). Risk factors for ICU -acquired infection were: The length of ICU stay (19 days for the infected, 7 days for the colonized and 3 days for the rest of the patients), duration of mechanical ventilation (11, 6 and 2 days respectively), TPN (15, 5 and 4 days), central venous catheters (CVC) (10 out of 15 of the infected, 11 out of 17 of the colonized and 24 out of 94 of the rest of the patient used CVC). There was no correlation between APACHE II score and infection. The mean APACHE II score was 6 for the infected, 10 for the colonized and 5 for the rest of the patients. The overall mortality was 6.3% (8/126). The mortality was higher for the infected 2 (13.3%) and for the colonized 2 (11.7%) in comparison to the rest of the patients 4 (4.25%).

P149**DIAGNOSIS BY BRONCHOALVEOLAR LAVAGE (BAL) OF BACTERIAL NOSOCOMIAL PNEUMONIA (BNP) ACQUIRED IN INTENSIVE CARE UNITS (ICU): COMPARISON BY A META-ANALYSIS OF THE ROC CURVES OF THE PERCENTAGE OF INFECTED CELLS (%-IC) AND OF QUANTITATIVE CULTURE.**

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Objective: To find if the %-IC in BAL is a better diagnostic marker of BNP than quantitative culture of BAL.

Design: This meta-analysis compares 2 tests of respiratory secretions collected by BAL, the %-IC and quantitative culture. The method of meta-analysis used, recently described by Moses and Shapiro, takes into account both sensibility and specificity; it allows to compare the ROC curve (Receiver operating characteristic) of 2 tests, the curves being constructed by combining the best global value of selected studies (Stat Med 1993;12: 1293-1316).

Data Sources: The relevant literature was identified through computer searching, references found in published papers and by writing to the authors of original studies.

Study Selection: A study was included in the meta-analysis if at least 2 of 3 independant readers consider it as fulfilling the following criteria: prospective study, performed on human beings, published from January 1969 through January 1995, in English or French-language, and estimating the value of the %-IC and of quantitative culture of a sample of respiratory secretions collected by BAL for the diagnosis of BNP. A study including community-acquired pneumonias was excluded.

Measurements and Main Results: This meta-analysis includes 9 studies of the %-IC (633 patients) and 11 studies (435 patients) of quantitative culture. It shows that the %-IC is better than quantitative culture for the diagnosis of BNP, but the difference is not statistically significant.

Conclusion: This meta-analysis demonstrates that the %-IC is as reliable as quantitative cultures for the diagnosis of BNP. Using these 2 techniques together could be useful: the %-IC allows an early diagnosis of BNP; thereafter, the culture would identify the responsible(s) organism(s).

P150**FATAL SINONASAL ASPERGILLOSTIS IN A GIRL WITH APLASTIC ANEMIA**

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Invasive sinonasal aspergillosis is a severe and frequently fatal infection in immunocompromised patients. We describe a case of persistent fever, facial swelling and neurological deterioration in a girl with aplastic anemia rapidly progressing to multi-organ failure and subsequent death. Pathological examination revealed aspergillosis of the maxillary and ethmoid sinuses with invasion of the vascular walls of the anterior and posterior cerebral artery in the leptomeninges and brain tissue.

Nasal symptomatology in severely immunocompromised children should yield a high index of suspicion for the diagnosis of fulminant sinonasal aspergillosis and warrants early and vigorous diagnostic procedures and therapy.

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P151**Successful treatment of Fusarium Infection in an Immunocompromised Child. with LLA-L3.**

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The fungal infection to fusarium species in immunocompromised child have been reported in the literature with a rare, severe and high, mortality rate in spite of the use of antifungal drugs.

We report a case of successful treatment of a severe disseminated fusarium infection in a 11-year-old boy with acute lymphocytic leukemia (LLA-L3), after use a chemotherapy followed by absolute granulocytopenia.

The patient developed fever, skin lesions, pneumonia and fungaemia. Fusarium species was cultured from the blood, necrotic skin lesions and lung secretion.

The child developed multiple organ system dysfunction in spite of use broad spectrum antibiotics and antimycotic therapy needing. UCI during 18 days.

The patient receive suport treatment (mechanical ventilation, Inotropic drugs, Diuretics, Imunestimulants, Blood Components, a broad spectrum antibiotics and antifungal agents).

We absorbed a gradual recovery in the white blood cell count and regression on the sites of infection.

The association of precoce diagnostic and the therapeutic with increase in the white blood cell count was the most important in a successful treatment.

P152**DIAGNOSIS, PREVENTION AND TREATMENT OF SERIOUS INFECTIONS AND SEPSIS IN NEWBORN AND INFANTS**

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Objectives: Evaluate the immune system parameters: intensity of oxidative reaction of phagocytes measured as hemiluminescent response and ability to reduce nitro-blue tetrasodium (NBT), immunoglobulins, C3 and C4 components of complement, in newborns and infants suffering serious infections and sepsis treated in The ICU.

Methods: In Children with serious infections of the respiratory, urinary, CNS, and gastrointestinal system both: clinical (clinical examination, standard biochemical and microbiological analyses) and immunological parameters were examined. Hemiluminescent response of the phagocytes was determined by the method of Tono Oka, the ability of the phagocytes to reduce NBT by the modified method of Pick, immunoglobulins, C3 and C4 component of the complement were determined by radial immunodiffusion.

Results: 29 newborns and 25 infants suffering serious infections have shown high oxidative metabolic activity both with opsonised and unopsonised test of hemiluminescence. Newborns have shown delay in the hemiluminescent response, with low opposing activity of the serum (low or absent hemiluminescent response with unopsonised cells of yeast). High initial values of the hemiluminescent response were seen in newborns with fethopaties (CMV, Herpes simplex, Toxoplasmosis). The newborns and infants with the most severe clinical forms of infections have shown decreased hemiluminescent response, which was a bad prognostic signs. Those children had shown negative NBT test without PMA pre-stimulation, while in the other patients the results of NBT was variable. The values of immunoglobulines were mostly high, particularly IgM in newborns with fethopaties. The C3 and C4 complement level was low mainly until the age of six months.

Conclusions: The children with high hemiluminescent and NBT response, low level of IgM and high level of IgG, C3 and C4 components of the complement had shown better response to treatment.

P153**BRAIN ABSCESS AND SUBDURAL EMPYEMA CAUSED BY SALMONELLA ENTERITIS : SUCCESSFUL TREATMENT WITH PARENTERAL CHLORAMPHENICOL AND LOCAL CEPHTRIAXONE**

VUKELIĆ D, BOŽINOVIC D, KUZMANOVIĆ N, MIKLIĆ P, ROJIĆ G, BAŠNEC A.

ALTOUGH MOST SALMONELLA INFECTIONS ARE LIMITED TO THE GASTROINTESTINAL TRACT INVASION OF THE BLOODSTREAM AND FOCAL COMPLICATIONS CAN OCCUR. INTRACRANIAL MANIFESTATION IS A RARE COMPLICATION OF SALMONELLA INFECTION. ONLY EIGHT CASES OF SALMONELLA BRAIN ABSCESES AND 14 CASES OF SUBDURAL EMPYEMA IN THE PEDIATRIC AGE GROUP HAVE BEEN DOCUMENTED IN THE LITERATURE. THE CASE OF BRAIN ABSCESS AND SUBDURAL EMPYEMA CAUSED IN THE COURSE OF TREATMENT OF SALMONELLA MENINGITIS WITH CHLORAMPHENICOL WAS DESCRIBED. THE TREATMENT WITH CHLORAMPHENICOL WAS RESTRICTED TO ONE MONTH PERIOD. AT THE END OF THE THERAPY CRANIAL COMPUTERIZED TOMOGRAPHY (CT) SHOWED A MILD SUBDURAL EFFUSION AND THE FINDINGS OF THE LUMBAR PUNCTURE WERE NORMAL. TWO DAYS AFTER THE END OF THE TREATMENT THE CONDITION DETERIORATED . THE CT SCAN PERFORMED THE FOLLOWING DAY REVEALED A FRONTAL ABSCESS AND INTERHEMISPHERIC SUBDURAL EMPYEMA. DUE TO ITS LOCALIZATION THE EVACUATION OF THE SUBDURAL EMPYEMA WAS ONLY PARTIALLY SUCCESSFUL, SO THAT IN THE COURSE OF THE SUBSEQUENT FOUR DAYS AN OUTER DRAINAGE SYSTEM FOR PUS EVACUATION HAD TO BE INSTALLED ENABLING THE ADMINISTRATION OF CEFTRIAXONE. UPON THE REMOVAL OF THE DRAINAGE SYSTEM THE TREATMENT WITH CHLORAMPHENICOL WAS CONTINUED WITH A GOOD CLINICAL EFFECT.

P154**APNEA AND RESPIRATORY SYNCYTIAL VIRUS (RSV) INFECTION.**

HA van Steensel-Moll, MCJ Kneyber, AH Brandenburg, K Joosten, PhH Rothbarth, R de Groot.

RSV infection is associated with apnea.

The aim of the study is to identify the clinical characteristics of infants with apnea and to describe the risk for apnea in young infants (< 2 months) and prematures (< 32 weeks) with RSV infection.

Patients and methods: 185 infants with RSV infection admitted to the Sophia Children's Hospital Rotterdam (1992-1995) were included. RSV infections was proven by a positive direct immunofluorescent assay on nasopharyngeal washing.

Results: 20.5% (N=38) presented with apnea, 37% of them required mechanical ventilation. Apnea at presentation was not related to gender gestational age, underlying disease state, weight at diagnosis, clinical features (feeding difficulties, wheezing, retractions, respiratory rate, temperature).

Young age ($p=0.05$), low SaO₂ measured by pulsoximetry ($p < 0.05$) and atelectasis ($p < 0.05$) were significantly related to apnea. In 92 infants younger than 2 months and/or prematurity (< 32 weeks gestational age) cardiorespiratory registration was performed during 24-48 hours. 18.5% (N=17) developed apnea during disease course. 12 Infants presented themselves with apnea. In 5 infants the first apnea was detected during 24-48 hour monitor registration. Two of these require mechanical ventilation. To detect apnea in the early illness of RSV infected infants monitor registration is indicated for young and/or prematurely born infants.

P155**THE EFFECT OF HALOTHANE ANAESTHESIA ON IMMUNE RESPONSE OF CHILDREN**

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The aim of this study was to investigate the influence of minor operative trauma under halothane anaesthesia on the number of T and B Ly and on their reactivity on mitogens ConA, PHA, and PrA. The investigation was held on 60 children aged 1-12 years admitted for minor operations. The children were divided in: Group A (30) aged 1-3 years, and Group B (30) aged 3-12 years. Heparinized peripheral blood samples were taken preoperatively before any medication, immediately after operation, first and sixth postoperative day. Mononuclear cells were separated by ficoll-hipaque gradient and assayed for T and B Ly number and Ly subsets (CD4, CD8) by immunofluorescence. The reactivity of the cells was investigated after mitogen stimulation PHA, Con A, PrA. After the operation and the first postoperative day, the number of T Ly decreased in both groups. The number of T helper cells(CD4) decreased with significance in group A ($p<0.05$). T suppressor cells(CD8) increased in group A ($p<0.001$).The ratio CD4:CD8 decreased postoperatively without significance. Lymphocyte transformation response to PHA and Con A was depressed in both groups. The older children recovered fully their responsiveness to Con A and PHA 6th day postoperatively. The small children recovered fully to Con A, but not to PHA. The postoperative immunological alterations in children depend on age and severity of operative trauma. The younger children are more sensitive to anaesthesia and operation. Even small trauma induced long duration immunodepression. Conclusion: operative induced immunodepression in children is related with age.

ECMO/PPHN

P 156

DEVELOPMENT OF LOCULATED PLEURAL BLOOD DURING ECLS AND TREATMENT WITH UROKINASE. Montgomery VL, Eberly SM, University of Louisville, Kosair Children's Hospital, Louisville, KY.

A 5 year old African-American child suffered a severe pulmonary injury in a house fire. Initial survey revealed 1% total body surface burns, soot on the face, and bloody endotracheal secretions. Initial chest radiograph revealed diffuse, bilateral infiltrates. Severe respiratory failure with an oxygenation ratio of 73 rapidly developed. He developed a pneumomediastinum and subcutaneous emphysema. Although transient improvement occurred with inverse I:E ventilation and surfactant, he became more hypoxic (SaO_2 as low as 47%) and acidotic. On day 2 post injury, he was placed on veno-venous extracorporeal life support (ECLS). On ECLS day 30 he was decannulated.

Chest radiograph on ECLS day 15 showed an opacity in the left chest. Ultrasound of the left chest was consistent with atelectasis rather than pleural fluid. Flexible bronchoscopy failed to reveal any obstruction in the left lung. A computed tomography (CT) scan of the chest, which was performed after decannulation, revealed a large loculated collection of fluid in the left, anterior chest. Under CT guidance, a 14 F cope loop catheter was inserted and 40 cc of thick blood was removed. Follow-up CT performed immediately after this procedure revealed minimal change in the size of the fluid cavity. Over the next 48 hr, we instilled urokinase 20,000 units over 20 minutes every two hours. A 30 minute dwell time was allowed before draining the fluid. Repeat CT scan done at the end of the urokinase infusion showed a marked decrease in the size of the fluid cavity.

A CT scan was not performed prior to decannulation because the ECLS circuit tubing was too short to allow appropriate positioning of the child in the CT scanner. After a CT scan revealed loculated pleural fluid, a simple drainage procedure was diagnostic but inadequate treatment. We were able to successfully dissolve the thrombus after 48 hr of urokinase therapy even though the thrombus was > 14 days old. We suggest that large loculated pleural thrombi which develop as a complication of ECLS therapy may be successfully managed with urokinase infusion.

P 157

THE INFLUENCE OF NAFAMOSTAT MESILATE ON PLATELETS IN AN EXPERIMENTAL PERfusion CIRCUIT

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Introduction: Haemorrhages, particularly intracranial, are major complications experienced in 10-35% of neonates treated with extracorporeal circulation. An induced thrombocytopenia and impaired platelet function play a key role in the increased bleeding tendency observed in these patients. The aim of the present study was to establish a dose-response curve for the effect of a synthetic protease inhibiting agent, Nafamostat Mesilate (FUT-175), on platelet membrane glycoprotein density and platelet activation during experimental perfusion.

Methods: Two identical Extracorporeal Life Support (ECLS) circuits were primed with fresh, heparinized human blood and circulated for 24 h. Four different concentrations of FUT-175 (7.12 mg/L blood/h; 14.25 mg/L/h; 14.25 mg/L/h+25% bolus at the start of the perfusion and 28.5mg/L/h+25% bolus) were used in different perfusion experiments. A total of eight paired experiments were performed. Platelet count, plasma betathromboglobulin levels and platelet membrane density of glycoprotein Ib and IIb/IIIa were followed as well as plasma concentration of haemoglobin.

Results: A protective effect of the agent on platelet count, plasma concentration of BTG and platelet membrane GPIb could be observed during the first 3 hours of the perfusion when a bolus dose was added. No positive effect could be recorded with the two lower doses used. Plasma concentration of haemoglobin was higher in all the FUT-circuits compared to the control circuits.

Conclusion: The addition of a bolus dose of FUT-175 at the start of the perfusion seem to induce a protective effect on platelets during the first hours of perfusion.

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EFFECTIVE AND SIMPLE TREATMENT OF PERSISTENT PULMONARY HYPERTENSION IN NEONATES

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OBJECTIVE: We present effective, easy and simple treatment of persistent pulmonary hypertension of neonates (PPHNS) by 100% O_2 breathing.

DESIGN AND METHODS: During 1994/95 we treated 19 neonates (NS) (2.9%), 5 female and 14 male, with PPHNS, born on term. BW=2850-4300 gr, BL=49-55 cm, APGAR 5-9. Data about fetal stress were obtained for 6 NS (31%). The disease was manifested during initial 18 hours of life by cyanosis, tachypnea, hypoxia, hypercapnia, acidosis, alveoarterial O_2 gradient (A-a DO₂) of 82.6-96.5 kPa, characteristic auscultatory, ECG and x-ray findings. PPHNS was confirmed by ECHO. In 17 NS (89.5%) 100% O_2 breathing for 10 minutes, induced a statistically (T-test) significant increase in pO_2 , HbO_2 saturation and pH, and a decrease in blood pCO_2 .

RESULTS: 17 NS were treated with 100% O_2 breathing during 24-96 hrs, while during the next 96-192 hrs O_2 in the inspired air was decreased to normal values. After 48-96 hrs pulmonary artery (PA) pressure was decreased below the systemic and normalized after 10-14 days of treatment. A-aDO₂ was gradually decreased and normalized. There was a correlation between blood gas findings and PA pressure (regression line). Of 2 NS who required mechanical ventilation, one died. NS were under followup for 1-18 months and all had normal findings.

CONCLUSION: Although PPHNS treatment is conducted dogmatically and according to personal experience, it is necessary to respect the principle of gradual approach, which should be initiated with 100% O_2 breathing (effective in 89.5% of our patients).

P 159

EMCO IN PEDIATRICS, PROBLEMS IN DEVELOPING COUNTRIES

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Extracorporeal membrane oxygenation (EMCO) is a form of invasive cardiopulmonary support that can provide temporary physiologic stabilisation in reversible circulatory failure and/or respiratory failure.

We reviewed our experience with extra corporeal membrane oxygenation in 4 children aged 1 day to 4 years between 1991 and 1995.

Two neonates were successfully decannulated, but died 1-2 weeks after decannulation due to septic complications. One child 4 years old, one neonate died on day 5 and day 7 respectively while still on EMCO.

Complications which were encountered were heavy bleeding in case 1 (child), 4 (neonate) and rectal rupture in case 2 (neonate).

Problems which are specific developing countries like Indonesia are: high cost (20,000 US\$ for 7 days) difficulty in transportation (transporting intubated baby) from the origin hospital, lack of knowledge and understanding of the primary physician and nurses and difficulty organizing in 24 hours EMCO team.

Monitoring

P 160

RESPIRATORY MONITORING IN PICU
Z.ZIVKOVIC, S. MIHAJLOVIC, O. TOSEV

Respiratory monitoring in Pediatric Intensive Care Unit (PICU) provide the important informations for understanding of the pathophysiology of the clinical signs, aid with the diagnosis, and assist in therapeutic management and predicting prognosis. Picu in Children's Hospital for Pulmonary Diseases and Tuberculosis remained for the last two and a half years relatively limited for diagnostic tools and therapeutic regimens, mostly because of the poor financial support. The number of children admitted for acute asthmatic attack, severe pneumonias, bronchiolitis, complicated pulmonary tuberculosis, foreign bodies and exacerbations of chronic pulmonary diseases was 1362. For all patients the respiratory monitoring system means: physical examination, chest X rays, capillary blood gas analyses (very few children experienced invasive arterial blood gases), noninvasive oxymetry, measuring of the vital capacity in cooperative patients, and capnography. Later on, after the initial critical illness, a complete lung function tests was performed, as well as bronchoscopy in selected cases. Our experience revealed that about 60% of children has successful outcome, without sequells, instead they had been treated in limited conditions. The rest of our patients were previously diagnosed as chronic pulmonary patients, with high risk score system for having sequells. The mortality rate were 0,5%.

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P 161

UNDERSTANDING OF PULSE OXIMETRY

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Pulse oximetry is a useful, non-invasive monitor, routinely used on the ITU and increasingly often on the general wards. We used a questionnaire incorporating questions on the theory and clinical uses of the pulse oximeter to assess understanding of pulse oximetry in medical and paramedical staff.

Doctors indicated grade, speciality, pulse oximetry tuition and neonatology experience.

45 doctors, 15 ITU nurses, 19 medical students and 4 physiotherapists completed the questionnaire. Some confusion existed between the principles of pulse oximetry and transcutaneous oxygen measurement. Wide variations in the lowest acceptable saturation in fit children were seen (80-95%), with around 20% of respondents in all groups accepting values of 90% or less. Some potentially serious mistakes were made in the evaluation of oxygen saturations in the clinical scenarios. There were widespread variations in correct responses at all grades of medical staffing. Nurses scored well on more clinically-orientated questions but relatively poorly on theory.

Only 15% of doctors (mostly senior grades) had received tuition in pulse oximetry. Neonatology rotations appeared to confer little additional knowledge on pulse oximetry.

Few doctors and nurses receive tuition in the use of pulse oximetry. A significant proportion of nurses and doctors, of all grades, exhibited a lack of understanding of the principles of pulse oximetry. This may result in unsafe use of the equipment and put patients at risk.

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EVALUATION OF THE PARATREND 7 CONTINUOUS BLOOD GAS ANALYZER IN PEDIATRIC PATIENTS

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Introduction: The continuous blood gas monitor, Paratrend 7 (Biomedical Sensors, Ltd., High Wycombe, Bucks, England) has the capability of measuring pH, pCO₂, and pO₂ via an indwelling optical absorption optode/Clark electrode sensor that is placed through an intra-arterial catheter. We evaluated the accuracy of the sensor in radial and femoral locations in critically ill pediatric patients.

Methods: The simultaneous values of pH, pCO₂, and pO₂ recorded from the Paratrend 7 monitor were compared to values measured by standard arterial blood gas analyzer (Corning 278, Ciba-Corning Diagnostics, Medfield, MA). Criteria for the elimination of data points included a core vs. sensor temp. gradient, and sensor pulled back beyond accepted insertion distance. Mean time of monitoring per sensor was 108 hours (range 0.75-403.7 hrs). Mean time of radial monitoring was 35 hrs (range 0.75-160.5hrs) and of femoral monitoring was 137.2 hrs (range 12.8-403.7 hrs.). Linear regression and Bland-Altman analysis for bias and precision for each parameter were calculated.

Results: A total of 49 patients (age range 2 weeks to 18 years) had paired samples of pH, pCO₂, and pO₂ made by the sensor and blood gas analyzer. The range of measurements were pH 6.99-7.66, pCO₂ 16.0-114.2 torr, and pO₂ 34-480 torr.

Variable	# Data Sets	y = mx + b	r	R ²	Bias+Precision
pH	1342	y=0.994x+0.046	0.93	0.857	0.002±0.039
PCO ₂	1329	y=0.909x+4.226	0.92	0.840	0.36±4.56 torr
PO ₂	1198	y=0.961x+4.874	0.89	0.784	-1%±18.7%

Conclusions: The Paratrend 7 monitor demonstrated accuracy that is comparable to the accepted standard of blood gas analysis in a group of critically ill pediatric patients manifesting wide variation in pH, pCO₂, and pO₂. This technique appears to be very useful especially in the extreme values of the parameters measured.

Funding provided by Biomedical Sensors.

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VENOUS-ARTERIAL GRADIENTS ON BLOOD PLASMA SUMMARY GAS PRESSURE IN GAS EXCHANGE ASSESSMENT OF "NORMAL" HUMAN FETUS

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The knowledge of "normal" fetal gas exchange is important for newborn condition evaluation. To know it the gas composition in umbilical vein and artery (Uv,Ua) is determined basing on PO₂, PCO₂ (mm Hg), pH, SO₂ and their venous-arterial gradients Δ(v-a).

METHODS: We calculate summary gas pressure (SGP)- PE=PO₂+PCO₂ and their gradient denoted as "gas functionals"ΔPE=(PE Uv-PE Ua).study the role of SGP tests in Uv and Ua, and "gas functionals"(APE) in particular, was investigated during the delivery at the placental gas exchange stage with maternal spontaneous breathing. The analysis was based on 51 cases, presented in literature [1,2,3] where PO₂ and PCO₂ were identified in both vessels. We used there data for peculiar "independent" examination of a number of SGP tests characteristics.

RESULTS:

Uv	Ua	Δ	PCO ₂		PE		pH	
			Uv	Ua	Δ	Uv	Ua	Δ
27.8	14.7	13.2	45.3	57.8	-12.6	73.6	72.6	0.90
±1.2	±1.9	±0.8	±1.3	±1.4	±1.0	±1.5	±1.6	±2.90

One can see from the table that blood composition in Uv and Ua differs in some characteristics, and similar in SGP magnitude. Venous-arterial gradients "gas functionals" between Uv and Ua represent the measure of difference in this characteristics. The gradient can be positive, zero - order or negative and change both in value and in sign but not reach ΔPO₂ (positive) and ΔPCO₂ (negative) in absolute significance. Minimization of "gas functionals" deviations from the zero is achieved due to "mutual replacement acts" between PO₂ and PCO₂ in Uv and Ua blood. We suggest that presented tests can be useful in full evaluation of gas exchange in newborns. Additional properties of SGP are reported in previous publications [4,5]

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VENOUS OXYGEN SATURATION (SvO_2) AND CHANGE IN LACTATE DURING PROGRESSIVE ISOVOLEMIC ANEMIA IN 10 DAY OLD PIGLETS. Mark A. van der Hoeven, Wiel J. Maertzdorf, Carlos E. Blanco, University of Limburg, Department of Neonatology, Maastricht, the Netherlands.

Background: Venous oxygen saturation (SvO_2) reflects the residual oxygen after tissue oxygen extraction and represents the relation between tissue oxygen supply and demand. We studied SvO_2 and arterial lactate during progressive isovolemic anemia to assess the relation between SvO_2 and tissue hypoxia.

Subjects: Ten 8-10 day old anesthetized ventilated piglets.

Intervention: We induced progressive anemia by exchange of blood with plasma. SaO_2 and SvO_2 were measured continuously by a fiberoptic catheter (Oximetrix, Abbott Lab.) in the carotid and pulmonary artery. Aorta flow (Qt), arterial and venous bloodgases, hemoglobin and lactate (Δ lact) were measured. O_2 delivery (DO_2) and consumption (VO_2) were calculated.

Results:

Hb (g/dl)	6.75 ± 0.90	4.01 ± 0.78	2.92 ± 1.28	1.26 ± 0.70
SaO_2 %	98.5 ± 0.60	97.3 ± 1.20	96.5 ± 2.70	96.3 ± 3.20
SvO_2 %	53.5 ± 15.5	47.9 ± 19.9	37.2 ± 19.2	32.6 ± 16.5
Qt (ml/kg/min)	168 ± 48.0	207 ± 52.0	203 ± 72.0	190 ± 90.0
DO_2 (ml/kg/min)	17.3 ± 3.70	14.2 ± 4.10	9.8 ± 3.30	5.7 ± 2.80
VO_2 (ml/kg/min)	8.7 ± 1.60	7.8 ± 2.30	6.7 ± 1.80	4.3 ± 2.0*
Δ Lact (mmol/l)	-0.04 ± 0.09	-0.11 ± 0.21	1.21 ± 1.87	6.05 ± 4.18*

Linear regression analysis comparing SaO_2 and SvO_2 with DO_2 yielded a r^2 of 0.12 and 0.54, respectively. Tissue hypoxia was confirmed by a reduced VO_2 and an increase in lactate.

Conclusion: SvO_2 reflects better a reduced DO_2 obtained by progressive anemia than SaO_2 .

Circulation/Cardiology

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Pulmonary Hypertension and Treatment with Magnesium-Aspartate-Hydrochlorid

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In some cases severe pulmonary hypertension (PHT) in childhood is caused by adult respiratory distress syndrome (ARDS) or congenital heart disease with left-to-right shunt. Several therapeutic trials have been undertaken to reduce PHT: deep sedation, muscle relaxation, prostacyclin, calcium-antagonist, NO and ECMO.

There is good theoretical and experimental evidence to support that magnesium reduces PHT.

Aba Osba et al treated 7 of 9 new-borns with persistent pulmonary hypertension successfully with magnesium sulphate

Two children with VSD, left to right shunt and severe PHT and three children with ARDS were treated with magnesium-aspartate-hydrochlorid. 1-2 mmol / kg magnesium were given slowly intravenously. Serum magnesium concentration was maintained between 2-4 mmol / l ionized and 3-7 mmol / l total magnesium by continuous intravenous infusion. After six hours four patients had a 50% reduced oxygenation index. Two of them died later with severe Sepsis. One patient with ARDS did not improve.

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NEBULIZED NITROPRUSSIDE (NP): A HIGHLY EFFECTIVE, READILY AVAILABLE AGENT TO SELECTIVELY REVERSE HYPOXIA-INDUCED PULMONARY HYPERTENSION. William Meadow, Brian Rudinsky, Anthony Bell, Robert Hippes Department of Pediatrics, University of Chicago, Chicago IL USA

Selective reduction of pulmonary artery pressure (PAP) in the context of pulmonary hypertension is oft desired but rarely achieved. Inhaled nitric oxide (NO) has been shown to produce this desirable effect, but is relatively difficult to administer or monitor. We wondered whether NP, chemically related to NO but more stable in solution, would produce similar physiologic effects when administered in the convenient modality of nebulization.

Methods: 9 piglets were anesthetized, mechanically ventilated, and surgically instrumented. Systemic blood pressure (BP), PAP, and cardiac output (CO) were monitored continuously. After post-operative stabilization, 0.9% NaCl nebulization was begun, and pulmonary hypertension was induced by reducing FiO₂ from 0.30 to 0.07. The piglets were monitored for 15 minutes during this hypoxic phase. Next, without altering FiO₂ or ventilator settings, NP (10 mg/ml, dissolved in 0.9% NaCl, flow 4 lpm) was substituted for 0.9% NaCl in the nebulizer circuit. NP was nebulized for 15 mins.

Results: During hypoxia, PaO₂ fell from 150 to 29 mm Hg. PAP rose during hypoxia from 14 to 31 torr ($p < 0.01$), while BP and CO did not change significantly. PAP fell during nebulized NP in each piglet, (mean Δ PAP = 31 to 21 torr; $p < 0.01$; mean reduction of hypoxia-induced rise in PAP = 61%; range: 36 to 78%; $p < 0.01$). PVR/SVR fell by 28% during NP nebulization ($p < 0.01$), while BP and CO did not fall significantly (90 to 86 torr; 653 to 636 mL/kg-min). The reduction in PAP began within 2 minutes of the onset of nebulized NP, and appeared to reach a plateau by 15 minutes. No tachyphylaxis to nebulized NP was noted. Nebulized NP did not significantly affect PAP, BP, or CO under normoxic conditions.

Conclusions: 1) Like NO, NP selectively reduced hypoxia-induced pulmonary hypertension without altering systemic BP. 2) Unlike NO, NP can be administered by nebulizer, a technique familiar to virtually all health-care providers, and potentially adaptable to both intubated and non-intubated patients. 3) Nebulized NP may be beneficial in clinical contexts where inhaled NO is impractical.

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PURULENT PERICARDITIS: CLINICAL FORMS

Dang Phuong Kiet and Nguyen Xuan Thu

Examining 6 cases of purulent pericarditis with various clinical forms treated by surgery, the authors drew the following experiences for their diagnosis.

I. Clinical factors.

Purulent pericarditis appeared like a cardiac tamponade in a septicemia due to staphylococci with classical symptoms: severe dyspnea, tachycardia, faint heart sound, big liver, prominent cervical vein ; rentgenography of the chest showing enlargement of the cardiac silhouette, a diminution of ventricular pulsations, a clear lung field. By an emergency operation, 500ml of diluted blood were drained.

Purulent pericarditis and pleural effusion appeared at the same time but at first the symptoms of purulent pericarditis were masked by the predominant symptoms of pleural effusion. After the pleura was drained, its pus was no more, the general state was relatively stabilized but there still were big liver, dyspnea, enlargement of the cardiac silhouette while central venous pressure increased.

Purulent pericarditis appeared late. In the first stage (about 2 weeks) there was no suspected sign. Later on gradually appeared such symptoms as dyspnea (during serum transfusion for instance). Central venous pressure also raised. The heart chest diametre increased at first (up to 60-65%) then decreased (down to below 50%) but the liver kept on swelling together with the particular changes of electrocardiogramme. Now the pericardium had no more pus but get fibrous (up to 3mm) thus constricting the heart and its main arteries (like Pick syndrome).

2. Diagnostic values of electrocardiograms :

Common signs of ECG related of these purulent pericarditis were: a diminution of voltage, a widespread elevation of the ST segment, the TF wave flattened and inverted. However, what should be stressed was : the diagnostic values of an electrocardiogram for purulent pericarditis was mainly in the dynamics of their signs: in the first week, the voltage diminished corresponding to a pericardium containing pus, while the ST segment went up then seemed parallel to the fibrosis of the epicardium, the liver swelled, the central venous pressure increased, the heart/chest dimension ratio decreased, the ST segment went down, the T wave became more flat and inverted.

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BALLOON DILATION OF CRITICAL VALVAR PULMONARY STENOSIS IN THE FIRST MONTH OF LIFE

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Between 1986 and 1995 23 neonates, aged 2 - 23 days (median 5), weight 2,38 - 4kg (median 3,28) with critical valvar pulmonary stenosis were scheduled for balloon dilation (PSVP). 19 children (83%) were on PGE1 and 13 (57%) needed mechanical ventilation. After stepwise dilation a final balloon : pulmonary valve (PaV) ratio of 114% (25-150) was achieved. There was a significant correlation ($p < 0,01$) between an adequately sized balloon and freedom of reintervention. Two valves could not be passed, four neonates underwent surgical procedures (brock n = 3, commissurotomy n = 1), two children (10%) died of sepsis. 17/23 patients (73%) were successfully palliated by PSVP in the first month of life. The RV : systemic pressure value fell from 132% (75-231) to 58% (40-87). Complications included 2 transient dysrhythmias, 1 transient hypoxia, 3 vessel occlusions; 1 right ventricular outflow tract perforation. In 16/17 patients follow up data is available. The residual systolic peak doppler gradient over the PaV on the last out patient visit (5-103 months after PSVP) was 10-41 mmHg (median 20). Four children needed repeated PSVP 26 to 72 months after the initial intervention.

Conclusion: PSVP of critically ill newborns is possible. The risk of mortality is relatively low. PSVP in neonates with an adequately sized balloon is a challenging alternative to surgical treatment .

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POST HYPOXIC-ISCHEMIC REPERFUSION INJURY OF THE NEWBORN HEART REDUCED BY DEFEROXAMINE. Majidah Shadid, Paul Steendijk, Ralph Moison, Enno T van de Velde, Jan Baan, Howard M Berger, Frank van Bel. Depts. of Peds. & Cardiol. University Hospital, Leiden. The Netherlands.

Post hypoxic-ischemic (HI) reperfusion induces the formation of non protein bound iron (NPBI), leading to production of the reactive hydroxyl radical. It was investigated if the iron-chelator deferoxamine (DFO) could reduce free radical production and improve neonatal myocardial performance after HI. Severe HI was produced in 13 newborn lambs and changes from pre-HI values were measured at 15, 60 and 120 min post-HI for (mean) aortic pressure (mean Pao), cardiac output (CO) and stroke work (SW). Left ventricular (LV) contractility and CO were assessed by measuring LV pressure (tip-manometer) and volume (conductance catheter), using inferior caval vein occlusion to obtain slope (Ees) and intercept of the end systolic PV relationship (V10). NPBI, reduced and oxidized vitamine C ratio (VCred/ox) and lipid peroxidation (MDA) were measured from sinus coronarius blood. 7 Lambs received DFO (10 mg/kg i.v.) immediately post-HI, control lambs (CONT) received a placebo.

Results: Mean Pao was stable, CO and SW decreased up to 60 and 40% respectively in CONT as compared to pre-HI. In both DFO-groups CO and SW remained within the normal range. Ees and V10 decreased in all groups post HI, but did not differ between groups. NPBI and MDA were higher at 15 min post HI ($p<0.05$), VCred/ox was lower at 15 min post-HI ($p<0.05$) in CONT as compared to DFO-group, indicating more oxidative stress in CONT.

Conclusions: DFO reduced the oxidative stress of the heart and prevented CO and SW to drop, suggesting a positive effect of iron chelation on the myocardium after HI.

P170

ON HUMAN HEART "VENTRICULAR BLOCK" FUNCTION
(HEART PERFORMANCE MONITORING DURING AND AFTER DELIVERY)

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From 1987 we published reports with analysis of performance of the heart as a whole organ. While analysing the heart performance as a whole, we recognize three block in it located intrapericardially: 1."atrial"block - left (LA) and right (RA) atriums; 2."aorta-pulmonary" block-aorta bulb (A) and pulmonary artery(PA); 3.ventricular "three-chambered" block (VB) consisting of:
- left (LV) and right (RV) myocardial chambers, both with blood outflow into "aorta-pulmonary" block vessels, and
- spongy (venous) myocardial chamber with the blood outflow through coronary sinus (CS) and Thebesian vein (TV) into "atrial" block. The following concepts are introduced for VB functions assessment "common" systole and "common" diastole of "three-chambered" VB.

The process of normal "common" VB systole:

- begins with blood ejection from VB spongy chamber into the "atrial" block;
 - continues with blood outflow from RV and LV into "aorta-pulmonary" block with venous minimums - x-collapses -formation in "atrial" block;
 - completes with "three-chambered" VB general emptying.
- At this period the following blood volumes are transferring:
- two-from RV and LV(their stroke volumes)into "aorta-pulmonary"block;
 - two-from "spongy" chamber into "atrial" block;
 - two-from systemic and pulmonary veins into "atrial" block during the process of so called "systolic" membrane suction (at pulling atrio-ventricular valves into RV and LV chambers as blood ejects out of them). It appears to be the regulation of blood inflow to "atrial" block by blood outflow from "three-chambered" VB into "aorta-pulmonary" block.

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P171

CHANGES IN LEFT VENTRICULAR FUNCTION IN SHOCKED NEWBORNS

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The role of heart rate and stroke volume in regulating cardiac output (CO) in newborns is still controversial. The purpose of this study was to assess the change of left ventricular function due to fluid administration in shocked infants and to determine if CO is regulated by heart rate (HR) and/or stroke volume (SV).

Material and Methods: 13 newborns with a mean gestational age of 38 (35-41) weeks, mean birth weight of 2915 (2200-3850)g were examined at mean age of 37 (2-26) hours. Indication for administration of 20ml/kg body weight of Ringer's lactate was blood pressure <10th percentile related to age and weight. Left ventricular diastolic (LVDD) and systolic (LVDS) diameter, aortic diameter (AoD), aortic velocity-time integral (VTIAo) were determined by M-mode, two dimensional and Doppler echocardiography. Shortening fraction (SF=LVDD-LVDS/LVDD), stroke volume (SV=VTIAoAoD), cardiac output (CO=SVxHR) and cardiac index (CI=CO/min/kgBW) were calculated.

Results: Changes in blood pressure (31±5 vs. 37±5mmHg, $p<.005$) stroke volume (9.7±2.2 vs. 11.2±1.8mL, $p<.005$), cardiac output (793±309 vs. 900±290mL/min, $p<.005$) and cardiac index (282±120 vs. 321±120mL/min/kgBW, $p<.005$) were statistically significant. Changes in heart rate, LVDD, LVDS, and SF did not differ significantly.

Conclusion: Volume replacement in hypovolemic newborns lead to improvement of left ventricular cardiac output by increasing stroke volume and not by increasing heart rate.

Nutrition/Metabolism

P172

CHOLELITHIASIS IN NEONATES SUPPORTED BY TPN.
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Total parenteral nutrition (TPN) is a well known cause of cholelithiasis in adult and pediatric age. Aim of this prospective study was to evaluate the incidence of cholelithiasis in the neonates submitted to TPN in the neonatal intensive care unit (NICU). During 1 year, 46 neonates (28M-18F) were supported by TPN in the NICU of our hospital; mean gestational age was 31,7 weeks (range 26-39); mean birth weight was 1625g (range 610-3400); mean onset of TPN was on 5th day of life (range 1-25) with a mean duration of 16 days (range 3-60). The administration of hyperalimentation was always by central venous line: in 7 patients PN was associated with minimal oral food. The study stated the first ultrasound and serum examination at the onset of TPN, a control every 10 days till the end of TPN and a successive check after 1 and 12 months. We used, as control group, 35 infants affected by pyloric stenosis (mean age 45.6 days) in whom, during US examination to confirm the diagnosis, the gallbladder was also studied. Twenty two patients conclude the study, 15 did the examinations till one month after the discharge and 9 patients died. GGT was increased in 26 patients, in 5 of them direct bilirubin was also raised. Three out of 26 patients with increased GGT had cholelithiasis; one, with both indices raised, had stones. Three with stones were affected by necrotizing enterocolitis (NEC). One patient had cholecistectomy during other surgery, 3 are asymptomatic and followed. The control group didn't present any sign of cholelithiasis. The incidence of cholelithiasis in this study is 8.7%. In our experience the association between TPN and NEC is at high risk to develop cholelithiasis. A follow-up US study in all the neonates submitted to TPN is suggested.

P173

TRANSPYLORIC ENTERAL NUTRITION IN CRITICALLY ILL CHILDREN
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Objective: To evaluate the efficacy and complications of Transpyloric Enteral Nutrition(TEN) in critically ill children
Patients and methods: From June 1994 to January 1996 23 children (10 boys and 13 girls), aged from 5 days to 11 years (mean 1.8 ± 3.4 years) were treated with TEN. 18 patients were included after cardiac surgery, 3 with acute respiratory failure, and 2 after cerebral surgery. The indication of TEN was mechanical ventilation in 22 patients and failure of nasogastric nutrition in 1 patient. 19 children (82 %) had previously received parenteral nutrition. 8 and 10 FG enteral tubes were inserted into duodenum through nasogastric intubation in 21 patients and by endoscopy in 2 patients. Rx and pH determination were used as methods to control tube situation. 18 children received adapted formula, 7 caseine hidrolisate, and 3 enteral formulas. (In 5 patients the nutrition formula was changed during TEN). 22 patients were supported with mechanical ventilation during TEN, 17 received midazolam perfusion (range 2 to 15 mcg/kg/min), 15 fentanyl (1 - 12.5 mcg/kg/h), and 6 vecuronium (0.1 - 0.3 mg/kg/h).
Results: TEN was used during 3 to 73 days (mean 18.3 ± 19.3 days). Mean maximum volume administered was 132 ± 47 ml/kg/day (range 34 - 208). Patients with midazolam, fentanyl and vecuronium tolerated TEN similar than children without sedatives. Complications were diarrhoea 1 patient, abdominal distension and/or important gastric fed residuals 2 patients. Pulmonary aspiration or respiratory complications were not registered. TEN was ended in one patient due to diarrhoea, in 18 due to change to oral or nasogastric nutrition, 3 children continue yet with TEN and 1 was discharged of PICU with TEN.
Conclusion: TEN is an useful method of nutritional support in critically ill children with mechanical ventilation and/or nasogastric intolerance.

P174

TOTAL PARENTERAL NUTRITION IN THE COMPLICATED SURGICAL PEDIATRIC PATIENT
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Total Parenteral Nutrition (TPN) has become very important in the management of the sick pediatric patient, both medical and surgical, without significant side effects, so allowing the survival of very low birth weight newborn infants and complicated surgical children.

Sepsis, trauma and surgery may cause a catabolic derangement of nitrogen balance.

The aim of this study was to verify if our TPN experience was able to balance the metabolic state of complicated surgical children.

Between January 1985 and January 1996 10 pediatric patients, 5 newborns and 5 children (mean age 5.2 years; range: 20 months - 10 years), 6 females and 4 males, were submitted to surgery for abdominal diseases in the Department of Pediatric Surgery of the University of Siena: nine were emergency surgical procedures. The patients were affected by peritonitis in 3 cases, acute appendicitis in 1, familial polyposis in 1, diaphragmatic hernia in 1, multiple bowel atresia in 2, annular pancreas in 1 and bowel malrotation in 1. The patients were submitted again to surgery after a mean period of 12.4 days (range: 4 - 21 days).

From the first postoperative period till after the second operation each patient received a continuous TPN containing glucose and fat as source of nonprotein calories; only in one case the child began to eat between the 2 operations. Each perioperative period implied an induction phase of TPN followed by progressive introduction of proteic and caloric requirements according to age.

The newborns received TPN containing 1.0 - 2.5 gr/kg/24 h amino acids (Trophamine 6 %: 9.3 gr N2/l), 80 - 100 kcal/kg/24 h as nonprotein calories and 100 - 150 ml/kg/24 h as fluid intake. The children received TPN containing 1.0 - 1.5 gr/kg/24 h amino acids (Parentamin 10%: 14.5 gr N2/l), 35 - 60 kcal/kg/24 h as nonprotein calories and 80 - 100 ml/kg/24 h as fluid intake. Electrolytes, trace elements and vitamins were given according to international standards.

The clinical monitoring of all the patients was based on: body weight, arterial pulse, blood pressure, temperature, central venous pressure (CVP), blood and urinary values.

Our results show that during the period of TPN each patient maintained an optimal metabolic balance without complications, so confirming the efficacy of this kind of clinical nutrition also in complicated surgical children.

P175

SAFETY AND TOLERANCE OF THE ENTERAL NUTRITION(EN) AT THE PICU SETTING. Garcia Roig,C MD; Schachner,B RD; Giraudo,N RD; Schnitzler,E MD.
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Introduction: the enteral nutritional support of the critically ill child may reduce the morbidity and mortality by attenuating the hypermetabolic and catabolic response, decreasing the gut translocation and the septic complications, improving the bowel mucosa integrity and the wound healing. The aim of this study was to show the safety and tolerance of EN.

Methods: we enrolled 36 consecutive patients admitted to our Unit from May to December 1995, mean age 3.4 years (range 1 month to 17 years). The PRISM, mechanical ventilation, inotropic use, opiates and other drugs were recorded. The EN was delivered by continuous infusion across a polyurethane tube. We kept the patients head elevated 30°, and we used cisapride routinely. The gap between admission and the EN beginning, average time to meet the nutritional objective, EN duration, selected formula, patients outcome and complications were recorded.

Results: PRISM groups were 0-1=0 patients; 1-5=1; 5-10=13; 10-15=7; 15-30=12. Two patients with MOF (Multiorgan failure) died. 72% needed mechanical ventilation. The average time elapsed from PICU admission to initiation of EN was 2.1 days (range 1 to 7) and the average duration of the EN was 7.3 days (range 3 to 14). The average time to meet the nutritional objective was 2 days (range 1 to 3). The selected formula were: lactose free infant formula in 10 patients, elemental diet in 8, Pediasure in 16 and Jevity in 2. We recorded vomiting in 4 patients, diarrhea in 5 and constipation in 4. None of them forced the EN suspension. We didn't record any case of aspiration or pneumonia. We found no relation between drugs, selected formula and complications.

We think that EN may be a safe and well tolerated procedure at the PICU setting.

P176

LIPID PEROXIDATION AND ANTIOXIDANT ACTIVITY IN POSTOPERATIVE CARDIAC PATIENTS ON PARENTERAL NUTRITION.
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Generation of free radicals in lipid emulsions used in parenteral nutrition (PN) has been described recently. This seems to be due to high polyunsaturated fatty acid content. We studied lipoperoxidation status and antioxidant parameters presurgically and through the postoperative period (5 days) in a group of twelve children (ranging from 4 months to 12 years of age), who underwent heart surgery and received nutritional support with PN.

Malondialdehyde (MDA), an end product of lipid peroxidation was used as a marker of oxidative stress. It was determined by the Yagi spectrofluorometric method. Antioxidant activity was measured with an assay based on the inhibition of spontaneous autoxidation of a brain homogenate, and vitamin E in serum by the technique of Hansen and Warick. Erythrocyte MDA release following incubation in H₂O₂ in vitro was used as a functional measure of tissue vitamin E levels. Data were compared using one-way variance analysis.

There was not significant differences in the plasma MDA production among the values obtained before surgery (3 ± 0.5 nmol/mL), postoperative pre-PN (3.5 ± 0.6 nmol/mL) and through the course of PN (3.5 ± 0.6 nmol/mL).

Levels of vitamin E previous to surgery were 5.1 ± 1.1 µg/mL and decreased to 3.2 ± 1.4 µg/mL at 24 hours post-surgery before starting PN. While receiving PN, concentrations of vitamin E increased progressively up to 7 ± 4.1 µg/mL ($p = 0.08$). Pre-surgical plasma antioxidant activity values ($72 \pm 11\%$) diminished in the first postoperative day ($56 \pm 9.5\%$) and then showed a clear increasing tendency, directly correlated with that observed in vitamin E levels.

The measurements of the maximal percentage of MDA release of erythrocytes in vitro, showed an inverse relationship with plasma vitamin E levels and with the plasma antioxidant capacity: preoperative $5.8 \pm 2.4\%$ and postoperative descending from $20.5 \pm 14\%$ to $12 \pm 9.5\%$.

Our results indicate that during surgery and within 24 hours postsurgery, a decline in antioxidant defenses occurs. In the postoperative period, while patients are on PN and taking into account our obtained data: the unaltered MDA values, the rise of plasma vitamin E levels, the recovery of both functional erythrocyte membrane antioxidant protection and the plasma antioxidant activity, they do reflect that during the intravenous administration of lipid infusions, oxidative damage does not occur, probably due to the addition of vitamin E to PN solutions in order to avoid autoxidation of lipid emulsions.

P177

KETO-ACIDS AND PARENTERAL LIPID ADMINISTRATION.
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Some metabolic studies have suggested that the administration of medium-chain triglycerides (MCT) might induce a marked increase in ketone body concentrations; the aim of this study is to evaluate the effective ketogenetic risk of infusing MCT emulsions in total parenteral nutrition (TPN).

Two groups of seriously infected children were examined: A- 12 septic infants were given to TPN with a 100 % of long-chain triglycerides (100 LCT). B- 10 septic infants, in which the lipid source in TPN consisted in a 50-50 mixture of LCT and MCT. The children in the different groups showed similar severity and therapeutic scores (PRISM, TISS, Ω_1 , Ω_2 , Ω_3); the lipid intake was the same, corresponding to 1-1.5 g/Kg bodyweight/day. In all patients a sample of urine was taken six times a day for the whole time of TPN. The urine samples were screened by the diphenylhydrazone test, and the ketoacids excretion was confirmed by a chromatography. The urinary excretion of β -keto-acids equivalent to p-OH-phenyl-pyruvate (mcg/ml urine) is summarized in the table below.

Day of T.P.N.	1	2	3	4	5	6	7
100 LCT	187 ± 36	186 ± 33	194 ± 26	186 ± 28	187 ± 23	200 ± 15	196 ± 27
50-50 LCT-MCT	183 ± 28	188 ± 26	177 ± 14	168 ± 28	169 ± 21	171 ± 21	158 ± 8
t Student test	p n.s.	p n.s.	p n.s.	p n.s.	p n.s.	p n.s.	< 0.05

No significant increases in frequency and/or in severity of Acid-Base Disturbances were found in all studied patients in consequence of the lipid infusion. The patients of B-group showed a lower excretion of β -keto-acids. The α -keto-acids excretion was ever unsignificant and seemed to be correlated with the illness severity more than with the lenght of the triglycerides chain. This observations let us suppose that the MCT, at employed doses, can be safely administered also in children with metabolic acidosis and/or serious illness.

P178**BREAST MILK CARNITINE INTAKE IN PREMATURE INFANTS**

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Carnitine is one of the essential nutrient in the diet of newborn infants.

Mothers milk represents the natural carnitine source for the newborn infants.

We studied enteral carnitine intake in 71 premature infants 35 eutrophic (Eu) and 36 hypotrophic (Hy), fed with mothers milk trough 5 consecutive days-from fifth to tenth day of life. Mean gestational age was 33 (range 32-36) weeks for Eu and 34 (range 32-36) weeks for Hy. Birth weight was ranged 1430-2450 g for Eu and 1250-2300 g for Hy ($p < 0.05$).

Breast milk carnitine concentration was 78,88 µmol/l in mothers milk delivered eutrophic babies, and significant higher mean coconcentration 113,88 µmol/l, of hypotrophic premature infants ($p < 0.05$).

Breast milk carnitine concentration was ranged between 39,15-163,71 µmol/l, and daily carnitine excretion was between 9,7-165,48 µmol/l, mean 60,6 ± 38,71 µmol/l.

The daily mean carnitine intake was from 1-1,93 mg/kg/d. in eutrophic and 1,23-1,93 mg/kg/d. in hypotrophic premature infants, in milk volumene intake from 150-200 ml/kg/d..

The results of this study suggest that premature infants should be fed with own mothers milk in early neonatal period in attempt to prevent carnitine deficiency.

P179**REYE SYNDROME**

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Five patients with Reye syndrome were studied; included were those diagnosed from January 1991 to March 1994 and treated at Cayetano Heredia Hospital. The age of presentation varied from 1.5 to 7 months. The syndrome occurred more frequently in males (4/5); the time of illness at the presentation varied from 2 to 10 days, and the following features were found: fever (3/5), alteration in mental status (5/5), seizures (4/5), gastrointestinal illnesses (diarrhea) (4/5), and respiratory insufficiency (1/5) — in this case ventilatory support was needed. In all cases hepatomegaly, intracranial hypertension, hypokalemia hyponatremia, metabolic acidosis, hyperammonemia and elevation of hepatic enzymes were found. Coagulation blood tests were abnormal in three patients. Cerebrospinal fluid (CSF) showed hypocellularity in all cases (less than 8 cells/mm³). The cultures were negative, and the final diagnosis was confirmed by hepatic biopsy. No deaths were due to Reye syndrome.

P180**A CONTRIBUTION TO THE STUDY OF REYE'S SYNDROME***Dang Phuong Kiet and Hoang Cong Chanh*

The authors analysed 38 records of patients meeting all the clinical, biochemical and anatomic criteria put forward by Hutrenlocher and Samaha (1975) who were treated at the emergency and Resuscitation Department of the IPCH in 10 years.

The average age of the children was 3 years (the youngest 11 months and the eldest 7 years. Most of them (34/38) came from the countryside to the Institute within 24 hours of the outbreak. A few days previously the patients would have fever (some of them with diarrhea or cough) and vomit then rapidly fall into coma and convulsion. They came to the Institute with the signs of typical increased intracranial pressure (stages 2-4 according to Lovejoy for most cases) but the liver was unlikely big.

The main biochemical change of the blood was acute hepatic failure

- The blood glucose decreased : (in the average 23,46mg% (26) could not measured in five cases (glucose traces).
- The blood ammonia increased from 158 to 275 microg/dL (in the average 220, n = 3)
- The percentage of prothrombin was low, in the average 44,5% (n=9), 11% at the lowest (a case of melena lasting five days was cured with vitamin K).
- GOT and GPT enzymes increased 3 - 4 times (n=14)

Besides, there was decompensated acidosis with the average values pH = 7.19; pCO₂ = 26,6mmHg and EB = -14,6 mEq/L (n=3).

The characteristic change in the cerebrospinal fluid was a low glucose concentration in the average of 18,65mg/dL (3 cases of glucose traces) ; meanwhile protein decreased in the average of 14mg/dl (4 cases below 10mg/dL). Besides there was no inflammatory lesion (postmortem examination) : very serious brain oedema and fatty degeneration of liver scatteredly or partially. Microscopically (biopsy and necropsy) in the brain appeared bright space around blood arteries and glioma extended Virchow - Robin space, with no inflammatory reaction. Liver: the structure was intact there was no inflammatory cell, the Kupffer cells did not show hyperplasia but show a heterogenous degeneration. Heart: also showed a fatty degeneration in some areas of the myocard cell. Kidney: the fatty degeneration scatteredly in the tubular cell. Pancreas:fatty degeneration scatteredly in the pancreatic cell.

Two cases of liver biopsy for the 2nd time (check before leaving the Institute) found that fatty degeneration was restored nearly completely. The exact cause remained unknown.

P181**ELECTROLYTE DISORDER IN CHILDREN WITH RESPIRATORY FAILURE***Hrnjak D.*

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Objectives: To analyse whether there exists serum and urine electrolyte disorder in children with respiratory failure.

Methods: We have made prospective study of 48 children in our ICU during a 12 month period. Electrolyte concentrations were measured in serum and urine collected during 24 hours (sodium-Na, potassium-K, chloride-Cl, calcium-Ca, magnesium-Mg and phosphorus-P).

Results: Average values in serum were: Na 139.28 +/- 3.20 (RV:133-146) mmol/l, K 4.22 +/- 0.55 (3.3-5.2)mmol/l, Cl 95.20 +/- 3.98 (93-106) mmol/l, Ca 2.12 +/- 0.12 (2.20-2.65)mmol/l, Mg 0.82 +/- 0.22 (0.77-1.12)mmol/l. Average electrolyte levels in 24 hours urine were: Na 64.23 +/- 44.11 (42-202)mmol/day, K 22.14 +/- 10.33 (22-112)mmol/day, Cl 56.14 +/- 27.22 (100-244)mmol/day, Ca 1.17 +/- 0.13 (1.68-6.8)mmol/day and P 11.89 +/- 7.12 (11.7-32)mmol/day.

Conclusions: Average serum Cl and Ca levels were decreased in children with respiratory failure. In urine, average K, Cl, Ca and Mg levels were decreased and urine P concentration was increased. We concluded that serum and urine electrolyte disbalance may be expected in children with respiratory failure.

Nursing Programme

N 001

A METHOD OF AUDIT OF NOSOCOMIAL INFECTION ON A PICU.
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Introduction

One of the authors (LJS), as part of doctoral studies, has developed nurse-based prospective audit of nosocomial infection in Adult Intensive Care. We wished to apply this method to a Multidisciplinary Regional PICU to determine the incidence of nosocomial infection on such a unit.

Method

Patient risk assessment: On admission - document risk factors (e.g. diabetes or steroid therapy), placement of invasive devices and major surgical procedures. 4 categories of infection were looked for: ventilator associated pneumonia, urinary tract infection, IV device related infection, and surgical wound infections.

Daily Assessment: 1: Assess status of each invasive device and surgical wound. 2. Using algorithm, decide on infection status of each site. For each site infection status is evaluated by 4 parameters: *a*. Clinical signs and symptoms (graded according to increasing severity). *b*.Positive bacteriology. *c*. Antibiotic prescription. *d*. Written medical diagnosis. Infection at that site is present if 2 or more of *a,b* and *c* or if *d* are positive.

Results

69 patients were admitted in a 3 month period from June 1995. Documentation was complete on 39 (56%). 5 patients (12%) acquired ventilator associated pneumonia and 2 patients (5%) developed intravenous device related septicemia. There were no urinary tract or wound infections.

Conclusion

We have developed a bedside method of prospectively monitoring nosocomial infection rates in a PICU. Use of this tool not only allows us to measure the effect of infection control interventions, but also increases staff awareness and encourages effective care planning.

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N 002

Cardiac Outputs by Thermodilution: A Comparison of Iced and Room Temperature Injectate in Pediatric Patients after Cardiac Surgery. S. Norman, MSN, L. Thompson, MD, L. Medicus, MN, Valley Children's Hospital, Fresno, California 93703, U.S.A.

Cardiac output determination by thermodilution, using iced injectate has been shown to be valid and reliable in pediatric patients. It has been demonstrated in adult patients that there is no difference in cardiac output values when using room temperature injectate as compared to iced temperature injectate. The purpose of this study is to examine the effect of injectate temperature on cardiac output values in pediatric patients. Our study consisted of sixteen pediatric patients who had oximetric thermodilution catheters in place after cardiac surgery and who had cardiac output determined using both iced and room temperature injectate. With each patient, cardiac output was measured once on the day of surgery and again the following day. In each case cardiac output was measured using both iced and room temperature injectate. Statistical analysis included a two-way, repeated measures analysis of variance for each individual injectate administered and no significant differences were found in cardiac output. No statistically significant differences were found between groups with regard to the order of injectate administration or volume of injectate used (i.e., 3 or 5 cc's). The correlation coefficients between groups for cardiac output measurements at each injectate administration time, and for the average measurements across times, ranged between 0.81 to 0.94 ($p < .0005$). Preliminary data analysis suggests that cardiac output measurements for children are not effected by the temperature of injectate.

N 003

NURSING QUALITY IN NEONATAL AND PEDIATRIC INTENSIVE CARE

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In order to improve nursing quality, we recently adapted nursing care to the "five nursing functions" (activities of daily living, accompaggnement in crisis, treatment, prevention and research) as described by the Swiss Red Cross in accordance to the new educational guidelines of the European Community. The aim of this study was to document complications of "treatment nursing function".

Methods: All treatment complications were prospectively collected by the nursing and medical staff. The nursing staff included patient (pt) name, time of occurrence and exact description of complication, proposal for prevention and information of parents. The medical staff reported type of complication together with pt information, diagnosis, medication, treatment and interventions, outcome and referral. All complications were discussed in monthly meetings including nursing and medical staff.

Results: From January until December 1995, 685 pts were admitted to the PICU/NICU for 3233 nursing days (81% of total bed occupancy). 337 pts needed endotracheal intubation for an average of 4.0 days and 47 pts required nasal CPAP. 26 complications in 21 pts were noted (1 per 26 pt): inadequate check-up of equipment 11; accidental extubation 4 (1 in 85 intubated pts); bedsores 3; false drug dosing 2; wrong drug 2; umbilical bleeding 2; wrong transfusion setup 1; nasal septal necrosis 1). There was no mortality due to these complications.

Conclusion: Exact documentation of treatment complications and their meticulous discussion within the medical and nursing staff may improve "treatment nursing function". However, documentation and evaluation of nursing within all "five nursing functions" will be necessary in order to achieve optimal nursing care.

N 004

6 YEARS EXPERIENCE OF A UNIT FOR LONGTERM-ILL AND TECHNICALLY-DEPENDENT CHILDREN

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A lengthy stay at a Paediatric Intensive Care Unit will always have side-effects on a child's well-being and will put a high strain on the parents. In order to minimize the side-effects Longterm Intensive Care Unit opened in 1990 at the Childrens' Hospital.

Admitted children are all longterm-ill and technically-dependent and the ventilatory support can alter from a tracheostoma to CPAP or Portable Volume Ventilator. Nutritional support is applied by gastrostomies. A homelike atmosphere surrounds the children, they share a dormitory, a living-room and a dining-room. The main purpose is to send the child home with or without technical equipment. This can only be implemented by giving structured education (theory and practice) to all categories involved. The multi-disciplinary team consists of one anaesthesiologist, head nurse, clinical specialist, RN nurses, nurses, one habilitation doctor, one social worker and therapists.

Results

Twenty-four patients have been admitted to LICU during these six years. Length of stay was from one day to four years. Four are presently staying at the unit.

Diagnosis:	No	Decannulated
Neuromuscular Disorders	7	-
Respiratory Insufficiencies	6	-
Airway Disorders	7	5
Miscellaneous	4	1

19 patients have been discharged. One has died. Six patients have been decannulated. 15 patients, all technically- dependent with a tracheostoma and ventilatory support, are being cared of at home by their trained parents and assistants. Follow-up by the team is carried out twice to three times per year.

N005

THE NURSE IS GOING TO KILL ME! (ICU SYNDROME)

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Content description: This presentation will provide the critical nurse with background information concerning the identification, the prevention and management of the critical ill child who has developed the ICU syndrome. The results of a questionnaire concerning the occurrence of ICU syndrome on a PICU will be presented.

Behavioral objectives: At the end of this session the participant will be able to:
 1. describe four clinical symptoms of the ICU syndrome, 2. identify major sources of PICU environmental stress, 3. discuss nursing's unique role in helping the child to cope with the ICU syndrome, 4. discuss nursing's unique role in preventing ICU syndrome.

Content outline: The ICU syndrome is a situation in which the individual is not able to deal with changes in observation and interpretation of both quantity and of patterns of sensory perceptions. In other words the borders between the inner and outer world becomes unclear for the person. The exact incidence of the ICU syndrome in the critical care setting is unknown. We have limited knowledge of the occurrence of the ICU syndrome in critical ill children. Yet critical ill children in our hospitals sometimes show the symptoms of ICU syndromes. To be able to identify the occurrence of ICU syndrome we developed a questionnaire. The thesis of the questionnaire was: Does the ICU syndrome occur in critical ill children in the age between three and ten, who have been intubated and/or ventilated in a PICU? Eighteen questionnaires have been send out to parents of critical ill children in two hospitals. The response was 90 percent.

Conclusions: 1. Most of the children were anxious (n=11), showed regression (n=8) or had sleeping problems (n=10) during the stay on the PICU. 2. Children showed the same problems after discharge. 3. There is no relationship between environmental factors and symptoms of the ICU syndrome during the stay. 4. There is no relationship between preexisting behavior and symptoms of the ICU syndrome during the stay.

Because the lack of a scientific definition for the ICU syndrome in children and good criteria for diagnosis, we were not able to get an answer to our thesis. More research is needed.

N007

VENO VENOUS HAEMOFILTRATION IN THE PAEDIATRIC INTENSIVE CARE UNIT - A NURSING PERSPECTIVE

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Continuous Veno Venous Haemofiltration (CVVH) was adopted as a first line renal replacement therapy in our Paediatric Intensive Care Unit (PICU) some three years ago. The process of introduction and development of CVVH proved to be an exciting challenge for nurses as indeed it was for the whole multidisciplinary team involved. We have successfully used CVVH in the treatment of over 20 infants and children, weighing between 3-85 kg. The range of conditions treated is ever increasing. To date we have not only used CVVH for patients in renal failure and fluid overload, but also to gain biochemical control in tumour lysis syndrome and metabolic disorders. Other distinct patient benefits in comparison with more conventional means of renal replacement therapies are that, it is a continuous controlled treatment being extremely effective in creating 'space' for nutrition, which is especially important in the fluid restricted, catabolic patient.

Of paramount importance in providing this level of service is the education and training necessary to impart the skills and knowledge for nurses to become expert practitioners in this field. We now have a team of highly advanced practitioners who have developed their nursing skills to provide even more holistic care for their patients. This group are embracing new challenges and responding positively to the developing service whilst expanding their knowledge base.

This paper will discuss the advantages and disadvantages of CVVH as we have experienced, relating it to the wide variety of patients we have treated. We wish to share how CVVH has become an accepted role of the PICU nurse and how the service has been successfully implemented.

N006

INTEGRATED CARE PATHWAYS AND CASE MANAGEMENT: CONTINUOUS EVALUATION OF CLINICAL PRACTICE AND OUTCOMES IN A PAEDIATRIC CARDIAC INTENSIVE CARE UNIT

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Integrated Care Pathways (ICP's) define the optimum course of events in the care of a patient with a specific condition, within a set timescale.

Aims and methods: ICP's and Case Management (CM) were introduced to evaluate and improve clinical practice. ICP's were developed for patients undergoing surgery for atrial septal defect (ASD) ventricular septal defect (VSD) and Fallots tetralogy. They were based on the median experiences of the last 31 patients. 108 patients have been managed using ICP's.

Results: Analysis of variation from the ICP's shows a reduction in the following potentially avoidable causes of variation: Delay in extubation has been reduced from 29% to 10%, and 31 patients (29%) were extubated earlier than the median. Prolonged stay on the intensive care unit (ICU) has decreased from 13% to 0%, and 24 patients (22%) were discharged to the ward a day earlier than the median. The number of patients receiving inadequate post operative analgesia has decreased from 35% to 15%. Delayed feeding after operation has been reduced from 52% to 28%. Unavoidable delays in extubation and discharge from ICU occurred in 22 patients (20%) because of haemodynamic instability or lung problems. CM utilising individualised pathways for these patients has reduced variation in care which can improve patient outcomes.

Pathways have been developed for other conditions and it is anticipated that approximately 80% of patients will be treated using an ICP Revision of ICP's results in continuous evaluation and improvement of the care provided.

Conclusions: The use of ICP's and CM has improved patient care and decreased avoidable delays and variations. The future development of other ICP's, combined with a case managed model for selected patients, is seen as a viable method of continuously improving patient care.

N008

AN AUDIT OF OUR EXPERIENCE WITH VENO VENOUS HAEMOFILTRATION IN PAEDIATRIC INTENSIVE CARE

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This paper is a retrospective audit of 24 children who received Continuous Veno Venous Haemofiltration (CVVH) whilst on the Paediatric Intensive Care Unit (PICU). Data was collected over a 21 month period from May 1994 to January 1996.

The 9 girls and 15 boys were aged from 1 day to 15½ years (median 4½ years) and weighed between 2.5 and 85 kg (median 17.75 kg). Length of admission to PICU was 2 to 47 days (median 9 days). Sepsis syndrome was diagnosed in 11 cases: 4 of these had bowel necrosis and 3 meningococcal disease. Eight patients had an underlying haematological, oncological or immune disorder. The remaining children had inborn errors of metabolism (2), nephrotic syndrome (2), or cardiac failure (1).

CVVH was instituted for a variety of reasons. Multiorgan dysfunction was present in 46% of patients, 29% had acute renal failure, 12.5% tumour lysis syndrome, 8.5% uncontrollable metabolic acidosis with hyperammonaemia and 4% required fluid management. Treatment was continued for between 4 hours and 26 days (median 4½ days).

Haemofiltration was successful in achieving its desired effect in all except one patient. 87.5% of children with haematological, oncological or immune disorders died despite successful haemofiltration. Survival was higher in cases of septicaemia (45.5%), nephrotic syndrome (50%) and errors of metabolism (50%). Overall mortality was 62.5%. This was attributed to the severity of the underlying disease process rather than the effectiveness of CVVH as a renal replacement therapy.

N009

CONDUCTED CURRENTS DURING DEFIBRILLATION AS POSSIBLE INJURY TO HEALTH CARE PERSONNEL.

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Asynchronous defibrillation and synchronized cardioversion deliver direct currents of high amplitude through the chest, to stop ventricular fibrillation or to convert life-threatening arrhythmias. Since the human body is partially conductive, it should be possible that after a brief delay of time, a derivation of this monophasic defibrillation pulse is measurable in regions of the defibrillated body, other than the traject between anodal ("sternum") and cathodal ("apex") paddles.

One could also estimate that health care personnel in the immediate environment of defibrillatory shocks, are always at risk to possible electric injury. Accidents might occur when health care personnel do not stand clear from the patient during firing and create an additional electric path from this patient through their own body. Most likely, the non-isolated parts creating a transversal electric path, will be the hands of the caretaker. Since defibrillation generates touch voltages up to 3000 V and 60-70 A in very short delay's (5 to 10 millisece), the total body resistance during skin to skin or skin to paddle contact, is calculated to be as low as 750 ohm (percentile rank 50 for the entire population). An experimental protocol was developed to evaluate the conducted currents during defibrillation. Mature pigs with a weight of 100 up to 150 kg. were used as animal models. They had barbiturate anaesthesia, inotropic support with dobutamine at 10 micrograms/kg bodyweight and all had a sinus rhythm at the beginning of the test-rounds. Synchronized defibrillation at 100 J (approx. 0.75 J/kg) and asynchronous - at 360 J (whenever ventricular fibrillation or ventricular tachycardia occurred), were attempted, through latero-lateral placed and firmly pressed defibrillation paddles and/or adhesive multi-function electrodes. Gel pads were chosen as contactmedium to cross the skin-paddle barrier. Subdermal electro-myography needle electrodes were put at different parts and regions of the pig's body, but not between the paddles. These electrodes were coupled to a resistance device of 800 ohm and a measuring computer. We measured monophasic and low current pulses up to 0,10 A during the defibrillation burst. Thus conducted currents are high enough to produce accidental electric shocks when additional electric paths are created by the caretaker. These are usually harmless, but in some "worst case" (wet or transpiring hands, rings,...) or in association with defective equipment, peak currents might be harmful, and can produce pain, burns, apnoea or cardiac (transient or persistent) arrhythmias.

N010**THE WITHDRAWAL OF OPIOIDS AND BENZODIAZEPINES: ADVERSE REACTIONS**

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The purpose of this study was to examine signs of distress exhibited by several patients following the discontinuation of opioids and benzodiazepines (O & B) in a 7-bed pediatric intensive care unit. The authors compiled a list of all cases of possible withdrawal reactions reported by nurses in the study setting over a one-year period. Five cases were selected for study in terms of their wide diversity of relevant circumstances. The 5 cases were examined through a retrospective chart review. Data pertaining to analgesic and sedative administration, along with nurses' reports of behavioral distress, were transcribed and coded. A remarkable pattern of behavioral distress was clearly associated with discontinuation of O & B. Cessation of benzodiazepines was associated with severe distress. These reactions were characterized by various combinations of crying, irritability, tremors, grimacing, gagging, vomiting, or feeding problems. Some of these persisted in spite of large amounts of bolus drug administration. These signs were manifested for 2 to 9 days following cessation of O & B. These findings demonstrate that the rapid weaning of O & B infusions, sometimes following short-term therapy, can cause severe withdrawal reactions. The particular course that a specific patient will follow will likely be modulated by underlying manifestations of "ICU psychosis" and unresolved pain and emotional distress.

N011**PLATELET EXHAUSTION IN EXPERIMENTAL PERfusion - EVALUATION OF AN IN VITRO MODEL.**

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Bleeding complications in extracorporeal circulation is partly due to perfusion-induced platelet dysfunction. The aim of this study was to evaluate an in vitro model for investigation of platelet function parameters in an extracorporeal system.

Study: Two complete extracorporeal life support systems were perfused with fresh heparinized human blood for 24 hours. Platelet membrane glycoprotein changes, platelet granule release and platelet count were followed. Eight paired experiments were performed. One of the circuits was perfused by a roller pump (Polystan) and the other by a centrifugal pump (Biomedicus), other components were identical.

Results: A continuous increase in glycoprotein (GP) Ib-negative platelets was seen in both circuits. A marked increase of plasma beta-thromboglobulin concentration and a decrease of the intracellular pool of serotonin was observed, indicating a marked release of alpha as well as of dense granules. The plasma concentration of glycocalicin increased in parallel with a reduced platelet surface expression of GPIb, suggesting that the loss of GPIb is caused by proteolysis rather than by a downregulation of this receptor protein.

Conclusion: 24 hours of ECLS perfusion induces pronounced platelet degranulation and causes changes of important membrane receptors. This is in accordance with clinical studies, suggesting that our in vitro model does mirror the platelet exhaustion observed in a clinical reality. No significant difference was observed between the two pumps.

N012**BRACHIAL ARTERY THROMBOSIS FOLLOWING ARTERIAL PUNCTURE ?**

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A female child, one year old, was referred to our Unit from another Hospital because she had ischemic symptoms in her right forearm which started three days before. She had a Down's syndrome and Fallot's tetralogy with a systemic-pulmonary bypass. Nine days before the admission in our Hospital she was undergone to a cardiac catheterization by arterial and venous femoral punctures with no incidences. On the admission to the PICU her forearm was cold and pale with absence of cubital and radial pulses and slow capillary filling. Treatment with Heparin was started unsuccessfully in the first 24 hours, so urokinase was added that later was changed to rTPA plus brachial plexus blockade. By the time the arterial flux became more and more evident (Doppler) it became also evident a regional edema which made necessary a fasciotomy of the wrist. She also developed necrotic delimited areas that included her first and fifth fingers. She was discharged from the PICU after 13 days and a week later she went to the operating room where an amputation of the distal phalange of the fifth finger was made. The etiology of this ischemic picture can't be attributed to the catheterization itself, but probably it should be due to some attempts in arterial puncture in its course, attempts that could be guess by the little marks noticed at the elbow flexure when she was admitted.

N013

LONG MAINTENANCE OF CARDIOVASCULAR FUNTION BY ASSISTED VENTRICULAR DEVICE WITH MEMBRANE OXIGENATOR
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 Lopez Bayón J.
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A little girl of three and a half years came to the Intensive Care Unit from the operating room. Affected of great vessels transposition with a pulmonary banding corrected with Rastelli technique. It became impossible to discharge her from the by-pass circulation. It was assumed that this fact was due to a transient myocardial dysfunction after the surgeon went through the technique and found no wrong step in it. At the PICU admission she had an ejection fraction below 20% (Echocardiography), and was maintained on ventricular assistance with a circuit consisting of a plate's membrane oxygenator, a Bio-Medicus pump and PVC rubber tubes, with monitoring of pulmonary, right and left atrial pressures. Initially she needed a ventricular support of 1.2 L/min with Dopamine, Dobutamine and Adrenaline; gradually the ejection fraction rose to 60% allowing a decrease in the mechanical and inotropic support. The organic function was preserved but X-Ray of the thorax showed images of pulmonary oedema with an increase in the O₂ needs until a FiO₂ of 0.4. Even though she was placed in a transplant program, she was removed when the ejection fraction rose to 50% on the 11th day of the evolution. There were no signs of infection (prophylactic coverage). On the fifteenth postsurgery day, with a good cardiac sound and an ejection fraction of at least 60%, it was considered the withdrawal of the ventricular support, but unsuccessfully despite the increase of inotropic drugs, so she died. We think that our patient is a good example of the possibility to maintain with ECMO during a prolonged period of time a potential transplant receiver without major complications.

N014**MECHANICAL VENTILATION OF CHILDREN AT HOME**

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Mechanical ventilation at home makes normal development of the child with chronic respiratory failure possible. The parents must be encouraged to accept the treatment at home; therefore, they should be enabled to take care of their children all by themselves and the continuous professional support has to be offered to them. It must be stressed that the nurse is the link between the diseased child and his family introducing them into the process of the medical care at home. All the equipment needed for the mechanical ventilation of the child at home (ventilator, suction device, pulse oximeter, oxygen tanks) has to be provided before the child is discharged. It is paid by the national insurance company. The maintenance service workers will make the necessary installations available and they will renew oxygen and compressed air weekly. The ventilation assembly must not interfere with the child's activities. The related dispensary and nursing service should be notified of the child's condition and the list of the required material (suction tubes, cannulas, disinfectants etc.) has to be made.

Table 1.
CHILDREN ON HOME VENTILATION

Patient	Sex	Age	Duration of home ventilation	Diagnosis	Type of ventilator
S. Z.	F	10	4 y	Adenoviral pneumonia	Monell D
K. Š.	F	5	1 y	Pulmonary fibrosis	Monell DC
N.G.	F	5	6 m	Muscular dystrophy	Monell D
T.P.	F	2	3 m	Posttraumatic tetraplegia	Puritan - Bennett

Our experience is so far - from the nursing and medical point of view - satisfactory, however the social status of the parents needs further regulations.

N015**FEASIBILITY OF EXTRA CORPOREAL MEMBRANE OXYGENATION (ECMO) WITHOUT PERfusionISTS; THE ROTTERDAM EXPERIENCE**

Joan Wierema, Marjan Mourik. Sophia Children's Hospital, Department of Pediatric Surgery, Rotterdam, the Netherlands.

The success of an ECMO program is heavily determined by the organizational structure and the daily availability of both well trained nurses and physicians. Until now there is no general guideline to determine the optimal training schedule to set up an ECMO program.

Objective: To evaluate the set-up of an ECMO program in an area without direct availability of perfusionists of cardiothoracic surgeons.

Description of the progress: During the preparation of the ECMO program which started November 1991, different phases are identified.

First phase, acquisition of experience by training abroad of one physician, staff member of the ICU, physician acting as a fellow and one ICU nurse with the primary task to serve as an ECMO coordinator and train the nursing staff.

In the second phase 12 animal experiments were performed by 2 paediatric surgeons, 2 staff physicians, 2 fellows and 12 nurses. Third phase, start of the actual ECMO program, priming by one trained nurse and ECMO fellow, daily care of the patient by 2 nurses, 1 ICU nurse taking care of the patient related activities, 1 ECMO trained nurse taking care of the circuit. Fourth phase, transition of the tasks for priming the system from the ECMO fellow to the ECMO nurse and changing daily care for the ECMO patient now including the circuit by 1 trained ICU nurse with special legislation for ECMO. Ongoing training of 6 to 8 nurses working for at least half a year in the ICU. During an ECMO run direct contact between the ECMO nurse and one of the staff members;

Patient data: In a 4 year period 52 neonatal ECMO cases were performed with an overall mortality of 74%, ranging from over 95% in meconium aspiration to 45% in congenital diaphragmatic hernia. In 7 other patients pediatric ECMO (age range 1 month - 14 months) mortality was 50%.

Conclusions: ECMO can be established without perfusionists or cardio surgical back up once a predetermined training schedule is available, resulting in comparable results with the international ECMO registry both for neonatal as well as for pediatric cases.

N016**EVALUATION OF CARE IN 23 PATIENTS WITH A (GIANT) OMPHALOCELE**

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In patients with (giant) omphalocele operative closure is impossible due to the lack of intra-abdominal space and a variable degree of pulmonary hypoplasia. Consequently conservative treatment allowing epithelialization is the treatment of choice with a high risk of infection and/or sepsis due to a sometimes very long stay in the ICU. This conservative treatment consists of daily application of an antibiotic containing powder on the cele which is covered by sterile gauzes. Furthermore the enteral intake is started as soon possible.

Objective: To evaluate whether this treatment renders a high risk for serious infections.

Patient characteristics: In a 10 year period 23 patients with a giant omphalocele were admitted; mean birth weight 2800g (1500-3990g) mean gestational age 38.5 (33-42 weeks). Overall mortality 6 (19%). 11 patients had to be ventilated for a median duration of 16 days (2,5-164).

Results: Patients were discharged at the mean of 68 days following birth (17-260) following complete epithelialization of the omphalocele. Following the initial stabilisation period parents were involved in daily care of all patients even during artificial ventilation. Enteral intake was started at a median of 2 days (1-18).

Colonization of the omphalocele was observed within 2 - 4 days in all patients. Although infectious periods were observed at regular intervals, sepsis was the primarily cause of death in only 3 of the 6 patients who died.

In conclusion: Nursing care to prevent sepsis in patients with (giant) omphalocele is feasible for a long period of time and can be performed with simple measures.

N017**THE INTRODUCTION OF THE COMFORT SCALE IN A PEDIATRIC SURGICAL ICU.**Corina Smits¹, Josien de Boer²'Sophia Children's Hospital, Dept. of Pediatric Surgery, Rotterdam, the Netherlands. ²Erasmus University Rotterdam, Dept. of Medical Psychology and Psychotherapy, Rotterdam, the Netherlands.

Introduction: The assessment of pain in children (0-3 yrs) is still difficult, because children of this age have limited language and cognitive skills. To standardize the assessment of postoperative pain and distress in the intensive care unit an observational instrument was needed that met several criteria. It should be easy to use in daily routine care, be suitable for the i.c. situation, and in children of 0-3 hrs of age. The COMFORT scale, an observational instrument designed to assess distress in infants in i.c. units, met these criteria. To accommodate the use of the COMFORT scale in the i.c. units and in research, nurses should be trained to use the scale. An additional requirement was that the inter-rater reliability should be sufficiently high, (Cohen's kappa > .60).

Objectives: 1) To introduce the COMFORT scale in the I.C.U.; 2) to examine whether this instrument can easily be incorporated into routine care; 3) to investigate the inter-rater reliability.

Methods: The COMFORT scale is an 8-item instrument specifically designed for use in pediatric i.c. units and contains both physiological items (heart rate, blood pressure) and behavioral items (e.g., alertness behavior, calmness/agitation, body movement, facial expression, respiratory response, muscle tension). The observation period is 2 minutes. The scale is supplemented with an item on crying for children who are not mechanically ventilated. Groups of 8 i.c. nurses were trained by means of video's and observations at the wards. After the training, each nurse completed 10 scores with other nurses, after which the Cohen's kappa was computed. When the kappa's for the items met or exceeded our .60 criterium, a new group of nurses was trained.

Results: To date, 30 nurses have been trained. Nurses find the COMFORT scale easy to administer and a valuable addition to routine care in the i.c. unit. The Cohen's kappa's were higher than .60 for all items that the inter-rater reliability was high.

Conclusions: The COMFORT scale is feasible in postoperative care in the i.v. and is considered a valuable instrument to improve and maintain high postoperative quality of care in the i.c. unit.

N019**NUTRITIONAL ASSESSMENT IN CHILDREN WITH NEURO-MUSCULAR DISEASE AND NOCTURNAL NASAL MASK VENTILATION**

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Introduction: Children with neuro-muscular disease are believed to have a higher Resting Energy Expenditure (REE), because of their increased work of breathing. The influence of nocturnal nasal mask ventilation on energy metabolism and nutritional state of these children has not been studied so far. **Objective:** 1. Is the REE increased? 2. Is there an influence of nasal mask ventilation on the REE? 3. What is the nutritional state? 4. What is the estimated total energy expenditure(ETE) in relation to the caloric intake? **Methods:** A pilot study of 4 patients(12-16 years). The following measurements were performed: 1. Anthropometry. 2. Bioelectric impedance. 3. REE was measured by indirect calorimetry during the day (in bed) with and without nasal mask ventilation. REE was compared with predicted REE according to Schofield(PEE). 4. Caloric intake and activities were recorded during 48 hour before measurement. 5. Total energy expenditure was calculated as follows: measured REE x estimated activity factor.

Results: In all children weight for height was too low, <p3. All children had a low % of fat. 3. According to the healthy group, REE is not increased. 4. Nasal mask ventilation lowered REE in 2 patients, in 1 patient we measured a clear decrease. **Conclusion:** 1. Anthropometry and indirect calorimetry were helpful in evaluating the nutritional state. 2. There is no increased REE, in 1 patient there is clearly effect of nasal mask ventilation. 3. When caloric intake was related to REE and level of activity 2 patients had too low caloric intake. 4. The influence of nocturnal nasal mask ventilation and nutritional assessment should be evaluated longitudinally. **Table:** patient characteristics

Patient/age	M/14,3 y	F/16,6 y	F/15,6 y	F/12,8 y
weight (kg)	42,4< p3	30,3< p3	21,5< p3	32,6< p3
height (m)	1,68> p50	1,46< p3	1,47< p3	1,59> p50
REE kcal	1430	1129	1060	1208
MEE1/MEE2	1445/1521	1008/985	1107/877	1152/1080
ETE/intake kcal	2457/3066	1310/935	1439/839	1498/1831
% fat	12 %	18 %	9 %	22 %

MEE 1 = measurement 1, without nasal mask ventilation,kcal

MEE 2 = measurement 2, with nasal mask ventilation,kcal

N018**A CASE-CONTROL STUDY OF PAIN MANAGEMENT IN THE SURGICAL NEONATE: AN EVALUATION OF 52 PATIENTS WITH OESOPHAGEAL ATRESIA.**

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Increasing awareness that the neonate can percept pain and suffer following surgical procedures, has major impact on pain management. In our unit continuous morphine infusion (10 μ g/kg/hr) was introduced from January 1990 as a standard medication following surgical procedures. Before 1990 Morphine was given as a bolus (i.m., i.v., rectal) of 100 μ g/kg up till four times a day. Repeated gifts of morphine were only given following observation by the nurse that the child experienced pain. **Aim of the study:** To evaluate pain management before and following introduction of a continuous morphine infusion for postoperative pain in our ICU.

Patients and methods: Term born babies with isolated oesophageal atresia and tracheo-oesophageal fistula were included in the study. The total amount of morphine (μ g/kg/24 hours); number of days morphine was given; duration of artificial ventilation was evaluated in a case control study.

RESULTS:	1985-1990	1991-1994
Number of patients	36	18
Morphine 0	36	18
at day 1	20	17
2	12	18
Morphine dosage at day 0	156(0-330) μ g/kg/24hrs	264(0-456)
1	93(0-360)	193(0-480)
2	33(0-320)	165(0-396)
Median morphine dosage at day 0	145 μ g/kg/24hrs	240
1	60	216
2	0	240
Duration of artificial ventilation mean (days)	1.7(0.5-6)	2.9(1-7)
median (days)	1.	3.

Conclusions: Continuous morphine infusion following major operative procedures in the neonate results in much higher dosages; longer duration of morphine for the first 48 hours following operation and duration of artificial ventilation.

N020**CENTRAL VENOUS CATHETERS - OUR APPROACH**

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Central venous catheters (CVC) have been increasingly used also at our PICU, University Medical Centre Ljubljana. Besides advantages, the CVC has brought numerous risks of complications; the catheter sepsis occurs most often and can be fatal for the patient. For example, in 1995 we dealt with 400 children aged 0 - 12 years or in other words 1.14 CVP per a child treated at our PICU. A specialized unit for preparing parenteral nutrition started to function in the University Medical Centre Pharmacy in 1977. After that we equipped a special room for preparing other necessary infusion mixtures and organized a team of nurses - "catheter nurses".

Their tasks comprise: managing CVCs, replacing and installing infusion systems and mixtures made at pharmacy, preparing drugs and some necessary infusion mixtures in special room, permanent training and co-operation with related disciplines, pharmacy, epidemiology, microbiology, etc. All registered nurses at PICU have been trained for this work. The routine is as follows: in the morning - after the doctor's visit, we first check the CVC and change the dressings; according to the nurse's observations, the doctor decides whether there is a need to remove or replace the CVC. If the catheter site is inflamed, swollen, or purulent, a swab is taken for microbiological culture and the area cleaned. In case of systemic infection signs, CVC has to be replaced, blood culture taken and the infection treated with antibiotics. The dressings are always changed by two TMcatheter nurses together. Afterwards the infusion mixtures for the next 24 hours are prepared for each child. The infusion mixtures which will not be used immediately are kept on +4°C; before application they are, of course, warmed to at least room temperature. Finally the "catheter nurse" supplies the CVC with new infusion mixtures made at our pharmacy. Our observations show that such work requires responsibility and is demanding; but our permanent care lessens the number of complications. Thus the described scheme fulfilled our expectations.

N021

Peri-operative management of neonates with Hypoplastic Left Heart Syndrome

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Both the pre-operative and post-operative physiology of patient with Hypoplastic Left Heart Syndrome is critically determined by the pulmonary-to-systemic resistance ratio. A high ratio results in minimum volume work for the right ventricle but is at the expense of important hypoxemia. A low ratio is reflected in minimum hypoxemia but an unfavorable increase in excess ventricular volume work. A resistance ratio of approximately 1 results in an arterial oxygen saturation of 75% - 80%, a Qp/Qs of 1, and ventricular volume work only twice normal. This latter physiology appears best for oxygen delivery and systemic perfusion with tolerable volume work. Carbon dioxide (CO₂) in the inspired gas is known to increase pulmonary vascular resistance without significantly influencing systemic resistance in the range of 1 to 20 torr partial pressure. Hyperventilation with no CO₂ in inspired gas decreases pulmonary vascular resistance. Thus, managing CO₂ may be useful to modulate the pulmonary-to-systemic resistance ratio. In the last 16 months, 20 patients with Hypoplastic Left Heart Syndrome were managed by a Norwood procedure. 10 patients with endotracheal intubation pre-operatively had CO₂ added to inspired gas to modulate the pulmonary-to-systemic flow ratio. 17 patients had CO₂ added to inspired gas post-operatively. All but 1 patient had characteristically large pulmonary-to-systemic flow ratio with oxygen saturation mean 90 % pre-operatively, even in those patients receiving CO₂. CO₂ was accompanied by elimination of metabolic acidosis pre-operatively. The most common partial pressure of CO₂ added post-operatively was 14 torr. pO₂ ranged from 25 mmHg to 40 mmHg. All surviving patients developed a metabolic alkalosis (10 mean) when treated with CO₂. There were 4 deaths, one from drug toxicity, one from excessive post-operative hemorrhage, two from sepsis or myocardial insufficiency. Only one patient benefited from catecholamine support which can increase systemic resistance unfavorably. In this experience CO₂ was felt to be an important adjunct in some patients pre-operatively and most patients post-operatively to favorably modulate the critically important systemic-to-pulmonary flow ratio, to maximize oxygen delivery and systemic perfusion, while minimizing excessive right ventricular volume work.

N022

EMCO in the postcardiotomy infant : a simplified circuit and reduced management

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To improve postoperative survival of infants with repaired cardiac lesions but severe residual cardiopulmonary dysfunction, EMCO was used in 4 infants, ranging in age from 10 days to 9 months and in weight from 2,8 kg to 7,8 kg. Diagnosis included TGA / intact ventricular septum (2) (both subjected to rapid arterial switch operation because of unsuitable LV function) and TGA + VSD (2). The EMCO circuit included a Sarns roller pump, a Medtronic Minimax plus Hollow fiber oxygenator and tubing (1/4 - 1/16 inch) with bioactive surfaces, an arterial canula 10 Fr., 2 venous canulas : right atrial 20 Fr, left atrial 12 Fr., an air oxygen mixer and a Sarns heater. The ACT was kept between 180-200 sec. After the infant was connected to EMCO by the surgical team and the Perfusion Technologist, the patients were being cared for and controlled exclusively by the ICU nurse assigned to the patient and the physician on call for the ICU. Pump flows of 100-150ml / kg / min were targeted to insure an adequate urine output, a brisk capillary fill and physiologic left and right atrial pressures. Sodium nitroprusside was used to control systemic hypertension while all other inotropic drugs were discontinued. Inspired oxygen fraction on the ventilator was reduced to 0,25 at a respiratory rate of 10-15 breaths per minute. Body temperature was maintained close to normal. When the heart started to eject again, inspired oxygen was increased to about 0,40. The preparation for weaning from EMCO was done by the ICU nurse: including oxygen fraction and ventilator rate. Weaning from EMCO was coordinated by the medical / surgical team and the Perfusion Technologist. The duration of EMCO in the 4 patients ranged from 2 to 9 days. Three patients (75%) were successfully weaned from EMCO. One of the three died within 24 hours from neurologic complications, unrelated to the EMCO. The other 2 patients (both with TGA + VSD) are long term survivors and are doing well. Neither the survivors nor the patients who died had hemorrhagic complications, despite the fact that 3 of the 4 were placed on EMCO because of failure to wean from cardiopulmonary bypass. The simplified EMCO circuit worked reliably throughout this experience and no complications occurred nor could any shortcoming be ascribed to the use of this reduced, cost effective management team.

N023

NASAL CPAP AND SURFACTANT IN THE TREATMENT OF NEONATAL HYALINE MEMBRANE DISEASE

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Since June 1994, we have been using Nasal CPAP in the treatment of respiratory disorders in newborn infants (Severe Apnea Syndrom, Tachypnea, Hyaline Membrane Disease). In newborns presenting hyaline membrane disease, we have used CPAP and administered surfactant therapy to 25 premature babies out of 70. Clinical data were : Mean GA : 30.8 ± 23 weeks. Mean BW : 1686 ± 551 g. Mean administration time was 11 hours. Before administration, mean FiO₂ was 0.4 ± 0.07, mean PaO₂ 6.2 ± 1.8 KPa and mean a/AO₂ ratio 0.21. All babies were intubated for administration of surfactant (Curosurf) and were extubated after half an hour to 3 hours after administration. This treatment failed for seven babies and they were ventilated by oscillation ventilation ; all babies survived.

Complications : we have observed pneumothorax in 2 cases and 1 cerebral hemorrhage. Mean duration time of nasal CPAP was 71 hours for the 18 babies without assisted ventilation.

Nurses in charge of babies with nasal CPAP should be aware of neonatal care, of the possibility of surfactant administration and of complications during this type of treatment. Therefore nurses should know very well the use of nasal CPAP, the monitoring during this treatment, the fixation of the system on the baby, nursing of the babies during this treatment and finally should take care of the baby physical and psychological well being.

As a conclusion, nurses in intensive care neonatal units should know the possibility of treatment of RDS by nasal CPAP and should be aware of baby-nursing.

N024

10 YEARS OF PRACTICAL EXPERIENCE WITH EXTRACORPOREAL MEMBRANE OXYGENATION (ECMO) - THE VIEWPOINT OF THE NURSING STAFF

Monika Schindler

In 1985 a training program was started for the introduction of ECMO in the Kinderklinik of Mannheim/Germany. 2 years later (1987) the first European ECMO patient, a 3 days old newborn baby, was treated successfully in our institution. With ECMO, more treatment modalities were available after failure of conventional therapy in cases of severe lung diseases like meconium aspiration syndrome, congenital diaphragmatic hernia, sepsis/pneumonia, primary persistent pulmonary hypertension of the newborn and - in infants and children - ARDS (acquired respiratory distress syndrome) due to multiple underlying illnesses. In 1989 the first ARDS patient, a 5 years old girl, was treated successfully with ECMO in Mannheim. Until now 137 patients (age: 1 day - 10 years) were treated with ECMO in our institution; 111 additional patients were transferred to us from other institutions for therapy with ECMO, but could be treated with alternative modalities of therapy like improved conventional ventilatory support, high frequency oscillatory ventilation (HFOV) and inhaled nitric oxide (NO). Unexpectedly the more wide-spread use of HFOV and NO - also in other intensive care units - did not lead to a reduction of the ECMO frequency in our hospital. Due to this long ECMO practice, which is helpful in many critical situations, a certain routine came up in the nursing staff of our intensive care units; but ECMO continues to be a maximum strain for all co-workers and implies an high personnel and material/financial expense. But in our opinion the improved survival rates in severe respiratory failure (70 % in neonates and 50 % in infants and children, estimated survival rates under continued conventional management: < 20 %) by the use of ECMO justifies this expense, even in times of less financial support for public health.

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N025**NOSOCOMIAL INFECTION IN 18 FRENCH PICU AND NICU**

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Nosocomial infections (N.I.) represent a National Public Health problem that we need to prevent. A french N.I. surveillance network : REA PED was created under the Groupe Francophone de Réanimation et Urgences Pédiatriques supervision and the help of NPH network with 3 objectives :

- 1 - Evaluate the NI incidence rate according to age,
- 2 - describe the micro-organism responsible,
- 3 - analyse the differences between each unit.

Method : NI criteria were defined by the REA PED Group according to CDC criteria. All data were collected by a nursing and medical team. Data were dealied with EPI INFO software. All infections data were validated by an external investigator.

Results : 4 525 patients who stay more than 48 hours in an ICU were included over a 14 months period. 68 % were newborns, 19 % infants and 13% children.

371 NI were identified among 311 patients. The overall NI incidence rates was 8,2 % and 5,9 person day. Septicemia was the first cause of NI (50%). Staphylococcus epidermidis were isolated in 60 % of septicemia cases. Pneumonia was the other main NI (41 %) with Gram negative bacille isolated in 53 % (40 % of them being Pseudomonas). According to age, the septicemia incidence rate varied from 6,8 % to 10,9 %, catheter/day and pneumonia incidence rate from 3,9 % to 7,3 % ventilation/day with the lowest rate for newborns.

Discussion : this survey was possible thanks to the collaboration between laboratories, bacteriologist, physicians and nurses, and allowed each concerned unit to work together instead of every one in his own field.

The results of this survey bring changes in attitudes and empower the different team work.

The next step is to analyse the different nurses procedures of indwelling central venous catheter in each unit and implement a NI quality care program in all NICU and PICU.

N026**CHILDRENS' MANAGEMENT IN INTENSIVE CARE UNIT AFTER ENDO-VASCULAR TREATMENT OF VEIN OF GALEN ANEURYSMAL MALFORMATION**

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INTRODUCTION: So-called vein of Galen malformations are rare intracranial embryological anomalies, representing less than 1 % of symptomatic intracranial arteriovenous malformations. The spontaneous prognosis is usually fatal, because of cardiac failure due to left-to-right shunt through the fistula. Recent developments of new techniques of treatment of the malformation and its cardiac consequence have led to a revolution in the practical approach of children with Galen malformation.

OUR PURPOSE is to contribute, with our personal series of 75 newborns and infants admitted in our unit after endovascular embolization, to a better management of these children.

Such a management requires a multidisciplinary approach. Intensive care are required prior to embolization for patients with cardiac failure or cardiogenic shock and after embolization in order to insure cardiac and cerebral hemodynamic stabilities.

This overlooking suppose for the nursing team to understand:

prior to embolization : heart failure and cardiogenic shock,
after embolization : evaluation of neurological and hemodynamic consequences of this procedure, without forgetting the nursing and psychologic aspects.

IN CONCLUSION, this last ten years, these new approaches give to the patients and their family a good reason to hope a total recovery. In our experience, the global mortality is 9 % and 66 % of children are neurologically normal after embolization.

N027**PROBLEMES ATTACHED TO DRUGS PREPARATION AND THEIR I.V. ADMINISTRATION IN NEW BORN.
ERRORS ANALYSES AND PROPOSITIONS FOR SOLUTIONS.**

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Goals for survey : new born intra-venous drugs and their preparation encounter a lot of risk of errors, due to inadapted conditioning to pediatric and minimal amount injected. This study tried to evaluate degrees of dosage errors due to drugs preparation in neonatology and to come out with a method of dilution able to reduce risk to minima (errors $\leq 5\%$). At the same time, consequences on cost were studied.

Method : Amikacine was chosen because this antibiotic is regularly used in neonatology unit and its dosage is easily used by standardized method. 30 Amikacine doses (15, 23 mg doses and 15, 12 mg doses) were prepared by 15 nurses form 50 mg for 1 ml vial. Each dose was diluted to obtain 2 ml volume, following usual ward method. For each dilution, Amikacine concentration and its volume was measured and used equipment for preparation was registered.

10 "first solution" were prepared diluting 500 mg Amikacine powder into 50 ml glucose solution bag (Viflex Baxter bag with transfer cap). From those "first solution" 15 doses of 23 mg and 15 doses of 12 mg were prepared. Amikacine concentration for each preparation and their volume were measured, also number of serings were counted. "First solution" stability was controled after one week conservation at +4°C. Amikacine concentration were measured by fluorescence process (TDX ABBOTT) after sample dilution. On a 10 mg/l sample, technical reliability shows > 95 % of result reproduction and < 5 % of variation due to dilutions.

Results : when Amikacine injection were prepared from Amikacine 50 mg for 1 ml vial > 10 % dosage, errors were found in 19/40 cases ; $\geq 30\%$ in 4/40 cases. If preparation is done from Amikacine "first solution", less concentrated, it is more precise and only one dosage error > 5 % (6,3 %) is found in all 30 studied doses.

In addition to that, if 10 doses were prepared from one "first solution" bag, the cost economy should be of 32 frs, and if 20 doses were prepared from the same bag the saving money should be of 172 frs.

Conclusion : our survey shows that in neonatology the use of a "first solution" which can be kept for one week is enable to reduce dosage errors and is costsaving. Regarding I.V. administration method the survey is still on.