16. Respiratory – Posters

011

PROGNOSTIC VALUE OF TNF-α PLASMA LEVELS DURING FIRST 24 HOURS OF ACUTE LUNG INJURY AS A PREDICTOR OF DEVELOPING ARDS

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OBJECTIVES: Inflammatory mediators appear to play key role in the development of adult respiratory distress syndrome (ARDS) in critically ill patients. Cytokines involved in the early phase include tumor necrosis factor alpha (TNFα) and selected interleukins. Experimental infusion of TNFα has been shown to cause ARDS and increased concentration of cytokines in the lungs of the patients with ARDS has been described in both early and late phase of lung injury. The aim of this study was to evaluate the plasma levels of TNFα in patients with acute lung injury (ALI) who are at the risk of developing ARDS. We expected to observe higher and/or increasing TNFα plasma levels in patients with subsequent ARDS development.
METHODS: We prospectively studied 13 critically ill patients requiring ventilatory support with sign of acute lung injury (paO_2/FIO_2 =150-300) at the time of admission to ICU. Plasma levels of TNFα were measured at 4,8,12 and 24 hours after admission to ICU (T4, T8, T12, T24). Subsequent development of ARDS ($paO_2/FIO_2 \leq 150$), Apache II Score, length of ventilatory support and clinical outcome were also calculated. Results are expressed as mean ± SD. Student t-test or Mann-Whitney Rank Sum test (where appropriate) were used for statistical analysis, $p< 0.05$ was considered statistically significant.
RESULTS: Of the 13 patients 6 patients subsequently developed ARDS (Group ARDS), 7 patients did not (Group ALI). There were no significant differences in TNF alpha plasma levels between both groups. Values of TNFα plasma levels in pg/ml during first 24 hours after admission are presented in the table.

Time	T4	T8	T12	T24
ARDS	3,4±5,3	3,3±3,6	8,1±6,5	4,6±4,2
ALI	6,4±9,3	4,3±6,1	2,8±3,7	1,8±2,8

DISCUSSION: The mean TNFα plasma levels did not significantly differ between groups, but at time intervals T12 and T24 there were insignificantly higher TNFα plasma levels in patients who subsequently developed ARDS. The obtained values in this group also show increasing patterns of TNFα plasma levels during observed period. Because of small sample size, more patients will be needed to validate any clinical importance of these findings.

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018

EPIDURAL ANALGESIA FOR CONGENITAL DIAPHRAGMATIC HERNIA SURGERY: A STRATEGY TO LIMIT POSTOPERATIVE VENTILATION

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OBJECTIVES: This study was undertaken to assess the effect of epidural analgesia and delayed surgery with preoperative stabilisation on mortality and need for neonatal intensive care unit (NICU) admission following surgical repair of congenital diaphragmatic hernia (CDH).
DESIGN/SUBJECTS: The study is a retrospective chart review of all neonates who presented to our unit with CDH between November 1988 and November 1993.
METHODS: The following details were extracted from the charts: age at presentation, delay from presentation to surgery, pre- and postoperative ventilatory requirements, surgical findings and anaesthetic technique. Results were compared using appropriate analysis of variance techniques with statistical significance taken a the 5% level ($p<0.05$)
RESULTS: 35 of 41 records were available. 33 repairs were undertaken with an operative mortality of 30.3%. 23 repairs were done within 24 hrs of diagnosis (7 deaths) while 3 deaths occurred in 10 neonates having delayed repair (p - NS).
8 neonates had general anaesthesia (GA) with 6 deaths while 4 deaths occurred in the group of 25 who had epidural supplementation (ES) ($p=0.004$).
All neonates receiving GA required postoperative NICU admission for ventilation compared with 14 of 25 who had ES ($p=0.03$).
CONCLUSION: The change in anaesthetic management of neonates with CDH (ES) appears to be beneficial, allowing postoperative extubation and ward management in an appreciable proportion of cases. The benefit of delayed surgery with preoperative stabilisation could not be demonstrated.

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025

β_2-MIMETIC INHALATION THERAPY DOES NOT INFLUENCE AIRWAY PRESSURES AND LUNG MECHANICS IN VENTILATED PATIENTS WITH BRONCHOPNEUMONIA WITHOUT AIRFLOW OBSTRUCTION.

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BACKGROUND AND OBJECTIVES : β_2-mimetic agents, either given by nebulization (NEB) or by metered-dose inhalation (MDI) substantially reduce airway resistance in mechanically ventilated patients with COPD or ARDS. We assessed if this approach could be extended to mechanically ventilated patients with severe pulmonary disease in the absence of airway obstruction.
DESIGN : Prospective, randomized study .
SUBJECTS : 7 ventilator-assisted patients with bilateral bronchopneumonia but without any objective airflow limitation. All patients were curarized, sedated and ventilated using volume-controlled ventilation with a constant inspiratory flow.
METHODS : Patients were randomized to receive equivalent doses of salbutamol, delivered either via MDI using a spacer device (Aerochamber^R) or by NEB. After a 4 hr washout period, patients were crossed over to the alternative route of administration. Respiratory mechanics were obtained from ventilator digital readouts of exhaled tidal volume, peak inspiratory pressure (Pip) and plateau pressure (Pp) and calculations of resistive pressure (Pr = Pip - Pp), static lung compliance (Cst) and mean airway resistance (Mraw). Measurements were performed at baseline, 5, and 60 min after drug inhalation. Student t-test was used for comparisons within and between groups. A p value < .05 was considered significant.
RESULTS : Pr, Cst and Mraw were not different at baseline, at 5, and at 60 min between the NEB- and the MDI treated group. These parameters also did not change significantly within each group at any time point during the study.
CONCLUSION : Based upon these findings, the use of inhaled β_2-mimetic drugs seems superfluous in mechanically ventilated patients with severe bronchopneumonia without airflow obstruction.

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035

A PROSPECTIVE STUDY OF PREDICTING 3-DAY OUTCOME OF WEANING FROM MECHANICAL VENTILATION

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OBJECTIVES: To determine the accuracy of spontaneous minute ventilation (V_E), maximum inspiratory pressure (PImax) and rapid shallow breathing index (f/V_T) in predicting 3-day weaning outcome.
METHODS: The study included 42 patients on mechanical ventilation (MV), who were anticipated to have weaning difficulty in the 6-month period between August 1995 and February 1996. Just before the weaning assessment was performed, the nurse, respiratory therapist and attending physician taking care of each patient were asked to predict the number of days needed to wean the patient off MV. Spontaneous respiratory rate, V_E and PImax were measured and the f/V_T calculated. PImax $\leq$ -25, $V_E \leq$ 10 L/min and $f/V_T \leq$ 100 were considered to be predictive of weaning success. Weaning success was defined as sustaining spontaneous breathing within 3 days of weaning assessment and for at least 24 hours without ventilatory assistance. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and total correct prediction (TCP) were calculated.
RESULTS: Seventeen patients were male; 28 were African-American and 14 Caucasian. Their mean age was 56.0±14.1 years. The common causes of the respiratory failure were pneumonia(16), CHF(6) and COPD(6). They had been on MV for 12.8±9.6 (median 11) days before weaning assessment. Weaning was successful in 18(42.9%) patients. The predictive values of each test are listed in the table:

Test	Sensitivity	Specificity	PPV	NPV	TCP
Nurse	0.56	0.67	0.56	0.67	0.62
Respiratory therapist	0.56	0.67	0.56	0.67	0.62
Physician	0.61	0.67	0.58	0.70	0.64
PImax	0.94	0.17	0.47	0.80	0.51
V_E	0.39	0.46	0.35	0.50	0.43
f/V_T	0.72	0.46	0.50	0.69	0.57

CONCLUSIONS: PImax, V_E and f/V_T are not superior to clinical assessment alone in predicting 3-day weaning outcome.

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041

WEANING INDICES REVISITED TO INCREASE SPECIFICITY FOR SUCCESSFUL EXTUBATION

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OBJECTIVES: Prolonged connection to ventilator and emergency reintubation both expose to nosocomial pneumonia hazard, increased ICU stay and death. Thus, accurate determination of the proper time for extubation is a major issue. Weaning indices allow the screening of patients. Despite these indices, extubation failure often occur. The aim of our study was to determine new threshold values to increase the specificity of weaning criteria for successful extubation.
DESIGN: A prospective study in a medico-surgical ICU.
SUBJECTS: 52 patients ventilated for more than 48 h were studied. They were 59±16 y, their Apache II on admission was 20.6±8.6, they were ventilated for 10±11 days. 12 patients had COPD.
METHODS: The following weaning tests were performed after disconnection from the ventilator: RR, Vt, RR/Vt, VC, VE, MIP, MEP. If the attending physician judged the weaning tests correct, he decided extubation after a 2h T-piece trial independently of the investigators. Weaning was considered successful when the patient was extubated and no ventilatory support was needed for 48 h.
RESULTS AND STATISTICAL ANALYSIS: Weaning failure occurred in 8 (15%) patients (2 not extubated, 6 reintubated). Sensitivity (Se) and specificity (Sp) of the threshold values (old thresh) were determined, as well as the area under the ROC curve (auROCc) for each weaning index. Se and Sp of best threshold values (new thresh) deducted from ROC curves were calculated. With new thresh, the auROCc for the number (nb) of criteria met was 0.79.

	old thresh	Se	Sp	auROCc	new thresh	Se	Sp
RR	<35	1	0	0.65	<24	0.66	0.75
Vt(ml/kg)	>5	0.82	0	0.43	>8	0.30	0.75
RR/Vt	≤105	1	0	0.51	≤45	0.41	0.75
VC(ml/kg)	>10	0.89	0.25	0.64	>14	0.57	0.75
VE(ml/kg)	<200	0.95	0.25	0.73	<150	0.68	0.62
MIP(cm H_2O)	<-25	0.91	0.13	0.78	<-30	0.52	0.88
MEP(cm H_2O)	>+30	0.91	0.25	0.74	>+45	0.59	0.88
Nb criteria	≥4	1	0		≥3	0.68	0.88

CONCLUSION: The specificity of weaning criteria for successful extubation might be hugely increased by using these new threshold values.

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042

T-PIECE TRIAL DOES NOT IMPROVE PREDICTION FOR SUCCESSFUL EXTUBATION

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OBJECTIVES: Numerous weaning indices have been developed to help predict successful extubation after prolonged mechanical ventilation. When weaning criteria are fulfilled, the last step is often a T-piece trial. But spontaneous ventilation through the tracheal tube increases ventilatory work and may exhaust the patient, and allows less ventilatory monitoring. The aim of our study was to assess whether T-piece trial adds predictive information on that given by other weaning indices.
DESIGN: A prospective study in a medico-surgical ICU.
SUBJECTS: 52 patients ventilated for more than 48 h were studied. They were 59±16 y, their Apache II on admission was 20.6±8.6, they were ventilated for 10±11 days. 12 pts had COPD.
METHODS: Weaning tests were performed after disconnection from the ventilator. The following threshold values are routinely used in our unit: RR<35, Vt>5 ml/kg, RR/Vt≤105, VC>10 ml/kg, VE<200 ml/kg.min, MIP<-25 cm H_2O, MEP>+30 cm H_2O. No instruction was given to the attending physician regarding the number of positive tests needed for extubation. If he considered extubation possible, a 2 hour T-piece trial was performed. Clinical signs, blood gas analysis and lactate level were recorded at 30 min, 1h and 2h. Extubation was then decided independently of the investigators. Weaning was considered successful when the patient was extubated and no ventilatory support was needed for 48 h.
RESULTS AND STATISTICAL ANALYSIS: Weaning failure occurred in 8 (15%) patients (2 not extubated, 6 reintubated). In univariate analysis, only 4 weaning indices significantly differed between failure and success: MIP(cmH_2O), p=0.010; MEP(cmH_2O), p=0.020; VE(ml), p=0.039; VE(ml/kg), p=0.041. No parameter recorded during T-piece trial significantly differed between failure and success. In stepwise logistic regression, only MIP, p=0.038 and VE(ml/kg), p=0.040 remained predictive of extubation success. These indices had the largest areas under ROC curves (0.77 and 0.73 respectively), with best threshold values of -30 cmH_2O and 150 ml/kg respectively.
CONCLUSION: When MIP and VE(ml/kg) are used to screen patients for extubation, a subsequent T-piece trial does not appear to improve prediction for success.

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047

SEVERE ASTHMATIC CRISIS IN PEDIATRIC INTENSIVE CARE UNIT

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During the United Nation's embargo against Yugoslavia the prevalence of the asthmatic attacks in children araised. The most common causes have been: drammatic 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 cryses, 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 refugees 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 repeate.

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060

A COMPARATIVE STUDY OF SURGICAL VERSUS PERCUTANEOUS TRACHEOSTOMY IN ITU.

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Objectives: A prospective study over 1 year compared the indications and complications of conventional surgical versus (PCT) percutaneous tracheostomy (Portex).
Results : The clinical indications in the surgical group [n= 34]were principally cancer surgery (22) and airway obstruction(5) whereas in the percutaneous ITU group [n=38] respiratory failure (17) and long term ventilation following surgical complications (14) were more common and are tabled below.
Table of complications:

	Surgical 12/34	Percutaneous (ITU)10/38
Early bleed	0	3
Late bleed	3	1 (1 death)
Surg Emphysema	1(7 days)	3
False passage	0	1
Fistula	3	0
Severe chest infection	5 (1 IPPV)	2

Conclusion: Two studies, one randomised [1] and one prospective [2] showed PCT had an advantage in terms of convenience and complications, which is not borne out in terms of complications in this study.
Ref:
1.Hazard P, Jones C, Benitone J. Comparative trial of standard operative tracheostomy with percutaneous tracheostomy . Crit Care Med 1991; 19: 1018-24.
2. Griggs WM, Myburgh JA, Worthley LIG. A prospective comparison of percutaneous tracheostomy technique with standard surgical technique. Intensive Care Med 1991;17:261-3.

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064

PERCUTANEOUS TRACHEOSTOMY: Experience from a Cardiothoracic unit.

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Objective.

Percutaneous dilatational tracheostomy has been accepted as a safe technique in Intensive Care . We have studied its use in patients following cardiac surgery where anticoagulation and the proximity of the sternal wound may affect the outcome of the procedure.

Method.

We prospectively studied 80 consecutive patients undergoing percutaneous tracheostomy (Ciaglia technique). Complications and outcome were recorded. At 6 months evidence of airway compromise was sought by symptom based questionnaire and flow volume loops.

Results.

	Mean	SD
Age (years)	66	9.0
Days Intubated prior Trach.	6.1	2.7
Duration of Trach	13.4	6.52

22 of 80 patients were anticoagulated with heparin. (Mean APTT 52/ 31) All procedures were uneventful with the exception of 1 anticoagulated patient who required surgical haemostasis and clotting factors for bleeding. 1 patient required sternal rewiring and reintubation for this. 40 patients survived to leave ITU and were decannulated without difficulty and without early stridor. Of these 26 survived at the time of follow up. 25 completed the study. None reported unsightly scar or skin tethering. None reported impairment of respiratory function and none had evidence of air flow limitation on flow volume loop.
7 Patients reported hoarse voice, the cause of which is not yet clear.

Conclusions

These results compare favourably with other series that have reported laryngotracheal stenosis at decannulation 4 / 77 patients (1) and scar tethering 5 / 37 patients (2). We believe that Percutaneous tracheostomy is a safe procedure following cardiac surgery. We found no evidence of clinically important tracheal stenosis in the patients we have studied.

References

(1) Mcfarlane C. Anaesthesia 1994; **49:** 38 -40
(2) Whittet H B. Anaesthesia 1995; **50:** 892 - 894

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068

LUNG MECHANICS IN PIGS AT HEALTH AND ACUTE LUNG INJURY

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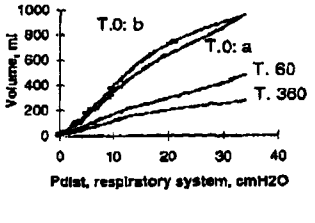
OBJECTIVES: a) to study lung and chest wall mechanics in healthy pigs in the supine and left lateral positions (SP and LP, respectively). b) to develop a model of acute lung injury (ALI) for studies of lung protective ventilation.
DESIGN: prospective, descriptive and observational animal study.
SUBJECTS: Anesthetized, paralyzed and intubated pigs of 20-30 kg.
METHODS: Mechanical ventilation was done in volume-controlled mode with a computer controlled Servo Ventilator 900 C (MV: 0.2 l/kg; RR: 20; ZEEP; Ti: 33%; Tpaus: 5%; FiO2: 0.6). Arterial, central venous and pulmonary artery catheters were inserted. Tracheal and esophageal pressures and flow were read by the computer. Lung mechanics was studied during a computer controlled low flow inflation. The distending pressure (Pdist) was calculated by subtraction of resistive pressure drop in connecting tubes and airways. After studies at health ALI was induced by continuous infusion of endotoxin (12 µg/kg/h) for 6 h. During ALI induction mechanics and hemodynamics were recorded each 30 min., blood gas each 60 min.



RESULTS: In both positions the Pdist/V curve of the respiratory system was complex with segments of low/high/low and high compliance (T.0:a). The non-linearity within the lower part was due to non-linear chest wall P/V curve. In the upper part the shape reflected a recruitment of lung units. P/V curves recorded soon after the first did not show the latter (T0:b).

After ALI induction compliance fell and recruitment phenomena disappeared after 60 to 360 min. (T60, T360). Hemodynamics showed features typical for septic shock including pulmonary hypertension. PaO2 fell.
CONCLUSION: Pigs may show a non-linear chest wall P/V curve, which leads to a 'false' lower inflection point of the respiratory system. They derecruit lung units faster than man. P/V curves should be recorded immediately after a recruitment procedure. The endotoxin model produces as expected a stiff lung and appears to be suitable for studies of therapeutic strategies.

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069

LATE COMPLICATIONS OF PERCUTANEOUS DILATATIONAL TRACHEOSTOMY (PDT): FOLLOW UP BY MEANS OF MAGNETIC RESONANCE (MR) AND FIBROBRONCOSCOPY.

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OBJECTIVES: a) assess late complications of Ciaglia's PDT by means of MR; b) validate the usefulness of MR study in PDT comparing it with fibrobroncoscopic study.
SETTING: 6-bed Intensive Care Unit in a 400-bed general hospital.
DESIGN: prospective study (follow up scheduled 6 months after PDT).
SUBJECTS: 65 patients (pts.) had PDT under fibroscopic control (Ciaglia's set, Portex Blu-line cannulae) in a 3 year period: age 63±10 years, timing pre-PDT 5,3±2 days. Pathologies: 18 neurological, 29 COPD, 5 ARDS, 9 sepsis, 2 tetanus, 2 politraumatism. 29 died, 11 to-day have not yet reached 6 months. Of the 25 patients eligible 19 accepted to enter the study, and were studied at a time post PDT of 182±20 days.
METHODS: The 19 pts. underwent MR (axial scans T_1-FFE and T_2-TSE and weighed coronal scans T_1, 3 millimeters (mm.) thickness, 0,3 mm interval). The MR was followed by fibrobroncoscopic study (Olympus XT 20).
RESULTS: In all cases MR achieved a good visualisation not only of the tracheal walls, but also of the cutaneous and subcutaneous layers. There were no tracheal stenosis; 1 pt. had a tracheo-cutaneous fistula, while in 18 pts. there was a normal scar. The fibrobroncoscopy confirmed the tracheal data.
CONCLUSIONS: a) We must increase the number of pts. examined in order to have reliable statistical data, but on the basis of preliminary results of our follow up it seems that PDT have a very low incidence of important complications like tracheal stenosis; b) MR is less invasive of the fibrobroncoscopy and allows to study accurately not only the trachea walls but also the surrounding tissues. Unfortunately MR is more expensive, so the first choice examination in the PDT-follow-up remains the fibrobroncoscopy. But in case of fibrobroncoscopy contra-indications, or patient's refusal, the MR becomes the first choice examination.

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093

INTERMITTENT PRONE POSITION IMPROVES OXYGENATION IN SEVERELY BURNED PATIENTS WITH INHALATION TRAUMA

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Introduction: Prolonged hypovolaemia or an inhalation injury are the main causes of pulmonary complications in severely burned patients.Areas of high density were demonstrated in the dorsal pulmonary segments of critically ill patients with impairment of the oxygenation (1). In this patients the therapy in a rotation bed as well as the intermittent prone positioning results in an improvement of the oxygenation (2). However, up to date there no results are available in burned patients.
Material and Methods: In a prospective study mechanically ventilated severely burned patients with inhalation trauma and a progressive deterioration of the respiratory function were treated with intermittent prone position. All patients required a FiO2 > 0,5 to reach an arterial pO2 > 80 mmHg. Every 8 - 12 hours the patients were turned using a special bed, the Stryker-Bed. Haemodynamic parameters as well as arterial oxygen saturation were recorded continuously. Ventilation parameters were documented hourly. Arterial blood gas analysis as a parameter of the respiratory function were determined two-hourly. As a parameter of the oxygenation the Ventilations-Index was calculated (3). This parameter considers a) pO2, b) FiO2, c) PEEP, d) I:E ratio. For calculation of the daily Ventialations-Index the worst value in each position was used. With a Ventilation-Index > 200 weaning of the patient from the respirator can be started.
Results: We present the results of 20 burned patients aged between 21 and 85 years. All patients suffered from burns of > 20 % of the body surface and aditional inhalation injury. During the preceding 48 hours prior to start of the treatment a clear decrease of the Ventialtions-Index was observed in all patients. 24 hours after the start of the treatment a distinct incrase of the Ventilations-Indices could be demonstrated. Alter a few days these changes were highly significant. Mean duration of treatment with intermittent prone position lasted 4,4 ± 1,6 days. During the early phase of the treatment in the intermittent prone position clear differences in the arterial pO2 were demonstrated between the prone and the supine position. Later on these diferences disappeared. At a difference < 10 mm Hg the treatment in the rotationbed can be stopped.
Discussion: In severely burn patients up to now no experiences exist with the intermittent prone position to improve the respiratory function. We were able to show that the treatment with intermittent prone position results in a significant increase of the oxygenation in these patients. Compared with polytraumatized patients the duration of the treatment in the rotationbed is shortener in burn patients (2).

Literatur: 1. Gattinoni et al.: Anesthesiology 1991; 74: 15
2. Walz et al.: Chirurg 1992; 63: 931
3. Tryba et al.: Clin Int Care 1992; 3: 44

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104

COMPARISON OF RESPIRATORY FUNCTION DURING PRESSURE SUPPORT AND ASSIST MECHANICAL VENTILATION.

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OBJECTIVES: During pressure support ventilation (PSV) the ventilator adjusts the inspiratory flow and inspiratory time at the patient's demand, improving the patient-ventilator synchrony. On the contrary, in assist mechanical ventilation (AMV), the ventilator delivers a fixed inspiratory flow (PIF) in a fixed inspiratory time. The aim of this study was to compare the effect of PSV vs AMV on respiratory function. DESIGN: We compared, using the Bear 1000 mechanical ventilator (Riverside, CA), PSV vs AMV, set with the same tidal volume (VT) and PIF obtained during PSV. We studied AMV in two different inspiratory flow waveforms: square (sq) and decelerated (dc). Moreover we compared AMV, maintaining VT constant, with PIF reduced by 30% (low PIF). SUBJECTS: We studied 6 intubated stable patients with acute lung injury (PSV 11±2 cmH_2O above PEEP, PEEP 5±1cmH_2O, PaO_2/FiO_2 201±99). METHODS: Gas flow, airway, esophageal and gastric pressures were recorded. We calculated: respiratory rate (RR), VT, PIF and work of breathing of the patient (WOB). At the end of each step blood gas analysis were performed. RESULTS: No expiratory muscle activity was observed in all the patients. The results are presented as mean±SD.

	RR	PIF	WOB	PaO_2	$PaCO_2$
	(bpm)	*(L/s)*	*(J/m)*	*(mmHg)*	*(mmHg)*
PSV	29±9	0.77±0.2	1.3±1.2	94±14	37±5
AMVsq	31±9	0.79±0.2*	1.1±1.4	92±17	36±6
AMVdc	30±9	0.76±0.2°	1.3±1.4	95±13	36±6
Low pif					
AMVsq	30±8	0.62±0.2*	1.4±1.5	99±26	35±6
AMVdc	27±8	0.61±0.2°	1.3±1.5	94±20	35±4

*(Anova) No significant differences between PSV, AMVsq, AMVdc (Student's paired T test) * P<0.05 AMVsq vs AMVsq low PIF; * P<0.05 AMVdc vs AMVdc low PIF*

CONCLUSIONS: 1) AMV when properly tailored can fully substain the patient's inspiratory demand. 2) The reduction of peak inspiratory flow during AMV by 30% does not affect the respiratory pattern and gas exchange.

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111

BRONCHODILATION DRUG EVALUATION BY CONTINUOUS BLOOD GAS ANALYSIS.

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Objectives bronchodilation drugs are routinely used in ICU in all patients with low oxygen. To find a judicious use for these drugs we scheduled a prospective study.

Methods 13 patients in ARDS due to aspiration under mechanical ventilation support with an arterial line for invasive monitoring of blood pressure were included in the study. All of them had no history of chronic obstructive pulmonary disease and audible airflow obstruction. A sensor for continuous blood gas analysis was inserted through the arterial catheter and the results were registered every 5 seconds in a computer. All patients were monitored for at least 30 minutes. After that normal saline in a quantity of 3 ml was given through a nebulizer with a t-piece connection with the endotracheal tube and an O_2 flow according to the company's recommendations Ipratropium bromide plus fenoterol in a dose of 0.5 mg fenoterol and 0.25 mg ipratropium and 2 ml normal saline were given through the nebulizer an hour and a half later. The PaO_2 of a period of 15 minutes each time before nebulizer use was averaged and taken as baseline. Twenty minutes after disconnection of nebulizer we averaged the PaO2 for 15 minutes.

Results: mean PaO_2 and standard deviation are shown in table 1. As we can see the patients taking either normal saline or fenoterol plus ipratropium bromide had no difference.

	Baseline	After N/Saline	Significance
Mean	66.27	66.9	NS
SD	3.22	4.1	
	Baseline	After bronchodilator	
Mean	66.81	67.45	NS
SD	3.7	3.67	

In conclusion from the results obtained the bronchodilator in doses used has proved to have no bronchodilator effect. Our opinion is that bronchodilator therapy failed because oxygen in ARDS patients is excluded from the pulmonary blood flow by airspace liquid while non flooded alveoli are perfused with blood which is nearly completely saturated.

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117

COMPARISON OF IMPOSED WORK OF BREATHING BETWEEN FLOW- AND PRESSURE-TRIGGERED VENTILATION

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OBJECTIVES: Sensitivity of the flow demand system is an important factor for imposed work of breathing (WOB) during mechanical ventilation. Flow triggering is believed to cause less work to a patient-initiated breath than pressure triggering. This study was purposed to compare imposed WOB at these two modes of triggering.

DESIGN: Prospective clinical study

SUBJECTS: 12 patients (64.8±4.2 yrs, M:F=8:4) stable on CPAP 3 cm H_2O by Servo 300 (Siemens-Elema, Solna, Sweden)

METHODS: Total and imposed WOB were measured by CP-100 pulmonary monitor (Bicore, USA) on four different sensitivities (0.7 vs 2.0 L/min on flow triggering; -1 vs -2 cm H_2O on pressure triggering).

RESULTS:

	Flow triggering		Pressure triggering	
	0.7 L/min	2.0 L/min	-1 cmH_2O	-2 cmH_2O
Total WOB (T)*	0.69±0.47	0.71±0.50	0.82±0.53	0.90±0.53
Imposed WOB (I)*	0.32±0.20	0.38±0.22	0.39±0.26	0.38±0.26
I/T	0.61±0.15	0.65±0.20	0.65±0.13	0.61±0.24

***p<0.05 by repeated measures of ANOVA**

CONCLUSION: The proportion of imposed WOB in total WOB was variable in patients on weaning from mechanical ventilation. Both imposed and total WOB were lower on flow triggering than on pressure triggering, and they were also significantly reduced by increasing the senstivities on each mode.

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119

DETERMINATION OF THE LEVEL OF MINIMAL PRESSURE SUPPORT DURING WEANING PHASE FROM MECHANICAL VENTILATION

Y Koh, BH Jung, CM Lim, SD Lee, WS Kim, PH Park*, DS Kim, WD Kim

OBJECTIVE: Minimal pressure support (PSmin) is the level of pressure support required to help patients overcome the imposed work of breathing (WOBimp). PSmin avoids excess respiratory muscle rest or fatigue and is thus desirable for successful weaning. We assessed the range of measured PSmin and its relationship with calculated PSmin.

DESIGN: Prospective clinical study

SUBJECTS: 14 stable patients in weaning phase from mechanical ventilation

METHODS: The patients were maintained with zero CPAP during the PSmin measurement. We measured tracheal end pressure via the monitoring lumen of Hi-Lo Jet tube (Mallincrodt, St. Louis, MO, USA) for WOBimp (CP-100 pulmonary monitor, Bicore, Irvine, CA, USA) and then increased pressure support gradually till WOBimp is less than 0.05 joules/L (measured PSmin). Calculated PSmin was obtained by the equation: calculated PSmin=peak inspiratory flow rate • total resistence.

RESULTS:

1) The measured PSmin of the subjects ranged 4 -15 cm H_2O (n=14).

2) The mean PSmin were: measured PSmin= 7.6±0.9 cm H_2O, calculated PSmin= 9.3±1.5 cm H_2O (n=8, r=0.98 [p=0.001], calculated PSmin/ measured PSmin=1.21±0.05). The calculated PSmin was higher than the corresponding measured PSmin in 7 out of 8 subjects (p=0.004).

CONCLUSION: The level of minimal pressure support was varied among study patients. There was a correlation between calculated and measured PSmin values, but the calculated PSmin was higher than the measured PSmin.

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140

VENOUS EMBOLISM DURING TOTAL HIP REPLACEMENT WITH CEMENTED PROSTHESIS. INFLUENCE OF DIFFERENT ANAESTHETIC TECHNIQUES. PRELIMINARY REPORT.

S. Mazzi, N. Petrucci, F. Agostini*, F. Vischi.

OBJECTIVES Venous embolism with transient haemodynamic and respiratory changes (increase in Pulmonary Artery Pressure and decrease in PaO_2) were demonstrated during total hip replacement with cemented prosthesis. Bone marrow elements and fat tissue responsible for the embolism were found in dogs' lungs, removed after insertion of prosthesis, and embolic structures were detected in the right heart by using Transesophageal echocardiography (TEE). It has been reported that fat embolism syndrome may be triggered or boosted by administration of vegetable oil. The aim of this study is to test whether a greater incidence of embolic events is associated to Propofol (a lipid-dissolved agent) used in the maintenance of anaesthesia compared to an inhalation agent (Isoflurane), in total hip replacement.
METHODS After informed consent, twenty patients, (age range 55 - 75) scheduled for total hip replacement with cemented prosthesis (cemex system®) were randomly assigned to Group A (Propofol) or Group B (Isoflurane). Patients with suspected previous fat/pulmonary embolism and deep vein thrombosis were excluded. Group A: anaesthesia was induced with fentanyl 2.5 mcgr/kg and propofol 2 mg/kg , the maintenance infusion rate of propofol was 9 mg/kg/h (mean total dose mg 1300+/-50); ventilation was maintained with 40% oxygen in air. Group B: anaesthesia was induced with fentanyl 2.5 mcgr/kg and thiopental 4 mg/kg and maintained with 60% N_2O in oxygen and isoflurane 1 MAC. All patients received suxamethonium to facilitate orotracheal intubation and pancuronium for muscle relaxation. All patients were monitored with biplane TEE (ATL Ultramark-9; 5 MHz), introduced into the oesophagus and positioned to visualize the four cardiac chambers simultaneously. Surgical procedure was the same in all patients.
RESULTS Data are presented in the table below. After insertion of the femoral prosthesis, TEE detected an increase of contrast intensity, with structures measuring up to 3 cm passing the right heart. The Propofol group showed a greater incidence of embolism (p=0.007; Chi-square test with continuity correction).

	embolism	no embolism
Group A (propofol)	8	2
Group B (isoflurane)	1	9

The contrast intensity decreased in 3 minutes. None of patients developed fat or pulmonary embolism syndrome afterwards. It has been suggested that the particulate contents of the reamed cavity may reach the systemic venous circulation during the pressurization of the canal by cement and prosthesis insertion. This process does not provide for the large size structures observed with TEE, being the maximum diameter of medullary vessels 150 micron. A process of fat agglutination, increased by Propofol emulsion infusion, may be involved.
CONCLUSION Fat and marrow embolism appear to be more frequently associated with Propofol infusion as anaesthetic maintenance in cemented total hip replacement. Further studies are in progress to confirm this preliminary finding.

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142

PROGNOSTIC VALUE OF ARTERIAL pH FOR SURVIVAL OF PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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The aim of the study was to examined the significance of the level of acidosis (arterial pH value) on the severity and prognosis of disease in patients with chronic obstructive pulmonary disease (COPD) and respiratory failure (RF). A group of 98 patients with COPD and RF hospitalized in Pulmonary Intensive Care Unit was examined. APACHE III first day score and predicted death rate were calculated. Sixty seven out of 98 patients survived (Group I) and 31 patients died (Group II). APACHE III first day score for the whole group was 50.5±21.04 and predicted death rate 24.1±19.23%. APACHE III first day score for group I was 44.4±13.06, predicted death rate 18.1±11.12%, and four group II APACHE III first day score was 63.7±28.17, predicted death rate 37.1±25.83%. The correlation between arterial pH and APACHE III score as well as predicted death rate in the whole group was statistically significant ($p<0.05$). Taking into consideration the groups of patients (I and II), predicted death rate was more significant for group II ($p<0.001$). It was concluded that level of arterial pH is very important predictor in estimating of severity of the disease and actual mortality rate.

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149

PERCUTANEOUS vs STANDAR TRACHEOTOMY.

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OBJECTIVE. To compare two bedside tracheotomy techniques performed in our Intensive Care Unit from October-1991 to December-1995.
DESIGN. An open prospective comparison of two techniques.
SUBJECTS. 278 critically ill patients requiring elective tracheotomy: 174 percutaneous tracheotomies (PT) (18-81 years, 114M:60F) and 104 standar tracheotomies (ST) (17-87 years, 65M:39F).
METHODS. PT was performed with the Seldinger technique of Ciaglia et al (Cook Incorporated, Bloomington, IN) and ST was performed bedside. We evaluate: **1.** Procedure time. **2.** Incidence and severity of complications. **3.** Costs. **4.** Ability to learn the technique by our residents.
RESULTS. 1. PT: 5-20 minutes (mean 12); ST: 13-44 minutes (mean 30). **2.** Complications:

	PT	ST
stomal infection	0.5%	4.8%
subcutaneous emphysema	6.8%	1.9%
atelectasia	1.7%	-
minor hemorrhage	6.8%	8.6%
major hemorrhage	1.1%	-
tracheoesophageal fistula	1.1%	-
tracheal rupture	1.1%	-
pneumothorax	1.1%	-

Two PT were ended by ST due to hemorrhage and 2 needed surgical reparation of the trachea. **3.** We performed the ST at the bedside and consequently we observed significant decrease in hospital expenditure, since ST equipment is less expensive than PT; on the other hand operating room, anesthetist and surgeons were not required. **4.** The tracheostomies were performed by a senior physician and a junior resident (43%) or by two residents (a senior and a junior) (57%). Our residents qualify PT easier to learn, but they felt more confident performing ST.
CONCLUSION. TP is easier and faster than SP, but we must pay attention of some major complications of this last technique.

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152

RECONSTITUTED SURFACTANT THERAPIES ON ACUTE LUNG INJURY CAUSED BY INTRATRACHEAL ENDOTOXIN INJECTION IN RATS

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OBJECTIVE: To compare the effect of the replacement therapies with a modified natural porcine surfactant (MNS) and a synthetic reconstituted surfactant (SRS) consisting of synthetic lipids plus surfactant-associated hydrophobic proteins on an acute lung injury caused by an intratracheal injection of endotoxin in rats.
DESIGN: Prospective randomized study.
SUBJECTS: Male Wistar rats weighing 330-420 g.
METHODS: Twenty-seven rats were anesthetized and mechanically ventilated with 100% oxygen. Then 40 mg/kg endotoxin was injected into the trachea. When the PaO_2 decreased below 200 mmHg, the rats were randomly assigned to three groups. In the MNS group (n=9), 100 mg/kg of MNS was instilled into the airway. In the SRS group (n=9), 100 mg/kg of SRS was instilled with an identical way. In the control group (n=9), no material was given.
RESULTS: Only four of nine rats survived in the control group until the end of the experiment (360 mins after assignment), but all rats survived in the MNS and SRS groups ($p < 0.05$ vs. control group). The mean PaO_2 values of the control group remained below 200 mmHg. On the other hand, the PaO_2 value of the SRS group, as well as MNS group, increased to 341 ± 122 (SD) mmHg within 30 mins after the instillation ($p < 0.05$ vs. control group), and the values were maintained significantly higher than those of the control group until the end of the experiment. No significant differences were seen between the MNS group and the SRS group in findings of the PaO_2 and the lung compliance.
CONCLUSION: A SRS consisting of synthetic lipids plus surfactant-associated hydrophobic proteins reverses an acute lung injury to the same extent as a MNS.

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154

THE MEASURE OF MINIMAL PRESSURE SUPPORT DURING WEANING FROM MECHANICAL VENTILATION

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OBJECTIVES: During the weaning from mechanical ventilation some degree of pressure support (PS min) is wasted to overcome the additional resistive load due to the endotracheal tube and the circuit and valves of ventilator (1). The measurement of PS min and its use during weaning trial could mine conditions of spontaneous breathing allowing a more precise predictions of the weaning outcome: the PIFR Raw product during CPAP at ZEEP as been recently proposed to estimate PS min (2). Nevertheless the presence of the triggers, the inertia of the valves and the high levels of working pressure of the ventilators could influence the measurements leading to false interpretations of the results obtained.

DESIGN: To evaluate the differences of PS min values collected using CPAP mode of the ventilator (ZEEP) and T-piece technique.

SUBJECT: 20 COPD patients weaned using PSV up 10 cmH2O and ready to be extubated.

		Mean	SD	Range
CPAP	1 m' (A)	6.37	4.51	1 - 15.1
	5 m' (B)	7.31	4.02	2.4 - 14.7
T-piece	1 m' (C)	7.01	3.28	1.3 - 14.8
	5 m' (D)	7.25	4.66	1 - 18.5

Tab I: p values: A vs B = 0.0006; B vs D = 0.001; C vs D = 0.0007.

METHODS: The values of PS min were calculated from the values of PIFR and Raw collected at the first and the fifth minute of spontaneous breathing trial using either CPAP mode of the ventilator ant the t-Piece technique. The values were compared using a paired t-test.

RESULTS AND STATISTICAL ANALYSIS: Higher values of PS min were found using t-Piece and after longer periods of trial, although there was a statistical significant agreement between (among) the results (tab). Besides a wide variability of the values was found among the patients (1-18 cm H2O) and in each patients among the trials (from 2 to 7 cmH2O of difference).

CONCLUSION: The degree of pressure support to overcome the resistive burden of the tube and ventilator can be highly variable and unpredictable: the use of thecniques able to recognise its value could tilde to perform more predictive weaning trials, although a more accurate methodologic approach seems advisable to reduce the variability of the resource.

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163

PRONE POSITION: THERAPY OF CHOICE IN ARDS?

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OBJECTIVES: Evaluate the efficacy of prone position as the premier treatment in post-operative ARDS and determine, whether it is successful as the only intervention.

DESIGN: Open non-randomized trial in a 16-bed surgical ICU.

SUBJECTS: 48 consecutive patients with severe ARDS (Murray-Score > 2,5; p_aO_2/f_iO_2 < 160 mmHg; 32 male, 16 female, mean age 62 years) and conventional ventilation (PCV, PEEP 6-16 mbar, I:E=1:1, p_{peak} < 30 mbar) after major visceral surgery.

METHODS: If after 24 hours of conventional pressure controlled ventilation pulmonary function did not improve, patients were placed in prone position. Change from prone to supine position was done every 12 hours. Beside ultimate survival, parameters investigated were $AaDO_2$, p_aO_2/f_iO_2, and venous admixture (Q_S/Q_T).

RESULTS AND STATISTICAL ANALYSES: During the first 12 hours in prone position 43 of 48 patients showed a significant decrease in Q_S/Q_T (25.0% vs. 17.9%) and $AaDO_2$ (231 vs. 182 mmHg), and an increase in p_aO_2/f_iO_2 (153 vs. 203 mmHg). Changes were most pronounced in patients with high Q_S/Q_T, and in patients with an onset of ARDS less than 48 hours before first application of prone position. After an average of 6 position changes (2 to 16) 29 of 43 patients could be weaned from the ventilator. 25 patient could leave the hospital. In the later course letality was primarily determined by additional organ failures and by the severity of the underlying disease. Negative side effects were minor, including slight cardio-vascular depression and increase in p_aCO_2, and never posed a limitation to continuation of prone position. Especially in patients with septic shock skin lesions in exposed areas could not always be prevented. Prone position alone could dramatically improve pulmonary function in the initial stage of treatment, but it appeared difficult to stabilize this success, as shown by the high mortality. Still, prone position could easily be combined with all ventilation modes and with all intensive care interventions. Also immediately after major surgery and in patients with open packing prone position was possible.

CONCLUSION: In this investigation prone position proved to be an efficient and safe method in the treatment of severe ARDS. Patients with a pronounced ventilation/perfusion mismatch and patients in the early stages of ARDS appear to profit most from prone position. Though the immediate effect on oxygenation is striking, still more than 45% of all patients die from multi organ failure and underlying diseases. It appears that prone position is a powerful therapeutic tool in ARDS. Nevertheless, prone position alone could not improve outcome in ARDS patients. Its great advantage is that it can be combined with any other treatment modality. Therefore, it can be concluded that prone position should best be employed in combination with other proven therapies in ARDS.

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167

AUTOINHALED NO INFLUENCES PaO_2 IN INTUBATED PATIENTS

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OBJECTIVES:Most of the endogenous nitric oxide(NO) produced in the respiratory tract is derived from the nasopharynx. We studied the effect of administering low dose NO on oxygenation to three groups of patients, in doses down to the dose they would have received from their own upper airways, had they not been intubated.

DESIGN: prospective, controlled study.

SUBJECTS: Three groups, each of ten patients. Group A were scheduled for elective abdominal surgery. Group B were ventilated (1-38 days) patients without ARDS and Group C consisted of intubated patients with ARDS, ventilated for 1-14 days.

METHODS: All patients inhaled NO for 20 minutes preceeded and followed by a control period, during which pipeline gases, almost free of NO were delivered. 500 parts per billion (ppb) NO was administered to Group A; 100 ppb to groups B and C. Group A were ventilated with a volume control mode at an inspiratory fraction of oxygen (FiO_2) of 0.29-0.32 and no positive end-expiratory pressure(PEEP); Group B with inspiratory pressure support, FiO_2 of 0.3-0.35, at a PEEP of 4-9 cmH_2O, and Group C with pressure controlled ventilation, FiO_2 of 1.0 and PEEP of 9-18 cmH_2O. NO was administered either by a prototype Siemens 300 ventilator(Siemens. Lund, Sweden), or by a Dräger Evita ventilator (Dräger AG, Lübeck, Germany) using the NO Domo unit'. Monitoring of NO concentrations was achieved by a chemilumenescence technique (ECO Physics, Duernten, Switzerland). NO concentrations were measured at baseline, 15 minutes after commencing NO, and 15 minutes after NO was switched off. Arterial blood gas analyses were performed simultaneously.

RESULTS AND STATISTICAL ANALYSIS:Data are presented as means +/- standard errors.Statistical analysis was performed with the Wilcoxon matched-pairs signed rank two-tailed test. P<0.05 was taken as sigificant *. Figures quoted are the PaO_2 values in mmHg.

	Control One	Under NO Administration	Control Two
Group A	135±9	141±10 *	135±8
Group B	94±4	101±5 *	93±13
Group C	82±5	86±7 *	81±18

All three groups showed a significant improvement in oxygenation with NO.

CONCLUSION: It could be postulated that the improvement seen at these very low doses was secondary to the replacement for endogenous NO, unable to gain access via the natural pathways due to the endotracheal tube. The mechanism of action may be due to the well recognised positive effects that NO is known to have upon ventilation /perfusion relationships.

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168

PRESSURE CONTROLLED VENTILATION + CONTINUOUS GAS FLOW TREATMENT IN PATIENTS WITH ACUTE LUNG INJURY AND REFRACTORY HYPOXEMIA

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Objective: Evaluate the use of pressure controlled ventilation with continuos gas-flow treatment (PCV+CGF) via injector in patients with acute lung injury (ALI).

Methods: Five patients (2 women and 3 men) with acute lung in volumen controlled/assisted or basal ventilation (CMV/A) were changed to pressure controlled ventilation mode (PCV) + continuous gas-flow (3,35 ± 1,05 l/minute; range 2-5) via injector attached to swivel elbow between the tracheal tube and ventilator. Servo 900 C (Siemens Elema) was the ventilator of choice. Pressurized gas is supplied from the hospital net. Out-flow gas pressure at 5 Kg/cm2 for both oxigen and air. Gas humidification was accomplished by means of a pressure reducer and flow regulator of the Hellister's ball type. Injectors exit width ranged between 0,8-1,4 mm. ETCO2 was monitored through capnography and air-way pressure was measured at tracheal level. Swan-Ganz's catheters were used on four patients. Student's *t* was used to compare paired means results.

Results: ($p<0,05$ was considered significant). Mean ± SD.

Parameters	CMV/A	PCV+CGF 3L/Min.	Statistical
Vt (ml/Kg)	8,57 ± 3,1	11,26 ± 2,11	p<0,1
PIT: Pressure inspiratory total (cmH_2O)	44,5 ± 16,8	34,7 ± 4	Ns
PEEP: End espiratory pressure positive (cmH_2O)	8,57 ± 4,42	5,77 ± 3,49	Ns
$ETCO_2$: End tidal CO_2	5,98 ± 0,91	4,65 ± 0,66	p<0,05
PaO_2 (torr)	66,45 ± 18,7	92,35 ± 20,3	p<0,05
SvO_2 (%)	65,76 ± 10,2	78,8 ± 8,8	p<0,05
PaO_2/FiO_2 (torr)	75,4 ± 22,2	111,9 ± 21,4	p<0,05
Qs/Qt : pulmonary shunt (%)	32,81 ± 4,45	25,99 ± 4,3	p<0,1
CI : Cardiac Index ($L/Min/m^2$)	3,85 ± 0,98	3,31 ± 0,68	Ns

Conclusions: PCV+CGF was initiated when the respiratory index (RI) PaO2/FiO2 was smaller than 100 torr. A significant improvement in RI values was observed after 3 l/minute administration of CGF. Hemodynamics parameters were not modified with the addition of CGF to conventional PCV ventilation. A significant decrease in ETCO2 values was observed.

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181

EFFECTS OF PEEP AND CNEP ON PULMONARY EDEMA

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Pulmonary edema and increased Extravascular Lung Water (EVLW) are a relevant aspect of Adult Respiratory Distress Syndrome. Both Positive End Expiratory Pressure (PEEP) and Continuous Negative Extrathoracic Pressure (CNEP) associated with mechanical ventilation may improve lung volume and gas exchange in ARDS patients.

Aim of this study was to investigate the effect of PEEP and CNEP on EVLW in patients with severe ARDS

Materials and methods We studied 9 patients (Lung Injury Score > 2.5) under controlled mechanical ventilation at 3 different levels of Intrathoracic Pressure (ITP) resulting from PEEP 0 (ZEEP), PEEP 15 and CNEP -20. The level of negative and positive pressure was chosen to obtain the same Transpulmonary Pressure (TPP) as computed by means of an esophageal catheter. Each pressure level was mantained for 20 minutes. At each ITP level we measured gas exchange, hemodynamic parameters and EVLW by the double indicator tecnique (COLD Z-02; Pulsion).

By an orthogonal comparison test (ANOVA) it was possible to recognize 1) the effect of PEEP+CNEP vs ZEEP and 2) the effect of PEEP vs CNEP. As shown in the table EVLW doesn't change in spite of lung function improvement due to both CNEP and PEEP.

	ZEEP	PEEP15	CNEP -20
EVLWi ml/m^2	993 ±383	1026±369	1068 ±514
Qva/Q %	* 46 ±16	33 ±8	34±12
PaO_2/FiO_2	* 103±49	167±38	145±51
TPP cmH_2O	-	10.1±2.9	9.2 ±3.5

* p<0.01 ZEEP vs PEEP +CNEP

Conclusion With similar levels of lung expansion obtained by PEEP and CNEP, EVLW did not change compared to ZEEP in spite of an improvement in lung function.

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230

THE CHANGES IN CIRCULATING BLOOD VOLUME AND HIS COMPONENTS IN PATIENTS WITH SEVERE MULTIPLE TRAUMA

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OBJECTIVES: ARDS in traumatic patients is result of multiple factors. One of them is the disturbances in liquid equilibrium in lungs.

SUBJECTS AND METHODS: In 74 patients with severe multiple trauma admitted to the ICU with picture of traumatic shock was followed the changes in circulating blood volume (CBV).32 of them survived and 42 died. CBV was determined with 132-I humanserumalbumin.

RESULTS AND STATISTICAL ANALYSES: Even in the first posttrauma day CBV was found in normal limits in the majority of patients by means of circulatory ressuscitation, but the circulating plasma volume (CPV) was augmented (+11,1±15,6% of predicted values) and circulating erythrocyte volume (CEV) was diminished (-18,4±20% of predicted values). In the next 7-10 days CBV had the tendency for elevation above normal values with augmentation of redistribution between CPV and CEV. Statisticaly the difference between survivors and nonsurvivors is highly significant (p CPV < 0,0008, p CEV <0,0283). The elevation of the CPV has an unfavorable effect over respiratory function - we found significant correlation between CPV and Qs/Q (r=0,531, p < 0,01); VA/Q (r=-0,458, p< O,01); with C(a-v)O2 and D O2.The diminuation of CEV deteriores the oxygen transport to tissues.

CONCLUSION: These findings suggest the bad prognostic significance of the elevation of CPV above 10% of predicted values in the cases with normal circulating blood volume and the necessity to consider the components of the infusion therapy so to avoid the redistribution of his components (CPV and CEV).

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183

PREDICTIVITY OF ARTERIAL DESATURATION SEVERITY DURING TRANSITORY INTERRUPTION OF LONG TERM EXTRACORPOREAL CO_2 REMOVAL ($ECCO_2R$).

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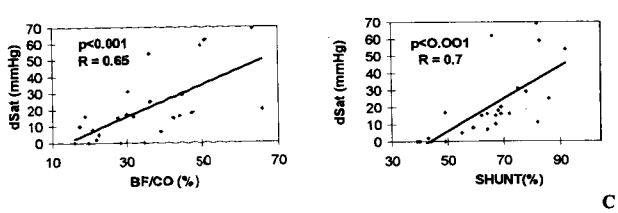
During long term $ECCO_2$ R the occurrence of haemolysis or decreased artificial lung performance leads to short interruptions of extracorporeal blood flow (BF) to allow changes of deteriorated centrifugal pump heads and/or artificial lungs. These interruptions can be associated to deep arterial desaturations.

Materials and Methods: In 5 ARDS patients treated with long term $ECCO_2R$ (veno-venous by-pass) we studied 28 consecutive interruptions. During these, the patients were mechanically ventilated with Volume Controlled Ventilation with low Tidal Volume (<7 ml/kg) at FiO_2=1 and were made hypothermic (°C 35.2±1.3). Parameters related to oxygenation (i.e. arterial and venous blood gases, Shunt, arterial and venous O_2 saturation) and to the amount of extracorporeal support (BF in ml/kg/min, BF/CO) were recorded 5 minutes before interruption. During the procedure the severity of arterial desaturation was calculated as dSat= basal arterial O_2 saturation - minimal O_2 saturation during interruption.

Results: Basal arterial saturation was 91.8±6.8%. Arterial desaturation was minimal (<5%) in 6 cases. We found a correlation between dSat and Shunt (dSat = 0.95*Shunt - 41.43) and between dSat and BF/CO (dSat=0.98*BF/CO - 14.35).



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onclusions: It is possible to predict the severity of arterial desaturation from basal shunt and basal BF/CO. Since profound desaturation may be life threatening, a double veno-venous circuit must be considered and this is currently our practice. Changes of components of extracorporeal circuits can be therefore performed safely due to maintenance of a certain amount of extracorporeal support.

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251

ACUTE RESPIRATORY FAILURE IN COPD : EFFECT OF HIGH INSPIRED OXYGEN ON ARTERIAL BLOOD GASES.

R Kishen, BJM Bowles, AN Thomas, IF Geraghty, J Goodall.

Objectives: We studied the effect of therapy with high Fio_2 in acute respiratory failure (ARF) in COPD patients referred to our intensive care unit (ICU).

MATERIALS & METHODS: All patients with ARF due to COPD were studied. Patients receiving narcotics, postoperative patients and those in cardiac failure were excluded. O_2 therapy with high FiO_2 (>.4) was started as soon as the patient was admitted to ICU and blood gases checked in an hour's time. Regardless of $PaCO_2$, if the PaO_2 was not above 85 mmHg(11.5 kpa), FiO_2 was increased till the desired result was obtained. Therapy was continued with frequent blood gas monitoring till patient's discharge from ICU. The patients were ventilated if they became exhausted, were unable to cough or if the hypoxaemia could not be corrected. Other medical therapy e.g., antibiotics, physiotherapy, bronchodilators and steroids were used as appropriate.

RESULTS: Results of unventilated patients are presented. Fifty four patients were studied over 4 year period, 31 did not need ventilation. Most patients received an FiO_2 of .6 or above. Paired 't' test was applied and a p value of <.05 considered significant. Arterial CO_2 showed a varied response to increasing PaO_2 though it increased in most instances (Mean $PaCO_2$ rose from 73±2.9 mmHg to 79.9±3.5 mmHg p= .045) and gradually showed a fall at discharge. $PaCO_2$ at discharge was much lower than that at the admission (mean $PaCO_2$ 73±2.9 on admission, mean $PaCO_2$ at discharge 43.5±.9 p= .001; corresponding PaO_2 was base 54.7±1.7 and 102±2.8)). There was no difference between the $PaCO_2$ of these patients and those ventilated although PaO_2 in the latter was lower.

CONCLUSION: ARF in patients leads to hypoxaemia and may cause hypercarbia. In our study, hypercarbia was temporarily worsened by O_2 therapy but as long as PaO_2 was optimal, this did not seem to be responsible for a worse outcome in these patients; rather patients needed ventilation because they remained hypoxic despite O_2 therapy. It has been suggested that the mechanism of rise of CO_2 is not the depression in central respiratory drive and unresponsiveness to CO_2 but remains unclear[1]. Similarly hypoxia is due to ventilation-perfusion mismatch[2]. We do not know the cause of the temporary rise in CO_2 on improvement in hypoxia. This phenomenon does not seem to be due to 'abolition' of hypoxic drive as the discharge PaO_2 was significantly higher than the base line PaO_2.

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262

ELASTIC LOAD DURING PARTIAL VENTILATORY SUPPORT

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During pressure assisted modes, increase in elastance (E_{st}) reduces minute ventilation (V_E) compromising weaning attempt. We studied patient-ventilator interaction following acute increase in E_{st} (restraining thorax and abdomen) using different partial ventilatory techniques. We studied PSV (Pressure Support Ventilation), VS (Volume Support, Siemens SV300) and PAV (Proportional Assist ventilation, Winnipeg ventilator) in six weaning patients. During PSV, a constant pressure (P_{appl}) level is applied by the ventilator, during VS Pappl is proportional to patient's E_{st}, while during PAV Pappl is proportional to patient's effort. Flow, tidal volume (V_T), V_E, respiratory rate (RR), pressure time integral of esophageal pressure per breath (PTP/b) and per minute (PTP/min) were measured. To rate the intensity of perceived sense of breathlessness after the elastic loading visual analogue scale (VAS) was assessed.

PSV	V_T (L)	RR (b/m)	V_E (L)	PTP/b (cmH2O*sec)	PTP/min (cmH2O*min)	VAS (mm)
LOAD OFF	0.40±0.01	22.3±0.8	8.9±0.8	1.50±0.51	33.45±9.48	20±5
LOAD ON	0.33±0.0*	26.8±2.6*	8.8±0.5	2.91±0.81*	77.98±11.5*	80±6*
VS						
LOAD OFF	0.42±0.04	20.5±0.3	8.6±1.2	1.56±0.62	31.98±14.2	22±4
LOAD ON	0.43±0.04	20.1±0.3	8.7±0.6	2.60±1.54*	52.26±15.4*	60±8*
PAV						
LOAD OFF	0.41±0.03	21.4±1.9	10.8±0.3	1.54±.37	32.95±8.61	21±5
LOAD ON	0.40±0.02	21.8±2.9	10.7±0.5	2.62±1.7*	57.11.2±11.6*	30±4*

X ± *SD.* * *p < 0.05: paired t test*

Application of elastic bands increased E_{st} from 32.6±11.2 to 46.1±9.1 cmH2O/L (p<0.01) and increased inspiratory muscle effort per breath similarly in all conditions. During PSV, increase in Est caused a fall in V_T, remaining V_E unchanged due to an increase in RR that doubled PTP/min. During VS, the increase in P_{appl} preserved V_T, RR remained unchanged and PTP/min increased 1.5 times. During PAV, the increase in inspiratory muscle effort was able to preserve V_T and no rise in RR was observed. Our data show that a reduction in V_T following increase in E_{st} is observed during PSV, while during VS, the increase in P_{appl}, proportional to E_{st}, is able to preserve V_T; PAV allows the increase in inspiratory muscles effort to preserve V_T despite the elastic load. Howevwer when elastic load was applied, a better patient confort was observed during PAV.

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278

CARDIORESPIRATORY IMPLICATIONS DURING WEANING OF POLYTRAUMA PATIENTS, WITH CONTINUOUS POSITIVE PRESSURE VENTILATION WITH OR WITHOUT INSPIRATORY ASSISTANCE, WHILE MEAN AIRWAY PRESSURE IS KEPT CONSTANT

E.Pavlou, E.Zevla, M.Stavropoulou, Ch.Papazacharias, E.Ioannidou.

OBJECTIVES : It is believed that mean airway pressure (Paw_m) is the main factor for PaO_2 ,FRC, and hemodynamic effects of continuous positive pressure ventilation (CPAP) . Weaning the patients from mechanical ventilation with CPAP, and keeping Paw_m constant , we tried to apply pressure support ventilation (PSV) with inspiratory assistance of several degree and measure the respiratory and hemodynamic implications of it .

METHODS : After consent , we studied 14 polytrauma patients (mean age of 54 yrs) who were treated in the ICU with mechanical ventilation because of acute respiratory failure (ARF) . They all were connected to Siemens servoventilators 900C , hemodynamically stable without sedation , inotropes or diuretics . They all had Swan Ganz catheters with continuous SVO_2 measurement (Oximetric ABBOTT). While patients were breathing spontaneously in CPAP, we applied pressure support ventilation (PSV) with inspiratory assistance of 20 cm H_2O , lowering the CPAP levels in order to keep mean airway pressure constant (10 ± 1 cm H_2O). Respiratory and hemodynamic measurements were done during CPAP and an hour after the inspiratory assistance . Statistical analysis was done with ANOVA .

RESULTS : With inspiratory assistance of 20 cm H_2O , tidal volume (VT) increased by 45% , to statistically significant levels (p<0.001). Respiratory frequency (RF) decreased by 25% , a statistically significant change (p<0.01). Minute volume increased and PCO_2 decreased but not significantly. As was expected PO_2 showed no change . From the hemodynamic parameters cardiac output (CO), cardiac rate (CR), mean arterial pressure (MAP), central venous pressure (CVP), mean pulmonary artery pressure (MPAP), and pulmonary capillary wedge pressure (PCWP) as well as the pulmonary vascular resistance (PVR) and the systemic vascular resistance (SVR) showed no significant changes . Oxygen consumption (VO_2)was lower but not significantly .

CONCLUSIONS : During weaning, switching patients from CPAP to PSV keeping mean airway pressure constant, improves mainly ventilation increasing VT and lowering RF, without affecting oxygenation or other hemodynamic parameters.

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283

CHANGES IN LUNG MECHANICS AFTER TRACHEOSTOMY IN PATIENTS WITH DIFFICULT WEANING

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OBJECTIVE: To verify the changes in ventilatory pattern before and after tracheostomy in patients with prolonged mechanical ventilation in a Surgical Intensive Care Unit (SICU).

DESING: Prospective study.

SUBJECTS: Surgical thracheostomy was performed in 36 patients in the postoperative period because of prolonged mechanical ventilation and weaning failure. The mean age was 64.6±16.3, and the APACHE II score at the admission in SICU was 19.8±7.3. The thracheostomy was performed at the 15.6±5.4 days after tracheal intubation.

METHODS: All the patients were mechanically ventilated with a Servo 900C (Siemens Solna Elema, Sweeden) and the following parameters were studied 24 hours before and after the thracheostomy: respiratory rate (RR), $PACO_2$, tidal volume (Vt), minute ventilation (V_E), peak inspiratory pressure (Ppeak) intrinsic positive end expiratory pressure (PEEPi), oxygenation index (PaO_2/FIO_2), aleolar-arterial oxygen difference(DA-aO_2), static lung compliance (Cs) and ventilatory modes.

RESULTS: The ICU stay in 22 patients after the thracheostomy was 10.5±10.7 who were sucessfully discharged from ICU. The RR, PaO_2/FIO_2 and D(A-a)O_2, varied significantly after thracheostomy was performed in these patients. Thracheostomy allowed the change in ventilator modality in 15 patients(42%) after 24 hours and progress with the weaning trial. Fourteen patients (38%) died during their ICU stay because other complications that were no related with thracheostomy.

	Pretracheostomy	Postracheostomy	*P*
RR	16.2±5.8	17.7±6.1	0.009
$PaCO_2$	36.7±7.0	35.5±9.6	0.06
Vt / MV	689±124 / 12.2±1.0	690±128 / 11.1±3.2	0.75 / 0.35
Pplt / Ppico	20.3±5.5 / 24.3±5.5	19.3±5.1 / 23.7±5.7	0.01 / 0.04
PO_2/FiO_2	251±85	291±93	0.0001
D(A-a)O_2	53.2±17.2	46.1±19.1	0.0001
Cs	35.5±9.6	36.8±12.5	0.19
Ventilatory modes(n)	CMV:15; SIMV:10; PS:11	CMV:9; SIMV:11; PS:12; O_2:4	0.0073

CONCLUSIONS: A significant increase in oxygenation index and a decrease in alveolar-arterial oxygen difference and in the airway pressure is produced after the realization of thracheostomy. Thracheostomy showed the efficacy in the weaning trial in orotracheally intubated patients under prolonged mechanical ventilation.

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284

EFFECTS OF END-INSPIRATORY PAUSE ON PULMONARY GAS EXCHANGE AND HEMODYNAMICS.

Zavala E., Ch. Hering, M. Ferrer, J.R. Masclans, M. Castellá, R. Anglés, R. Rodriguez-Roisin, J. Roca, J. Milic-Emili.

The impact of end-inspiratory pause (EIP) on pulmonary gas exchange and systemic O_2 delivery is controversial. We hypothesize that application of EIP can be either detrimental or beneficial depending on the end-result of the interplay among its effects on: a) improvement of alveolar gas mixing; b) increase of intrathoracic pressure; and, c) increase of intrinsic PEEP (PEEPi) due to reduction of expiratory time. Deleterious effects of EIP have been specifically shown in patients with chronic airflow limitation.

The present study examines the effects of EIP (10 and 20 sec) in 22 patients with acute respiratory failure (ARF) (PaO_2/F_IO_2 261±32 mmHg) and in 9 patients after cardiac surgery (CS) (PaO_2/F_IO_2 336±28 mmHg). Arterial and mixed venous respiratory blood gases, cardiac output, airway pressures and PEEPi were measured during volume-control ventilation at four different levels of EIP: 10, 0, 10 and 20 sec. Except for expiratory time (T_E), the ventilatory setting (tidal volume, respiratory rate, PEEP and F_IO_2) was kept unchanged throughout the study.

Application of EIP provoked a mild to moderate increase in mean airway pressure (Pmean) in both groups of patients. In ARF, Pmean changed from 7.9±3.6 to 9.4±4.0 and 10.2±4.4 cm H_2O (EIP of 10 and 20 sc, respectively) (p= 0.0001) and, in CS, Pmean increased from 5.4±2.4 to 7.0±2.4 and 8.0±2.7 cm H_2O, respectively (p= 0.0006). In contrast, arterial and mixed venous respiratory blood gases, cardiac output, systemic O_2 delivery and PEEPi remained unchanged with EIP (10 and 20 sec).

Despite that the type of patients examined in the present study were potential candidates for a beneficial effect of EIP, no improvement in arterial oxygenation was demonstrated. The application of EIP does not represent a contribution to improve the ventilatory support in patients with ARF.

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285

INVERSE RATIO VENTILATION and PULMONARY GAS EXCHANGE IN ARDS. **Zayala E., Ferrer M., Polese G., Masclans JR., Planas M., Milic-Emili J., Roca J., Rossi A., Rodriguez-Roisin R.**

Over the last ten years, the Inverse Ratio Ventilation (IRV) has been used as analternative ventilatory technique in patients with acute respiratory distress syndrome (ARDS) to improve oxigenation.
The **aim** of the study was to compare the effects of IRV using four ventilator settings: 1) controlled mechanical ventilation without PEEP (CMV); 2) controlled mechanical ventilation with PEEP (CMV-PEEP); 3) pressure controlled inverse ratio ventilation (PC-IRV) and 4) volume controlled -nverse ratio ventilation (VC-IRV) with similar levels of total end-expiratory positive pressure (PEEP) in 8 patients with ARDS on pulmonary gas exchange and hemodynamics, keeping the other variables of the ventilator settings constant. Arterial and mixed venous blood gases, inert gases, lung mechanics and hemodynamics were measured 30 min after each ventilatory mode.

	CMV	PEEP-CMV	PC-IRV	VC-IRV
Qt $L.min^{-1}$	8.3±3.5	8.0±3.2	7.9±3.5	7.8±3.7
PaO_2,mmHg	85±31	98±27	95±37	82±28
$PaCO_2$,mmHg	42±5	39±8	38±7	35±5
Shunt + low V_A/Q%Q_T	41±12	35±8	36±7	39±8
Deadspace	43±11	41±9	40±6	28±9

Recruitment of non-ventilated (and poorly ventilated) but well perfused alveolar units rose PaO_2 during CMV and IRV-VC ($p=0.002$). The fall of $PaCO_2$ during IRV-PC ($p=0.02$) can be explained by the concomitant effects of: 1) decreased dead space ($p<0.001$), imputable to the long end-inspiratory pause; and 2) a right shift of V_A/Q distributions. Both mean blood flow (mean Q, $p<0.01$) and mean ventilation (mean V, $p<0.04$) distributions increased during IRV-PC but the corresponding dispersions did not change. The increase in mean Q did not improve PaO_2 likely because it reflects redistribution of blood flow within areas with normal and/or high V_A/Q ratios. In conclusion, short-term IRV-PC improved CO_2 clearence but the lung was efficient as O_2 exchanger.

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309

EICOSANOIDS ROLE IN ACUTE RESPIRATORY DISTRESS SYNDROME
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OBJECTIVES: To evaluate the possible role of eicosanoids in Acute Respiratory Distress Syndrome (ARDS).
DESIGN: We studied the plasma levels (arterial -art- and mixed venous -mv-) of thromboxane B2 (TXB_2), 6-keto prostaglandin F1-alpha (PGF_{1a}), and leukotriene B4 (LTB_4), at baseline in the first 48 hours of ARDS.
SUBJECTS: 21 ARDS patients. Mean lung injury score (LIS) 2.85 ± 0.06, and APACHE II 21 ± 1.8.
METHODS: The plasma eicosanoids were determined by radioimmunoassay (RIA). 20 voluntary healthy subjects were used as control for the venous eicosanoid values. Mann-Whitney test was used to determine differences with survival, and Pearson's test to correlate with clinical parameters. Data are expressed as mean ± SEM.
RESULTS AND STATISTICAL ANALYSES: Plasma levels of TXB_2, PGF_{1a}, and LTB_4 in ARDS patients were higher than the reference values ($p<0.05$):

	TXB_2	PGF_{1a}	LTB_4
art	78.9 ± 17.9	201.9 ± 28.4	1.03 ± 0.23
m-v	91.2 ± 22.3	199.9 ± 25.6	1.83 ± 0.92
Ref.	< 40 ng/mL	< 80 pg/mL	< 0.7 ng/mL

We correlated the absolute plasma values of each eicosanoid studied, and their arterio-venous gradient with LIS, APACHE-II, pulmonary artery pressure, systemic and pulmonary vascular resistances, PaO_2/FiO_2 ratio, stage in ICU, and mortality. A correlation with art and m-v LTB_4 with LIS ($r=0.49$ and $r=0.45$, $p<0.05$) was observed. Patients who died had a LTB_4 arterio-venous gradient more negative (-1.27 vs -0.10 ng/mL, $p<0.005$).
CONCLUSION: It seems that the role of LTB_4 in the ARDS severity is important.

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311

RESPONSE TO INHALED NITRIC OXIDE IN ACUTE RESPIRATORY DISTRESS SYNDROME (ARDS) PATIENTS.
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INTRODUCTION: Inhaled nitric oxide (NO) is a vasodilating agent that has been shown to improve critical hypoxemia in ARDS.
OBJECTIVE: To evaluate prospectively the predictive factors of the response of inhaled NO in very hypoxemic ARDS patients.
SUBJECTS & METHODS: We studied 11 severe ARDS patients, who were ventilated with a *Puritan Bennet 7200*. We administered inhaled NO in the inspiratory line, that was monitorized with a chemiluminiscense analyzer *Seres-Air Liquide NOX 4000*. Seven patients presented a positive NO response (increase in baseline $PaO_2/FiO_2 > 20\%$). We analized at baseline (PRE) and 60 minutes (POST) after NO inhalation: PaO_2/FiO_2 ratio, mean pulmonary artery pressure (MPAP), cardiac output (CO), mean arterial pressure (MAP), and pulmonary and systemic vascular resistances (PVR & SVR). Results are expressed as mean ± SEM. We used the Mann-Whitney and Wilcoxon tests to study differences between groups.
RESULTS AND STATISTICAL ANALYSES: Patients received a NO dose: 8.6 ± 0.9 ppm. In the responders group ($n=7$) PaO_2/FiO_2 ratio was 67 ± 5 at baseline, and 113 ± 19 mmHg after 60 minutes of NO ($p=0.02$); although, in the non-responders group ($n=4$) PaO_2/FiO_2 ratio was 87 ± 14 (PRE), and 91 ± 9 mmHg (POST) ($p=0.5$). The patients who improved their oxygenation >20% presented at baseline a higher SVR (956 ± 110 vs 563 ± 117 $dyn.s.cm^{-5}$, $p=0.04$), and PVR (232 ± 38 vs 101 ± 26 $dyn.s.cm^{-5}$, $p=0.09$), a superior MPAP (40 ± 6 vs 27 ± 3 mmHg), and a lower cardiac output (7.5 ± 0.9 vs 10.9 ± 0.8 L/m, $p=0.06$).
CONCLUSION: The ARDS patients who are in a more hyperdynamic state, seem to present a worse response to inhaled Nitric Oxide as refractary hypoxemia support treatment.

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321

DETERMINANTS OF PAO_2/FIO_2 RATIO IN ACUTE LUNG INJURY (ALI)
SM Whiteley, MC Bellamy.

Objectives PaO_2/FiO_2 ratio in acute lung injury is an index of the severity of the condition but also an important clinical variable as hypoxaemia is the predominant clinical problem. We therefore carried out a hypothesis-generating study to identify patient factors predictive of this ratio.
Design Prospective observational study
Subjects 10 patients with acute lung injury
Methods All patients were intubated and ventilated for ALI. Pressure controlled ventilation and an inspiratory: expiratory ratio 1:1 was delivered using the Puritan Bennet 7200 ventilator. Extravascular lung water index (EVLWI) and haemodynamic variables were recorded using the double-indicator technique (COLD, Pulsion). 42 EVLWI measurements were made in 10 patients. Other variables recorded included pulmonary artery occlusion pressure (PAOP), mean pulmonary artery pressure (MPAP), cardiac index (CI), creatinine, serum albumin and number of days ventilated. Multiple regression analysis was applied to determine predictors of PaO_2/FiO_2 ratio.
Results PaO_2/FiO_2 ratio was positively correlated with MPAP. There was a negative correlation with creatinine, days ventilated and EVLWI. The regression equation describing the interaction was statistically significant, $P<0.0001$, $r^2 = 0.70$
Conclusion In ALI, the most significant individual predictor of PaO_2/FiO_2 ratio was EVLWI. We have determined a group of patient factors which could possibly be influenced to affect outcome. Interventional studies are required.

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322

EVIDENCE OF REDUCED SEDATIVE AND INOTROPE REQUIREMENT FOLLOWING TRACHEOSTOMY ON THE INTENSIVE CARE UNIT

SN Smith, A Bodenham

OBJECTIVES: The recent resurgence in the use of tracheostomy for tracheal cannulation on intensive care has been predominantly based on subjective impressions of its advantage over the orotracheal route. There is evidence of reduced ICU stay when tracheostomy is performed earlier, but no clear reason for this is demonstrated. This study aimed to look at one proposed reason for this improvement, namely increased patient comfort and hence reduced sedative and inotrope drug requirements.
METHODS: Data, collected retrospectively from patient charts covering a period of 18 months, included patient details, timing of the tracheostomy, total sedative and inotropic drug use, pain and sedation scores for 24 hours before and 24 hours following tracheostomy formation. In all cases the tracheostomy was performed using a percutaneous technique with a short acting anaesthetic of propofol, atracurium and local anaesthetic infiltration. Sedative drug infusion rates were nurse controlled to achieve a required degree of patient comfort guided by sedation and pain scores. Inotrope use was similarly titrated to achieve individualised haemodynamic goals. Drug use for the two time periods was analysed using a paired, two tailed Student t test.
RESULTS: Complete data was obtained from 58 patient charts. Mean age was 54 years (range 14 to 83). 36% were general surgical admissions, 36% neurosurgical, 10% respiratory medicine. A comparison of the two data collection periods shows a significant reduction in the use of propofol and alfentanil in the 24 hours following tracheostomy with a reduction in adrenaline and noradrenaline requirements. Pain scores remained unchanged and there was an expected shift to lighter sedation scores.

Drug (mg/24hrs)	Number	Mean dose Pre	Mean dose Post
Alfentanil	39	57	36.5 p<0.0005
Propofol	23	1970	900 p<0.01
Adrenaline	16	211	156 p<0.05
Noradrenaline	23	280	142 p<0.05
Dopamine	21	280	252 n.s.

CONCLUSION: This evidence supports a perceived advantage of tracheostomy over endotracheal intubation in that the reduction in sensory stimulation of the densely innervated oral and pharyngeal cavities is removed leading to improved patient comfort and a reduction in sedative and analgesic drug use. This in turn appears to allow a concomitant reduction in inotrope and vasoconstrictor requirements.

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325

LUNG MECHANICS IN PIGS AT HEALTH AND ACUTE LUNG INJURY

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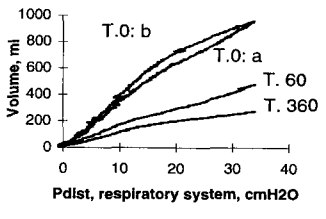
OBJECTIVES: a) to study lung and chest wall mechanics in healthy pigs in the supine and left lateral positions (SP and LP, respectively). b) to develop a model of acute lung injury (ALI) for studies of lung protective ventilation.
DESIGN: prospective, descriptive and observational animal study.
SUBJECTS: Anesthetized, paralyzed and intubated pigs of 20-30 kg.
METHODS: Mechanical ventilation was done in volume-controlled mode with a computer controlled Servo Ventilator 900 C (MV: 0.2 l/kg; RR: 20; ZEEP; Ti: 33%; Tpaus: 5%; FiO2: 0.6). Arterial, central venous and pulmonary artery catheters were inserted. Tracheal and esophageal pressures and flow were read by the computer. Lung mechanics was studied during a computer controlled low flow inflation. The distending pressure (Pdist) was calculated by subtraction of resistive pressure drop in connecting tubes and airways. After studies at health ALI was induced by continuous infusion of endotoxin (12 µg/kg/h) for 6 h. During ALI induction mechanics and hemodynamics were recorded each 30 min., blood gas each 60 min.



RESULTS: In both positions the Pdist/V curve of the respiratory system was complex with segments of low/high/low and high compliance (T.0:a). The non-linearity within the lower part was due to non-linear chest wall P/V curve. In the upper part the shape reflected a recruitment of lung units. P/V curves recorded soon after the first did not show the latter (T0:b).

After ALI induction compliance fell and recruitment phenomena disappeared after 60 to 360 min. (T60, T360). Hemodynamics showed features typical for septic shock including pulmonary hypertension. PaO2 fell.
CONCLUSION: Pigs may show a non-linear chest wall P/V curve, which leads to a 'false' lower inflection point of the respiratory system. They derecruit lung units faster than man. P/V curves should be recorded immediately after a recruitment procedure. The endotoxin model produces as expected a stiff lung and appears to be suitable for studies of therapeutic strategies.

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330

PRONE POSITIONIG IMPROVES OXYGENATION IN ARDS.

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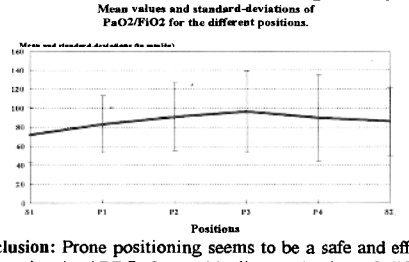
Objectives: To demonstrate the effect of prone positioning on arterial oxygenation in ARDS patients.
Design: Determination of arterial oxygenation on supine and prone positions.
Subjects: Nine hemodynamically stable ARDS ($PaO_2/FiO_2 \leq 150$ mmHg) adult patients (aged varying from 37 to 78, mean 58,5 years) were included in this study.
Methods: : To calculate oxygenation index (PaO_2/FiO_2), arterial blood, sampled from radial cannulization, was taken supine (S_1), 30 (P_1), 60 (P_2), 120 (P_3) and 180 (P_4) minutes of prone positioning, and after 60 minutes of supine repositioning (S_2) as well. Paralysis, sedation and constant ventilatory parameters (volume controlled ventilation) were assured during this investigation.
Results and statistical analysis: PaO_2/FiO_2 (mmHg) at supine position (S_{1-2})and after 30, 60, 120 and 180 minutes prone position (P_{1-4}) are shown bellow.

Position	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
S_1	68.1	96.1	136.0	72.3	50.2	46.2	50.0	51.0	77.0
P_1	74.4	108.8	148.0	110.5	83.2	57.9	74.0	54.0	63.0
P_2	69.6	136.5	143.8	124.9	92.8	54.8	80.0	59.0	55.0
P_3	87.2	110.1	148.3	173.6	93.2	57.2	96.0	46.0	54.0
P_4	78.7	110.4	147.6	174.6	58.6	61.1	80.0	49.0	47.0
S_2	81.3	114.6	141.0	135.5	50.9	52.9	56.0	59.0	82.0

Statistical treatment consisted of Friedman variability analysis.
Mean values of P1, P2, P3, P4 and S2 were significantly different from S1 ($p<0.05$).



Conclusion: Prone positioning seems to be a safe and effective method of improving oxygenation in ARDS. It would allow reduction of FiO2 obviating more complex procedures as nitric oxide inhalation and extracorporeal techniques.

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333

RESPIRATORY FAILURE (RF) IN PATIENTS WITH UNRECOGNIZED SLEEP RELATED DISORDERS BREATHING (SRDB): THE UTILITY OF POLISOMNOGRAPHY (PSG)

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OBJECTIVES: In some patients with RF a clear aetiology is not evident at presentation. In small proportion of these acute patients a previously unrecognized SRDB may be the cause of their RF.
SUBJECTS: We observed 14 patients, admitted to our Institute, with unexplained RF, 7 males and 7 females, with mean age 56,5 +/- 13,7 years, BMI 38,3 +/- 11,1 Kg/m2, PaO2 41,9 +/- 7,7 mmHg, PaCO2 58,7 +/- 14,6 mmHg. The mean FVC was 59,0 +/- 15,1 % of predicted, FEV1/FVC 76,7 +/- 13,6 % in the stable state. The admission diagnosis was COPD (2 subjects), congestive heart failure (CHF) (5), CHF plus hypothyroidism (1), obesity hypoventilation syndrome (5), multi brain infarction and relaxation diafragmation (1). METHODS: We evaluated the sleep and the breathing with a portable polisomnography during a full night recording.
RESULTS: We diagnosed obstructive sleep apnea (mean AHI 41,6/h) in 11 subjects, nocturnal severe hypoventilation with a severe decrease in SaO2 in 8, central sleep apnea (mean AHI 20/h) in 2, periodic breathing in 1 subject. Clinical features of these patients were a history of excessive daytime sleepiness, hypersomnia not correlated to hypercapnia, snoring, severe obesity, unexplained cor pulmonale, reversibility with non invasive ventilation (NIPPV, CPAP, BiLEVEL), RF not correlated to spirometric data.
CONCLUSION: We concluded that SRDB could be important in determining RF and that there is a need to look for SRDB in RF in obese and CHF patients without a recognized cause.

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334

CPAP AND BIPAP IN OBSTRUCTIVE SLEEP APNEA (OSA)

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OBJECTIVES: Although CPAP therapy is effective in the treatment of most patients with OSA, there is a small group of such patients in whom CPAP is not tolerated because of high pressure, or is ineffective with persistence of apneas, and/or hypoventilation and desaturation.
DESIGN: In this report we verified the utility of BiLEVEL by BiPAP in a group of 105 OSA, from two sleep centers, when CPAP failed, during therapeutic pressure titration.
SUBJECTS: 105 patients aged 20 to 72 years, with OSA, underwent CPAP trial during polisomnography. 43 patients were grossly obese (BMI > 35 Kg/m2), 20 were hypercapnic (PaCO2 > 45 mmHg), 18 were COPD (FEV1/FVC < 70%).
RESULTS AND STATISTICAL ANALYSES: CPAP (range 4 to 16 cmH2O) was effective in 81 (77%) patients; 24 (23%) patients failed to responde to CPAP therapy and required BiPAP st (IPAP range 8 to 18 cmH2O- EPAP 5 to 12 cmH2O). Comparing the CPAP group with the BiPAP group, the BMI, the FEV1/FVC, the PaO2, the PaCO2 and the oxygen desaturation index were significantly different ($p < 0,01$). The mean IPAP was inversely related to PaO2 ($R = -0,46$, $p < 0,05$), Buster pressure (difference between IPAP and EPAP) was directly related to PaCO2 ($R = 0,54$, $p < 0,01$).
CONCLUSION: CPAP is an effective therapy for the majority of OSA patients, but some patients in which high expiratory pressure is not tolerated or in case of persistence or emergence of hypoventilation BiPAP may be successfully administred.

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336

PERMISSIVE HYPERCAPNIC VENTILATION: THE EFFECT OF VENTILATING ABOVE THE INFLECTION POINT PRESSURE.

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OBJECTIVES: Recent evidence from a number of different studies suggests that mechanical ventilatory support may contribute to the lung injury seen in Adult Respiratory Distress Syndrome (ARDS) through mechanisms of volotrauma, barotrauma and shear stress injury.
DESIGN: The aim of this study was to compare the effect of ventilation with minimal volotrauma and shear stress, to conventional ventilation in an animal model of ARDS..
SUBJECTS: The study was carried out on two groups of anaesthetized dogs (n=5) using an oleic acid model of ARDS.
METHODS: Group 1 were ventilated with low tidal volumes (66% of baseline) and positive end expiratory pressures (PEEP) 2 cmH_2O greater than the measured inflection point pressure. Group 2 received conventional tidal volume ventilation and PEEP less than the inflection point pressure.
RESULTS: Statistical analysis between the two groups was performed using repeated measures of analysis of variance. Arterial oxygenation was significantly better and histological lung injury less, in the group ventilated with low tidal volumes and higher PEEP. There was no significant difference in cardiac output, systemic or pulmonary blood pressure or in peak inspiratory pressures between the two groups.
CONCLUSIONS: This study demonstrates that in an oleic acid model of ARDS, a reduction in tidal volumes in conjunction with the introduction of PEEP greater than the inflection point pressure improves oxygenation, maintains haemodynamic stability and limits the development of histologically demonstrable lung injury.

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410

HEMODYNAMIC AND RESPIRATORY MECHANICS IN CARDIOGENIC PULMONARY EDEMA PATIENTS: A CLINICAL BEDSIDE STUDY

A Gil, JM SamPedro, J Hernández, J Carrizosa, F Herrero, A Martin, D Sandaz.

OBJECTIVE: To find out if there is any difference in respiratory mechanics (RM) among patients with cardiogenic pulmonary edema (CPE) with and without shock.

DESIGN: Prospective study with follow up to Hospital discharge.

SUBJECTS: Thirty one adult patients mechanically ventilated for CPE (20 males, 11 females, mean (±SD) age 68 ± 6 years) were included in the study.

METHODS: RM was measured immediately at the beginning of mechanical ventilation using the pressure transducers incorporated into the Servo 900C Siemens ventilator. In every patient we reproduced and printed airway tracing and flow shape and obtained the static inflation compliance of the total respiratory system (Cst,rs), maximun inspiratory resistance (Rrs,max) and intrinsic PEEP (PEEPi). Shock diagnostic was established by clinical criteria (cuff blood pressure less than 90 mmHg, oliguria and periferical vasoconstriction) before tracheal intubation. Arterial blood gases obtained after tracheal intubation, SAPS-II score, CPE causes and in-hospital mortality were noted.

RESULTS AND STATISTICAL ANALYSES: Global RM were: Cst,rs (38.8 ± 2 ml/cmH_2O), Rrs,max (13 ± 1 cmH_2O/L/s) and PEEPi (6.1 ± 0.5 cmH_2O) (all values are expressed as mean ± SD). Before tracheal intubation, 16 patients (52 %) had shock (group I) and 15 did not (group II). Differences between both groups were tested using unpaired *t*-test: a $p<0.05$ was considered significant. Patients without shock had higher Rrs,max and PEEPi than those with shock (15.1 ± 1 *v. s.* 11 ± 0.8 cm H_2O/L/s: $p<0.01$, and 7.4 ± 0.6 *v.s.* 4.9 ± 0.8 cm H_2O: $p<0.05$), but Cst,rs was the same (37.2 ± 2 *v.s.* 40.3 ± 3 ml/cmH_2O: p: n.s.).

CONCLUSION: CPE patients: 1) had low Cst,rs and high Rrs,max and PEEPi, and 2) showed different RM in accordance with their hemodynamic status: while the Cst,rs was equal in both groups, patients without shock had higher Rrs,max and PEEPi than those with shock.

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411

f/V_T RATIO AND $P_{0.1}$ AS PREDICTORS OF EXTUBATION OUTCOME

G Rialp, G López-Velarde, M Subirana, E Bak, JA Santos, E Ormaechea, A Net, S Benito, J Mancebo, I Vallverdú.

Objective: To analyze the predictive value of the f/V_T ratio and $P_{0.1}$ as extubation indexes. Methodology: Prospective study in 68 patients under mechanical ventilation (MV) during at least 48 h, recovering from an acute respiratory failure (ARF). Measurements of f/V_T ratio and $P_{0.1}$ were performed within the 24 h prior to extubation. Patient extubation was made by the primary physician. Successful extubation (SE) was considered when spontaneous breathing was clinically well tolerated 48 h after extubation. Failure of extubation (FE) was considered when patients required reintubation and/or non-invasive ventilation (NIV) during this period. The predictive value of f/V_T ratio and $P_{0.1}$ is represented as sensitivity (S_e = TP/TP + FN), specificity (S_p = TN/TN + FP), positive (PPV = TP/TP + FP) and negative (NPV = TN/TN + FN) predictive values, where TP (true positive) is $f/V_T < 100$, $P_{0.1} < 5$ and SE; TN (true negative) is $f/V_T > 100$, $P_{0.1} > 5$ and FE; FP (false positive) is $f/V_T < 100$, $P_{0.1} < 5$ and FE; and FN (false negative) is $f/V_T > 100$, $P_{0.1} > 5$ and SE. Results: 68 patients were studied: mean age 66.4 years [(18 women and 50 men), (10 neurologic patients, 21 COPD patients, 35 ARF patients and 2 with neuromuscular disease)]. Extubation was successful in 49 patients and failed in 19 patients (15 were reintubated, 1 required NIV and 3 were tracheostomized, without previous extubation). Results were as follows:

	f/V_T				$P_{0.1}$			
	S_e	S_p	PPV	PNV	S_e	S_p	PPV	PNV
ALL PATIENTS 68(49E/19F)	0.86	0.16	0.72	0.30	0.71	0.12	0.70	0.13
COPD 21(16E/5F)	0.88	0.60	0.88	0.60	0.56	0.25	0.75	0.13
ARF 35(28E/7F)	0.82	0	0.76	0	0.79	0.17	0.81	0.14
NEUROLOGIC* 10(4E/6F)	1	0	0.4	0	1	0	0.4	0

*No neurologic patient had $f/V_T > 100$ or $P_{0.1} > 5$.

Conclusions: 1) f/V_T ratio < 100 and $P_{0.1} < 5$ detected success of extubation in COPD patients and in ARF patients, respectively. 2) 9/21 COPD patients and 11/35 ARF patients were succesfully extubated in spite of f/V_T ratio > 100 and/or $P_{0.1} > 5$. 3) Success or failure of extubation was not detected by indexes studied in neurologic patients.

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412

WEANING PARAMETERS TO DETECT EXTUBATION OUTCOME

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Objective: To analyze weaning parameters (WP) to predict extubation outcome. Methodology: Prospective study in 68 patients under mechanical ventilation (MV) during at least 48 h, recovering from an acute respiratory failure (ARF). Measurements of WP (f/V_T, $P_{0.1}$, MIP and MEP) were done in the 24 h prior to extubation. Patient extubation was performed by the primary physician. Results were analyzed according to: extubation outcome, etiology of ARF and cause of reintubation. Successful extubation (SE) was considered when spontaneous breathing was clinically well tolerated 48 h after extubation. Failure of extubation (FE) was considered when patients required reintubation and/or non-invasive ventilation (NIV) during this period. The statistical study used was the analysis of variance. Results: The study included 68 patients (p) (18 women and 50 men), with mean age of 66.4 years. Etiologies of ARF were: 10 neurologic p, 21 COPD, 35 ARF and 2 with neuromuscular disease. Extubation was successful in 49 p and failed in 19 (15 reintubations, 1 required NIV and 3 were tracheostomized without previous extubation). Extubation failed in: 60 % of neurologic p (6/10, 3 were tracheostomized), 24 % of COPD p (5/21) and 20 % of the ARF p (7/35). No WP showed significant differences between group SE and FE when all the 68 p were studied. Causes of FE were: hypoventilation and/or inability to clear secretions in 14 p, upper airways obstruction in 1, heart failure in 2 and respiratory infection in 2. When the 14 FE patients with hypoventilation and/or the inability to clear secretions were compared to the SE group, the results were as follows:

	SE (n=49)	FE (n=14)	P
MIP (cm H_2O)	65 ± 19	61 ± 19	NS
MEP (cm H_2O)	50 ± 25	37 ± 24	0.02
$P_{0.1}$ (cm H_2O)	4.1 ± 1.9	2.9 ± 1.1	NS
f/V_T (breath/min/L)	66 ± 34	66 ± 27	NS

Conclusions: 1) The weaning indexes studied did not detect the success or failure of extubation. 2) MEP values are orientative of failure of extubation when it is due to hypoventilation and/or inability to clear secretions.

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418

TRANSBRONCHIAL VASODILATOR THERAPY WITH AEROSOLIZED PROSTACYCLIN (PG12 ae) IN PATIENTS (p) WITH PULMONARY HYPERTENSION (PH) ASSOCIATED WITH ARDS

H. Stricker, G. Domenighetti, B. Waldispuehl

ARDS is characterized by a severe ventilation - perfusion mismatch leading to arterial hypoxemia often combined with acute pulmonary hypertension (PH) and right ventricular dysfunction. The treatment strategy is to decrease lung microvascular pressure and right ventricular afterload without inducing systemic effects, in order to prevent possible deterioration of gas exchange (GEx). Recent studies with inhaled NO and PG12 have shown promising results. We tested the efficacy of PG12 ae on haemodynamics and GEx in 5 patients with severe ARDS (LIS 2,5 ± 0,2; $\bar{X}$ ± SEM). The cause of ARDS was sepsis unrelated to pneumonia (3 p), trauma (1 p) and pneumonia (1 p). PG12 ae (FLOLAN ®) was titrated individually to find the effective dose for maximum improvement (MI) in PH and/or GEx. Data were collected at baseline (B); during MI and 60' after PG12 ae withdrawal. The table shows the relevant haemodynamic and GEx data (mean PG12 ae dose: 36 ± 9 ng/kg/min);

	B	MI	AW	
PAP (mmHg)	33 ± 2	29 ± 2	31 ± 1	
PVR (dyn.sec.cm-5)	198 ± 41	154 ± 26	164 ± 28	1)
MAP (mmHg)	82 ± 8	75 ± 6	73 ± 5	
CI (L/min/m2)	4,1 ± 0,4	4,2 ± 0,3	3,9 ± 0,2	
PaO2/FiO2	152 ± 33	162 ± 31	163 ± 42	
PAP (mmHg)	33 ± 1	27 ± 3*	31 ± 2	
PVR (dyn.sec.cm-5)	220 ± 44	154 ± 32**	180 ± 30	2)
MAP (mmHg)	81 ± 9	73 ± 5	77 ± 5	
CI (L/min/min)	3,8 ± 0,3	3,9 ± 0,2	3,8 ± 0,2	
PaO2/FiO2	160 ± 41	174 ± 38*	163 ± 42	

1): all 5 p; 2): ARDS not due to primary pneumonia (4 p) $\bar{X}$ ± SEM; * $p < 0,05$ ** $p < 0,01$ (MI vs B); PAP = mean pulmonary artery pressure; MAP = mean systemic arterial pressure; CI = cardiac index; PaO2/FiO2 = respiratory index; PVR = pulmonary vascular resistance.

CONCLUSIONS: PG12 ae may selectively improve GEx and reduce PH in ARDS patients. The individually titrated PG12 ae doses to catch the MI vary individually and were higher in our p than in those reported by others. One patient with pneumonia and extensive lung consolidation did not respond to PG12 ae.

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420

EFFECT OF SURFACTANT APPLICATION IN CHILDREN WITH ACUTE RESPIRATORY DISTRESS SYNDROME ON GASEXCHANGE

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OBJECTIVES: Surfactant deficiency or functionally defective surfactant can often be demonstrated in acute respiratory distress syndome (ARDS). In adults the application of exogenous surfactant has been shown to be beneficial, but to date, there exists no experience with respect to effect, timing and dosing in children. Therefore, we analysed the effect of surfactant application on gasexchange and ventilation parameters in all children with ARDS treated between 1993 and 1996.
DESIGN: Retrospective evaluation of all children with ARDS due to various causes treated with exogenous surfactant in a single institution.
SUBJECTS: Children with ARDS aged 2 weeks to 16 years.
RESULTS: A total of 18 children were treated with bovine surfactant (Alveofact®), 17 cases were evaluable in detail. In 9 cases ARDS was associated with pneumonia, in 4 cases with lung hemorrhage; in 4 cases isolated ARDS developed after 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 64 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 <500 . 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).
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 AaDO2 reflected the effect of therapy more acurrately than other indices such as oxygenation index (OI) or ventilation index (VI). No side effects were observed after exogenous surfactant application. However, in many cases the application of surfactant was too late after first symptoms of disease (median latency 16 days). Compared to adults with ARDS the applied surfactant doses in children may have to be increased to yield even better responses.

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436

VENTILATION-PERFUSION PATTERNS IN DIFFERENT STAGES OF ACUTE RESPIRATORY DISTRESS SYNDROME

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OBJECTIVES: This study was performed in order to investigate patterns of ventilation-perfusion (V_A/Q) relationship in patients with acute respiratory distress syndrome (ARDS).
DESIGN: Retrospective analysis.
SUBJECTS:
33 patients 17 to 59 years of age with severe ARDS at different stages in the course of the disease.
METHODS:
In each patient the continuous distribution of ventilation-perfusion ratios was determined using the multiple inert gas elimination technique.
RESULTS AND STATISTICAL ANALYSIS:
All patients presented severe ventilation-perfusion mismatch with true shunt, low V_A/Q, high V_A/Q and dead space. However, in the individual patients an unimodal, a bimodal, and a transitional pattern of ventilation-perfusion distribution could be differentiated according to the character of modes in regions with V_A/Q = 0.01-100. Patients with bimodal pattern were characterized by a significantly longer duration of their disease (33.2 ± 12.8 days) in comparison to patients with unimodal (13.4 ± 6.6 days, p=0.0003) or transitional pattern (20.0 ± 17.5 days, p=0.017)(mean ± SD, p according to Mann-Whitney U-test).
CONCLUSION: Our results suggest, that different patterns of ventilation-perfusion distribution represent different stages of ARDS. The unimodal pattern is present in early stage and develops through a transitional distribution into the bimodal pattern, which represents late ARDS. The demonstrated changes in distribution pattern are in accordance with known histologic changes in lung structure during the course of ARDS.

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438

TRANSPULMONARY ANGIOTENSIN II (ANG II) FORMATION IN PATIENTS WITH ADULT RESPIRATORY DISTRESS SYNDROM (ARDS): EFFECTS OF INHALED NITRIC OXIDE (NO)

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OBJECTIVES: The renin-angiotensin-system and NO are antagonists involved in the regulation of vascular tone. The systemic vasoconstrictor Ang II is mainly produced in the pulmonary vascular bed. Inhalation of NO decreases pulmonary vascular resistance (PVR) in patients with ARDS (1). We investigated whether inhalation of NO decreases transpulmonary Ang II formation.

DESIGN: prospective clinical study

SUBJECTS: 10 critically ill patients with severe ARDS (Murray score 3.15) and a mean pulmonary artery pressure (PAP) of 32±2 mm Hg who responded to NO inhalation by decreasing their PVR more than 15 dyn•s•cm^{-5}

METHODS: Patients were ventilated with positive end-expiratory pressure of 10-12 cm H_2O and an inspiratory oxygen fraction of 1.0. They were moderately dehydrated by continuous diuretic treatment. Arterial and mixed venous blood were obtained for radioimmunologic determination of plasma renin activity (PRA) and Ang II. We calculated the transpulmonary formation of Ang II (quantity=concentration • cardiac index • (1-hematocrit)) without NO and after a 20 minutes period of inhalation of NO (100 parts per million).

RESULTS: PVR decreased from 218±40 to 147±18 dyn•s•cm^{-5} (x±SEM) during inhalation of 100 ppm NO ($p< 0.05$). PAP decreased in all patients (mean decrease 20±3%). Arterial oxygen pressure increased from 200±39 to 269±38 mm Hg ($p<0.01$). Mixed venous PRA was 88±28 ng Ang I/ml/h and did not change throughout. Transpulmonary Ang II formation did not change during NO inhalation: it ranged from 0 to 244 ng/min/m^2 without NO (median=38 ng/min/m^2) and from 0 to 258 ng/min/m^2 (median=13 ng/min/m^2) during inhalation of 100 ppm NO (not significant).

CONCLUSION: Inhaled NO decreases PVR without influencing the transpulmonary formation of Ang II. We suggest that Ang II may have only a minor contribution to the increase of PVR in ARDS.

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439

COMBINED HIGH FREQUENCY VENTILATION IN ADULT ARDS PATIENTS REFRACTORY TO CONVENTIONAL VENTILATION

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Objectives : Retrospective report on the use of combined high frequency ventilation (CHFV) as rescue therapy for adult patients suffering from respiratory ARDS, with persistent arterial hypoxaemia (PaO_2<60mmHg) despite maximal conventional ventilation.

Design and Methods : In patients, admitted to the surgical ICU and developing ARDS with persistent arterial hypoxaemia despite maximal conventional ventilation (pressure controlled ventilation, FiO2 1.0, optimal PEEP and inversed ratio ventilation) CHFV was installed. HFV was started at a rate of 300/min superimposed on the conventional ventilation. Driving pressure of HFV was gradually increased while PEEP and conventional tidal volumes were stepwise decreased to avoid excessive airway pressures. Changes in oxygenation were monitored continuously with pulse oximetry, while changes in pH and $PaCO_2$ were controlled by frequent blood gas analysis.

Subjects : Over an 18-months period, 22 pts fulfilled the entry criteria of refractory arterial hypoxaemia despite maximal conventional ventilation.

Results : In 15 pts, combined HFV almost immediately resulted in a significant improve in oxygenation (PaO_2 range after 30 min CHFV : 97-282 mmHg). And although conventional tidal volumes were decreased by approximately 80%, we noticed a slight (non significant) decrease in $PaCO_2$ during CHFV. Conventional ventilation could be resumed in 8 pts after a mean of 3.5 days on CHFV, and 5 pts finally survived (whereas 2 pts died from multiple organ failure and 1 pt died from late ARDS non-responsive to a second trial of CHFV). In 7 of the 22 pts, the installation of CHFV did not succeed in improving oxygenation and was stopped after a few hours trial. All 7 pts subsequently died from severe respiratory insufficiency. It has to be noticed that 6 of these 7 pts suffered from so-called late ARDS, whereas 13 of the 15 good-responders to CHFV suffered from an "early" ARDS with a fulminant short lasting course.

Conclusion : Combined HFV could be considered as a rescue ventilatory therapy in pts suffering from severe ARDS refractory to conventional ventilation. It is easily applicable in an ICU setting resulting in an improved oxygenation in about 70% of the pts with persistent arterial hypoxaemia, thereby revealing potentially salvageable ARDS pts.

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441

RESULTS OF A PROSPECTIVE PRONE POSITIONING PROTOCOL IN PATIENTS WITH THE ACUTE RESPIRATORY DISTRESS SYNDROME

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OBJECTIVES: To assess the effects of a prospective prone positioning protocol on pulmonary and hemodynamic profiles of patients with Acute Respiratory Distress Syndrome (ARDS).

DESIGN: Prospective pre and post intervention observational study.

SUBJECTS: Thirty patients over an 18 month period, diagnosed with ARDS as defined by poor oxygenation (PaO_2/FiO_2<200), bilateral pulmonary infiltrates, no signs of heart failure.Thirteen were transferred to our institution for treatment of ARDS. The rest were direct admissions. Trauma was the cause of admission in 22 of the patients.
Mean age was 39 years (range: 19-82), Males-24, Females-6.

METHODS: Patients were placed on a lateral rotation bed (Stryker Frame).
The position was reversed - supine to prone or prone to supine, every 3 hours.
Monitoring included lung mechanics, blood gases and cardiovascular hemodynamics.

RESULTS: Rotation period: Mean - 7.8 days (2-29), +/- Standard Deviation (SD) - 5.9.
Ventilation duration: Mean-26.8 days(5-68),+/-15.2. ICU stay:Mean-35.4(6-78), +/- 17.7

Table: Results expressed in means and SD in parentheses (rounded to closest dec. point).

Parameter	Pre-Protocol	Post-Protocol	Change	P Value
PaO_2/FiO_2	110 (48)	318 (96)	208 (92)	<0.001
Pulmonary Shunt %	43 (9)	23 (5)	-20 (10)	<0.001
Cardiac Index	5.3 (1.4)	5.3 (1.0)	0.07 (1.6)	NS
Dynamic Lung Compliance	18 (6)	26 (10)	8 (9.6)	<0.001
Static Lung Compliance	45 (23)	82 (41)	37 (37.6)	<0.001

DISCUSSION: All patients showed significant improvement in pulmonary function.
Prone positioning was well tolerated without hemodynamic compromise.
Survival (discharge to home or rehabilitation) was 97 %. One patient died post protocol.

CONCLUSION: The prone positioning protocol appears to have favorable effects on pulmonary function and mechanics. Further research, in the form of a prospective, controlled and randomized study, should be done to assess the effect of prone positioning on the outcomes of patients with ARDS.

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465

SUCCESSFUL SINGLE LUNG TRANSPLANTATION (LT) IN PARAQUAT (PQ) INTOXICATION

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Background. Severe, acute lung injury frequently results from ingestion of PQ and respiratory failure is the major cause of death in patients surviving more than 2 days after ingestion. We describe a patient with whom single LT was performed late, 44 days after poisoning, for end-stage lung disease.

Case description. On October 28, 1995, a 17-year-old man was admitted to a regional hospital for bronchitis. He developed an acute respiratory distress syndrome (ARDS) and was transfered to an intensive care unit of an university hospital 2 days later. A lung biopsy showed severe lung fibrosis. Despite optimal mechanical ventilation, steroids and muscle relaxation, hypoxia worsened. The etiology of ARDS was unclear. 39 days after ingestion of PQ, the patient was transfered to our hospital for LT. On December 7, 1995, left lung allotransplantation was performed. The postoperative course was complicated by bacterial bronchitis and a native lung bronchopleural fistula for which a right pneumectomy was performed, 29 days after LT. Confirmation diagnosis of PQ poisoning was obtained from determination of PQ levels in lung (134 μg/l) and muscle (328 μg/l) biopsy. Histology of right and left lung showed severe, predominantly intraalveolar, fibrosis. After partial remission of an acquired neuromyopathy, the patient was discharged from the hospital on March 4, 1996, 122 days after ingestion of PQ and 88 days after LT.

Conclusion. LT for lung fibrosis after PQ intoxication is controversial, due to the slow release of large muscle stores of PQ and subsequent failure of LT. Prior to 1996, several LT had been performed for patients with terminal respiratory insufficiency due to PQ toxicity. All died between 1 and 122 days after PQ ingestion. Out patient survived possibly because LT was performed very late after PQ ingestion.

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473

DIAGNOSIS OF STAGES OF ADULT RESPIRATORY DISTRESS SYNDROME (ARDS) IN PERITONITIS PATIENTS

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OBJECTIVES: To create the diagnostic algorithm of ARDS stages in peritonitis patients. DESIGN: Prospective investigation of lung respiratory function of peritonitis patients in 1 - 7 day after surgery. SUBJECT: We examined 68 peritonitis patients (275 observations) 14-81 years old with different abdominal aetiology. METHODS: We used capnography for the valuation of respiration (R, 1/min), ventilation/perfusion relation ($\Delta p/\Delta t$, mmHg) and peak of CO_2 pressure in the end of inhalation ($FetCO_2$, vol%), pneumotachography for the evaluation of ventilation volume(V, l) and V per min ($\dot{V}$, l/min), tetrapolary chest reography for the valuation of resistance between breast and neck electrodes (Z, Ohm) and Micro-Astrup method for the evaluation of pO_2 and pCO_2 in capillary blood (mmHg). We used T-test, correlation and discriminant analyses (D.a.) and expert method (E.m.) for statistical analyses. E.m. was carried out by physician which used clinical picture, auscultation, X-ray and other instrumental and laboratory data and outcome for his conclusion. RESULTS AND STATISTICAL ANALYSES: We divided all observations on 5 classes (normal respiratory function, I stage of ARDS, ARDSII, ARDSIII, ARDSIV) using E.m. D.a. was carried out for first four classes. There were very few observation in group ARDSIV and we combined it with group ARDSIII. We received best results using following parameters: $\Delta p/\Delta t$, $FetCO_2$, pCO_2, Z, R, pO_2. We got linear discriminant functions (Y_n= const + $k_1 \cdot P_1$ + ...+ $k_6 \cdot P_6$, where n - number of discriminant function (1 - normal,...,4 - ARDSIII), const - value of constant, k_1,..., k_6 - coefficients, P_1,..., P_6 - values of parameters) which permit to identify more than 90% patients with norm, ARDSI, ARDSII, ARDSIII (see the table). CONCLUSION: We created diagnostic rules which allowed us to make conclusion about stage of ARDS in 92-100% of peritonitis cases.

P-ts	Norm	p	ARDSI	p	ARDSII	p	ARDSIII
R	17.7±0.4	<0.03	19.0±0.4	<0.0001	23.5±0.7	<0.0001	30.5±1.5
pCO	38.4±0.9	<0.0005	34.5±0.5	<0.0009	31.6±0.7	<0.02	27.9±1.3
pO_2	76.5±2.0	>0.05	73.3±1.2	<0.03	68.5±1.9	>0.05	67.4±2.9
$FetCO_2$	4.4±0.1	<0.0001	3.9±0.1	<0.0001	3.4±0.1	<0.0001	2.8±0.1
$\Delta p/\Delta t$	1.4±0.1	<0.0001	2.3±0.1	<0.0001	3.1±0.1	>0.05	3.6±0.3
Z	31.8±0.8	>0.05	30.0±0.5	>0.05	28.5±0.7	>0.05	27.1±1.5

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477

HIGH FREQUENCY OSCILLATORY VENTILATION IN THE TREATMENT OF SEVERE ACUTE RESPIRATORY FAILURE IN PEDIATRIC CANCER PATIENTS

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OBJECTIVES: We retrospectively studied patients (PTS) outcomes of high frequency oscillatory ventilation (HFOV) rescue therapy, for severe acute respiratory failure (ARF) comparing nonCA to CA (cancer) (including CA with bone marrow transplant [BMT]), death rates from 11/92 to 3/96 to determine HFOV efficacy.
DESIGN: Chi square (X^2) contingency table statistic was applied to all (n=61) survivors/non-survivors ± CA who received HFOV for ARF refractory to conventional ventilation over 41 months.
SUBJECTS AND METHODS: All 61 PTS (<18 years) had ARF due to lung disease with indications for HFOV being FIO_2>.6, inspiratory pressure >45cm H_2O, with PaO_2 <60mmHg.
RESULTS AND STATISTICAL ANALYSES: 47 of 50 nonCA PTS survived to discharge from hospital, with 1 death to mitochondrial disease, 1 death to fungal sepsis, and 1 death to AIDS. 10 of 11 CA PTS died, the 1 survivor treated for P.carinii pneumonia receiving HFOV for 53 days. 3 CA PTS who died had BMT. For nonCA vs CA deaths, X^2=10.5, p<.001 and for nonCA vs BMT, X^2=3.75, p<.05.
CONCLUSIONS: HFOV is a promising rescue therapy for pediatric nonCA ARF PTS, but much less so for those with CA, particularly with BMT(1).

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481

INCIDENCE OF SEVERE RESPIRATORY FAILURE AFTER THORACIC SURGERY

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Objectives : Retrospective report on the incidence of severe respiratory insufficiency after major thoracic surgery.
Design and Methods : During a 12-months periods, pts admitted to the surgical ICU after major thoracic surgery were reviewed for the presence of acute respiratory insufficiency, necessitating aggressive ventilatory management. Respiratory failure was defined as arterial hypoxaemia (PaO_2 < 55 mmHg) and tachypnea (>30 breaths/minute), necessitating intubation and ventilation (despite maximal conservative respiratory management) during the first 48 hours postoperatively .
Subjects : Sixty-one consecutively admitted pts were evaluated. All patients were extubated at the end of the operation and arrived at the ICU on oxygen mask with FiO_2 0.40.
Results : Three pts developed respiratory failure (for 1 pt within 24h of admission, for both others between 24h and 48h of ICU admission). In one pt respiratory failure was due to pre-exisiting myasthenia gravis with extreme muscle weakness. Patient needed ventilatory support with progressive weaning over several days, while optimalizing specific medical treatment for the mysthenia gravis disease. The other 2 pts suffered from acute respiratory failure with unilateral total opacification of the dependent lung on chest radiography, developing towards a full blown ARDS. Both patients needed aggressive ventilatory management (with optimal PEEP for one pt, and pressure controlled ventilation, inversed ratio for the other pt). Both pts were however successfully weaned after respectively, 5 days and after 24 days.
Conclusion : The occurrence of non-cardiogenic pulmonary edema in the dependent lung after lateral decubitus positioning during thoracotomy is described as a rare cause of post thoracic surgery ARDS. On 61 patients, we found 2 illustrative cases of dependent lung ARDS, necessitating prompt and aggressive respiratory managmement.

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487

COMPARISON OF TWO METHODS TO DIFFERENTIATE FLOW-RELATED AND VISCO-ELASTIC PRESSURE DISSIPATIONS AFTER RAPID AIRWAY OCCLUSION.

E.Bak, M.Subirana, J.Mancebo.

The technique of rapid airway occlusion during constant flow inflation is widely used to measure respiratory system resistances (Rrs). After an occlusion a biphasic pressure decay is observed: the initial rapid drop which represents the airway and endotracheal tube resistance (Rmin) and the additional slower decrease (δR) is caused is by stress relaxation and/or redistribution of gas within the lung (pendelluft). An alternative way to analyze total Rrs is by fitting a biexponential function to the pressure decay observed after the rapid airway occlusion: $Paw = A_1 * e^{(-t/T1)} + A_2 * e^{(-t/T2)} + P_0$, (being $T_1 < T_2$). The first exponential term is attributed to the flow-related pressure losses including pendelluft and the second term is due primarily to the stress relaxation [JJ Pérez Fontán et al, JAP 1992, 73:1297-1309]. The objective of this study was to compare the Rrs calculated with these two methods.
Material and Methods: In 10 ARDS patients ventilated in volume controled mode, end-inspiratory occlusions were performed using ventilator valves. We calculated: Rmin, δR, Rmax=Rmin+δR, A_1, T_1, A_2, T_2, $R_1=A_1/flow$, $R_2=A_2/flow$, $R_{1,2}=R_1+R_2$. Rmin, Rmax, R_1 and $R_{1,2}$ were corrected for valve closure time. Statistical analysis: paired T-test.
Results (mean ± SD): Biexponential fitting: A_1=8.1 ±2.6 cmH_2O, T_1=0.068 ±0.039 s, A_2=4.1 ±1.6 cmH_2O, T_2=1.65 ±0.77 s, correlation between observed and fitted points was 0.974 ± 0.020.
Comparison between two methods:

Rmax = 16.5 ± 5.7	$R_{1,2}$ = 16.5 ± 5.7	P=0.99	r=0.983
Rmin = 9.6 ± 3.1	R_1 =11.4 ± 4.2	P<0.001	r=0.941
δR = 6.9 ± 3.5	R_2 = 5.1 ± 2.1	P<0.001	r=0.939

All correlations (r) were significant (P<0.001).
Mean PEEPi in ZEEP was 2.7 ± 2.2 cmH_2O and δR-R2 (reflecting possibly pendelluft) was correlated with PEEPi (r=0.66, P=0.02).
Conclusions: The biexponential fitting method may be useful to differentiate stress relaxation from gas redistribution between lung regions.

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488

Combined effects of PEEP ventilation and nitric oxide (NO) inhalation in patients with severe acute lung injury.

AJ. Betbesé, M. Pérez, G. López-Velarde, G. Rialp, A. Santos, E. Bak, M. Subirana, A. Net, J. Mancebo.

Objective: To analyze if optimal PEEP titration, by means of pressure-volume (P-V) loops, could enhance the improvement in arterial oxygenation induced by NO inhalation in patients with acute lung injury.
Methods: We prospectively studied 11 patients who had acute lung injury (9 ARDS). All were under volume assist-control mechanical ventilation at FiO_2 1, with constant inspiratory flow. External PEEP was adjusted according to the initial inflection point obtained in a P-V loop. In six out of 11 patients we measured the recruited volume induced by PEEP. NO was administered at a fixed dose (5 ppm). NO, NO_2 and NO_X were measured by chemiluminiscence. The study protocol consisted in four randomized phases: 1) Basal (ZEEP without NO inhalation). 2) PEEP without NO inhalation. 3) ZEEP with NO inhalation. 4) PEEP with NO inhalation. Statistical analysis: ANOVA and simple linear correlation test.
Results: Mean PEEP was 12.2 ± 0.5 cm H_2O. We obtained a significant positive correlation between the improvement in arterial oxygenation and recruited volume in PEEP and PEEP + NO ventilation ($r = 0.95$, $P = 0.004$ and $r = 0.90$, $P = 0.01$ respectively). Seven patients did not respond to NO inhalation in ZEEP and only one patient did not improve after PEEP + NO.

	PaO_2 (mmHg)	$PaCO_2$ (mmHg)	MPAP (mmHg)	PVRI (mmHg)	CI (l/min/m²)	Qs/Qt (%)
1. Basal	104 ± 23	61 ± 6	29 ± 2	271 ± 21	5.00 ± 0.15	47 ± 5
2. NO	113 ± 25	60 ± 5	26 ± 2†	231 ± 15†	5.01 ± 0.27	46 ± 5
3. PEEP	161 ± 30*‡	61 ± 7	30 ± 2‡	289 ± 21‡	4.67 ± 0.30	37 ± 4*‡
4. PEEP + NO	193 ± 32§$¶	59 ± 6	27 ± 1§¶	252 ± 15¶	4.53 ± 0.29§$	31 ± 3§$¶
P	< 0.001	NS	< 0.001	0,01	0,03	< 0.001

P < 0.05: †(1 vs 2), *(1 vs 3), §(1 vs 4), ‡(2 vs 3), $(2 vs 4), ¶(3 vs 4).

Conclusions: PEEP and NO inhalation had sinergistic effects on arterial oxygenation. Optimal PEEP titration enhances the response to NO inhalation. Patients with a greater recruited volume presented a greater improvement in oxygenation in both PEEP and PEEP + NO inhalation.

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490

RELATIONSHIP BETWEEN PEEP INDUCED ALVEOLAR RECRUITMENT AND AIRFLOW RESISTANCE IN PATIENTS WITH THE ADULT RESPIRATORY DISTRESS SYNDROME (ARDS).

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Studies dealing with the effects of PEEP in respiratory system resistance (Rsr) in patients with ARDS are contradictory. We conducted a study to analyze whether the changes in lung volume induced by PEEP were related with changes in airway resistance (Rmin), and to test the hypothesis that PEEP-induced alveolar recruitment would lead to a decrease in Rmin.
Methodology: We studied 16 consecutive ARDS patients. Respiratory system maximum (Rmax), minimum (Rmin), and additional (δR) resistances were obtained by the end-inspiratory occlusion method. PEEP level (mean 11.4 ± 1.9) was titrated according to the lower inflation zone of pressure-volume curve (P-V). Measurements of resistances and end-expiratory lung volume (δFRC) were performed in ZEEP and PEEP. Recruited volume (Vrec) with PEEP was calculated as the difference in lung volume between ZEEP and PEEP conditions. Statistical analysis: ANOVA.
Results (mean ± SD): Resistances are expressed in $cmH_2O/l/s$.

	Rmax,rs	Rmin,rs	δR,rs
ZEEP	17.4±4.3	10.4±2.8	7±2.4
PEEP	16.1±3.8	7.9±2.2	8.3±2.7
P	NS	<0.001	<0.01

Application of PEEP decreased Rmin,rs in every patient. The mean Vrec with PEEP was 198.8 ± 106.9 ml. The decrease in Rmin,rs (%) between ZEEP and PEEP correlated with Vrec/δFRC(%) ($r = -0.84$; $P < 0.001$). In 4 out of 5 patients with Vrec lower than 120 ml Rmin,rs decreased less than 15%. In 10 out of 11 patients with Vrec higher than 120 ml, Rmin,rs decreased more than 15%.
Conclusion: PEEP application induced an increase in lung volume and recruitment, which led to a decrease in Rmin,rs. This effect seems to be dependent on the degree of Vrec.

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491

BRONCHODILATOR DELIVERY BY METERED-DOSE INHALER (MDI) IN ARDS PATIENTS.

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The ARDS is characterized not only by a low respiratory compliance but also by a high respiratory resistance. The objective of this study was to test the efficacy of inhaled beta-2 broncodilators in decreasing airway resistance.
Methodology: In 7 consecutive ARDS patients we analyzed total resistance of the respiratory system (Rmax), airway plus endotracheal tube resistance (Rmin) and δR (Rmax-Rmin) before and after administrations of 10 puffs (1 mg) of inhaled salbutamol (MDI) by means of an aerochamber device (AeroVent, Monaghan). All patients were sedated, paralysed and ventilated in volume controlled mode with constant inspiratory flow. Rmax, Rmin, δR and static compliance (Cst) were obtained by the end-inspiratory occlusion method. Measurements were performed before (basal) and 5, 30 and 60 minutes after salbutamol administration. Comparison was perfomed using analysis of variance (ANOVA). Significance was defined as $P < 0.05$.
Results (Mean±SD): Cst is expressed in ml/cmH2O and R in cmH2O/l/s.

	Basal	5 min	30 min	60 min
Cst	35 ± 10	34 ± 9	33 ± 8	34 ± 9
Rmax	18.1±5.5	16.6±6.8*	16.6±6.9*	16.9±6.3*
Rmin	9.9±2.2	8.7±2.2*	8.1±1.6*	8.6±1.4*
δR	8.1±3.7	8±5.1	8.5±6.2	8.3±6.1

*P < 0.05 compared with basal situation.
Conclusions: In ARDS patients, salbutamol decreases the abnormally high airway resistance.

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492

TITRATION OF POSITIVE END EXPIRATORY PRESSURE IN THE ADULT RESPIRATORY DISTRESS SYNDROME

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OBJECTIVES: To titrate Positive End Expiratory Pressure (PEEP) in the Adult Respiratory Distress Syndrome (ARDS) using the Alveolar Amplitude Response Technique (AART).
DESIGN: A pilot study to assess the efficacy of the AART in measurement of effective lung perfusion.
SUBJECTS: Eight mechanically ventilated pigs.
METHODS: The AART is based on the uptake of an inert soluble tracer gas. By sinusoidal variation of the inspiratory halothane fraction in low concentration (0.1%), the effect of recirculation can be neglected. The AART measures the part of the cardiac output that participates in gas exchange. This effective lung perfusion was measured before and after total alveolar lavage. The PEEP levels were varied between 4 and 20 cm H_2O after lavage. Cardiac output was measured with the thermodilution method. Arterial and mixed-venous blood gas samples were taken. Hemodynamic pressures were monitored. The effective lung perfusion measured by the AART was compared with the calculated effective lung perfusion ($\dot{Q}_{AART}$ versus $\dot{Q}_{thermodilution} * (1-\dot{Q}_{shuntfraction})$).
RESULTS AND STAT.ANALYSIS: In six out of eight pigs a significant correlation ($r>0.90$, $p<0.05$) between the AART and the calculated effective perfusion was found. This was calculated for a 95% confidence interval.
CONCLUSION: The AART can be used as a non-invasive technique to titrate PEEP in ARDS. It can be developed as a non-invasive monitoring technique to measure effective lung perfusion in mechanically ventilated patiënts.

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499

BiPAP VENTILATION: AN ALTERNATIVE TO INVASIVE MECHANICAL VENTILATION IN PATIENTS WITH IMPENDING RESPIRATORY FAILURE.

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OBJECTIVE: Evaluation of the outcome of patients with impending respiratory failure treated with a BiPAP ventilator.
METHOD: A total of 101 treatment episodes were reviwed in ninety-five patients during a sixteen month period. Patients had a variety of medical and surgical conditions, mean age 59 years, male to female ratio 1.3:1. Days on BiPAP, maximal inspiratory positive airway pressure ($IPAP_{max}$), and maximal expiratory positive airway pressure ($EPAP_{max}$) for each patient was recorded. Values of arterial pH, PaO_2, $PaCO_2$, and PaO_2/FiO_2 ratio before and within one hour of implementation of BiPAP were also examined. Sixty patients received BiPAP as initial therapy ("de novo" group), and forty-one patients received BiPAP after failing extubation (post-extubation group).
RESULTS: Days on BiPAP were 2±1, $IPAP_{max}$ 5±2, and $EPAP_{max}$ 10±3cmH_2O. Sixty-eight of the 101 episodes of acute respiratory failure responded to BiPAP and intubation was avoided (39/60 episodes in the "de novo" group, and 29/41 in the post-extubation group). Twenty-two episodes which did not respond to BiPAP were intubated and ventilated conventionally, and sixteen of them responded favorably. Eleven patients who did not respond to BiPAP were placed in "comfort measures" and died. Mean±Std of measured blood gases variables before and after BiPAP for patients who responded to treatment and avoided intubation (responders) and those who failed BiPAP (non-responders) are shown below.

	RESPONDERS		NON-RESPONDERS		p-value
	before	after	before	after	
pH	7.37±0.01	7.39±0.01	7.34±0.01	7.36±0.01	NS
PaCO2	48±2	46±2	47±3	43±3	NS
PaO2	75±4	90±4	74±6	94±6	NS
PaO2/FiO2	171±10	193±10	147±15	169±15	NS

Changes in pH, and PaO2/FiO2 ratio were significant in the "responders" group ($p<0.02$), however, these changes were not significant when compared with changes observed in the "non-responders".
CONCLUSION: Endotracheal intubation was avoided in approximately two third of patients treated with BiPAP. Response to BiPAP was similar in the "denovo" and the post-extubation group. Blood gases variables before and one hour after implementation of BiPAP failed to predict response to this modality of ventilation.

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515

TRACHEOTOMY AFTER CARDIAC SURGERY.

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Introduction: many patients required prolonged mechanical ventilatory support after open heart surgery. Objective: The aim of our study was to identify the major risk factors for tracheotomy in adult after cardiac operation.
Methods: We analized 950 consecutive patients who underwent cardiac surgical procedures (Feb.95-Feb.96); only 13 patients (1.3%) needed tracheotomy in ICU for weaning from mechanical ventilation, and prolonged ventilatory support (average 26 days). It was a mixed population (4 f 9 m, mean age 63 y, NYHA III-IV), ten elective procedures (3 CABG, 4 valve replacements, 1 aortic dissection, 1 pulmonary tromboendoarterectomy, 1 atrial septal defect) and three emergency (1 aortic dissection, 1 cardiac rupture, 1 CABG).
Results: Eigth patients (61,5%) developed low perioperative output state, three had cerebral damage, two had massive postoperative bleeding whith respiratory insufficiency). Five patients died: three for cardiac failure, two for multiple organ failure. Seven patients survived and they had an average stay in ICU of 40 days.
Conclusion: Risk factors for tracheotomy in ICU after open heart surgery is partly due to the nature of patient population, and partly to the perioperative complications (low cardiac output, cerebral damage,and respiratory insufficiency).

523

BRONCHODILATATION BY INTRAVENOUS MAGNESIUM IN PATIENTS WITH EXACERBATED CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COLD) ?

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OBJECTIVES: to assess the influence of i.v. magnesium on pulmonary function in patients with COPD
SUBJECTS & METHODS: In an intraindividual comparison in 16 patients (8 m.,8 f.,69 ± 9 y.) with exacerbated COPD the influence of intravenous 10 mval magnesium [Mg] (Magnorbin 20%,Merck,FRG) on pulmonary function was measured by bodyplethymography and flow-volume-curve and compared to placebo (10 ml NaCl).

RESULTS (mean values ± 1 SEM)

pulmonary function	before	NaCl	Mg
Airway Resistance Raw [cm/H20/s/l/]	9,2 ±1,6	9,7 ±1,4	7,5 ±1,6
Intrathoracic gas volume IGV [%]	171 ±38	164 ±32	149 ±17
forced expiratory volume FEV1 [%]	40 ±14	40 ±13	43 ±15
forced expiratory flow (FEF50%) [%]	21 ±9	20 ±8	22 ±10
inspiratory capacity IC [%]	46 ±13	42 ±10	49 ±12

CONCLUSION: Intravenous administration of magnesium leads to an improvement of airway resistance and can be used as an additional drug in the therapy of exacerbated COPD.

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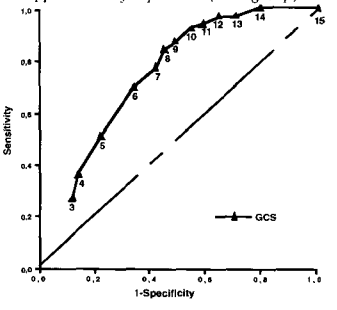
528

RELATIONSHIP BETWEEN GLASGOW COMA SCALE AND SUSPECTED ASPIRATION PNEUMONIA IN DRUG-INDUCED COMA

F Adnet, Benaissa ML, Bekka R, P Plaisance, C Lapandry , F Lapostolle, F Baud

OBJECTIVES : This study was designed to assess the relationship between the degree of impaired consciousness and the rate of suspected aspiration pneumonia in poisoned patients.
DESIGN : All consecutive drug poisoned patients admitted to the toxicological intensive care unit were included in this prospective study. The Glasgow Coma Scale (GCS) score before any sedation was collected. Patients were included in the "aspiration suspected" (AS+) group if an infiltrate was found on the chest roentgenogram during the first 36 hours after admission. A receiver-operating characteristic (ROC) curve was used to assess the usefulness of GCS as a test for the inclusion in the AS+ group.
SUBJECTS : Two hundred eleven consecutive patients were studied. The initial GCS, frequency of inclusion in the AS+ group were collected.
RESULTS :

ROC curve for different changes in GCS value as an indicator of radiographic appearance of aspiration (AS+ group).



The ROC curve for changes in GCS demonstrated that GCS > 8 was associated with a smaller risk of aspiration. This cut point was associated with a sensitivity of 0.84, specificity of 0.56, positive predictive value 0.44 and negative predictive value 0.89. The positive likelihood of GCS>8 was 1.09 and negative likelihood 0.28.

CONCLUSION : Our study demonstrates that GCS > 8 is associated with a smaller risk of aspiration peumonia in toxic coma.

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558

EFFECTS OF PRESSURE SUPPORT LEVEL (PS) ON PATIENTS WITH AND WITHOUT PREEXISTING CHRONIC OBSTRUCTIVE LUNG DISEASE (COLD) RECEIVING PRESSURE SUPPORT VENTILATION

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OBJECTIVES: Increasing PS reportedly causes tidal volume (V_T) to rise and respiratory rate (RR) and work of breathing to decrease. We investigated whether these changes similarly apply to patients with (*C*) or without (*A*) history of COLD. DESIGN: Case control study, in an University Hospital ICU setting. SUBJECTS: All *C* patients admitted for acute respiratory failure, and receiving pressure support ventilation during the weaning phase were entered consecutively. All *A* patients admitted during the study period, and also being weaned were similarly studied: those matching *C* patients' demographics and respiratory failure severity were entered. METHODS: After baseline assessement, PS was randomly changed to 5 (essentially no support, being such a value just enough to overcome endotracheal tube and circuit resistance) or 15 cmH_2O, and kept at each PS for 30 min before taking measurements. PS was at that point switched to the other level and the sequence repeated. F_IO_2 and PEEP were maintained unmodified throughout the study, and care was taken to disturb the patients as little as possible. Measurements included airway and oesophageal pressures and airflow by means of Bicore CP-100 pulmonary monitor, arterial blood gases and vital signs. Digitized data from Bicore were acquired by personal computer, and analyzed by custom software, to compute mechanics, and work and pattern of breathing parameters. Data are shown as mean±SD; one- and two-way factorial ANOVA was applied. RESULTS: The two groups were comparable (table) for baseline measurements, except for V_E. Increasing PS from 5 to 15 cmH_2O caused RR decrease (*A*: P<0.05; *C*: NS) and V_T rise (*A*: P<0.05; *C*: P<0.005), leaving V_E non significantly modified: this effected a modest P_aCO_2 reduction (*A*: P<0.02; *C*: NS). In both groups, pattern of breathing and respiratory drive ($P_{0.1}$) were not affected by increasing PS, while oesophageal pressure-time product (PTP) was reduced by approximately 60% (P<0.002). Patient performed work of breathing, both in absolute terms and as percent of total work, was significantly decreased as well (P<0.02 and 0.002, respectively) in both groups, in the face of substantially unchanged V_E. CONCLUSIONS: Increasing PS effected similar changes of ventilation in both *A* and *C* patients. At least during weaning from pressure support ventilation, the major impact in both groups was on work of breathing: its reduction resulted of the same order of magnitude, irrespective of COLD preexistence. *P<0.05

	age	weight	height	PS	PEEP	F_IO_2	P_aO_2	P_aCO_2	V_E*
A	58±19	68±15	162±9	11±2	7.7±0.8	0.47±0.08	118±32	39.1±6.1	12.3±2.9
C	70±11	70±13	163±9	10±2	7.8±0.4	0.52±0.16	95±18	45.0±4.4	8.4±1.7

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568

In case of an excessive diurnal sleepiness, can clinical examination and oxymetry contribute to the detection of sleep respiratory disorder? A40 patients prospective study.

R Piquemal, PF Dequin, Hazouard E, A Legras, D Perrotin and G Ginies.

Objectives: to investigate the respective value of clinical evaluation and oxymetry to predict the diagnosis of sleep respiratory disorders (SRD).
Subjects and methods: from march 1994 to january 1996, 40 succesive patients were hospitalized for suspected SRD because an excessive diurnal sleepiness. All underwent questionning about snoring, nocturnal interrupted breathing, sleepiness while driving, hypertension, body mass index (BMI) and tobacco use. Clinical evaluation was followed by overnight oximetry (Oxi) and then polysomnography (PSG). Oximetry could be normal, positive (significant desaturations) or undetermined (non permanent desaturations). PSG could distinguish 1) patients with normal sleep 2) those with sleep apnea syndrom (SAS) defined by the apnea-hypoapnea index (AHI) 3) those with superior airways resistance syndrome (SARS) and 4) patients with desaturations but without apnea (Desat).
Results: PSG was 11 times normal. Most often these patients were women but there was no significant difference between these patients and those with SAS for importance of diurnal sleepiness, hypertension, BMI and tobacco use.

Oxi / PSG		Normal	minor SAS AHI: 10-30	grave SAS AHI> 30	SARS	Desat
Normal	12	9	1	1	1	0
Undetermined	14	1	6	4	1	2
Positive	14	1	3	9	0	1
Total	40	11	10	14	2	3

Conclusion: in this study, even in case of an excessive diurnal slipiness,
- clinical examination cannot assert or predict SAS
- if oxymetry is normal, SRD is unlikely (negative predictive value = 75%) but SARS can be unrecognized.
- if oxymetry is anormal, SRD is probable (positive predictive value = 92.8%); so, it is possible to start a treatement by continuous positive airway pressure.
- PSG is essential to diagnose and characterize SRD.

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578

PLASMA LEVELS OF CATECHOLAMINES, PROLACTINE, ACTH AND ADH DURING VENTILATOR WEANING WITH SIMV AND BI-PAP AFTER AORTOCORONARY BYPASS SURGERY.

E Calzia, KH Lindner, P Radermacher.

OBJECTIVES: Our aim was to quantify the stress exerted by different modes of partial assist ventilation in intubated patients by measurement of the plasma levels of hormones involved in the stress response. We supposed BIPAP, when compared to SIMV, to be particularly comfortable for the patient because it allows spontaneous breathing throughout the machine's cycle.
DESIGN: Patients were ventilated using controlled positive pressure ventilation (CPPV) until rewarming and recovery from anaesthesia. When haemodynamics and pulmonary function had stabilized, weaning was started by switching the ventilator in a randomized order to one of the two partial support modes synchronized intermittent mandatory ventilation (SIMV) + pressure support (PS) and Bi-level positive airway pressure (BIPAP) + PS. The points of measurement were before switching from CPPV to partial ventilation (point 1, control) and after one hour of partial support with SIMV + PS and BIPAP + PS (points 2 and 3).
SUBJECTS: 10 patients recovering from uncomplicated aortocoronary bypass surgery. Institutional approval and written consent for the study were obtained.
METHODS: We determined the plasma levels of epinephrine (e) and norepinephrine (ne) by HPLC and prolactine (p), ACTH and ADH by a radioimmuno assay. VO_2 was measured by the Deltatrac™ (DATEX corp., Helsinki, Finland). We used the ventilator EVITA-2 (Drägerwerk AG, Lübeck, Germany) that permits supported breathing with both modes SIMV and BIPAP.
RESULTS: (Values are MD±SD in pg/ml, VO_2 in ml/min, Temperatur in °C)

	e	ne	p	ACTH	ADH	VO_2	Temp.
control	257±156	741±391	1,2±0,7	494±357	52±33	300±73	37.0±0.7
SIMV	267±144	353±352	0,9±0,4	462±305	50±22	289±20	37.7±0.3
BIPAP	244±99	721±319	0,8±0,3	462±370	57±22	282±41	37.6±0.3

Statistical analysis performed by wilcoxon-test revealed no significant differences between the values measured as control and during SIMV or BIPAP.
CONCLUSIONS: We conclude that partial assist ventilation during weaning does not exert additional stress to the stress response induced by surgery no matter the ventilatory mode applied.

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594

NITRIC OXIDE IN CRITICALLY ILL PATIENTS: IMPACT ON CARDIOPULMONARY PERFORMANCE AND OUTCOME ?

H. Steltzer, P. Krafft, C.G Krenn, P. Fridrich, AF Hammerle

OBJECTIVES: To determine acute and chronic effects of nitric oxide (NO) inhalation on mean pulmonary pressure (MPAP), oxygenation and outcome. Moreover, we evaluated possible side effects of NO -therapy.
DESIGN: retrospective study, meta analysis after review of the literature from 1992-1995
SUBJECTS: 200 patients with acute respiratory failure and 226 patients with pulmonary hypertension due to another causes.
METHODS: Only clinical studies published in indexed journals between 1992 and 1995 were included. Case reports, abstracts, reviews or editorials were excluded from this evaluation. More than one publication from the same group of authors were only included if it was obvious that the results were derived from separate sets of patients. Relevant data were extracted in duplicate and followed by quality checks on 80% of data extracted. In order to evaluate effects of NO on haemodynamic and oxygenation the maximal improvement of each variable was selected and registered in a data base.
RESULTS AND STATISTICAL ANALYSIS: We screened 26 papers and after fulfillement of entry criteria, 20 papers reporting data on 426 patients (200 with acute respiratory failure= group A, 226 with pulmonary artery hypertension= group B) were included. The mean values for the decrease in MPAP was -5.3 mm Hg in A and -7 mm Hg in B. The mean increase in the ratio of PaO2/FIO2 was 42 mm Hg in A and 41 mm Hg in B. The decrease in pulmonary vascular resistance was (-83) in A and (-95) in B. There were no data on mortality from patients of group B, the mean mortality rate was 36% in patients of group A. Concerning the side effects of NO-inhalation, methemoglobine levels were less than 3.7% in A and < 3% in B. the time of inhalation ranged from 3 to 53 days. No toxic events were reported. All values were compared using chi square test.
CONCLUSIONS: By focusing on cardiopulmonary pattern , inhalation of NO was effective in both patients groups. Regarding pulmonary pressures and resistance, a significantly better decrease could be extracted from the reported data. Despite the fact, that only in patients of group A mortality rates were reported, we conclude, that only large prospective randomized studies could give us information about any benefit of the drug on survival.

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596

EFFECT OF CHEST PHYSIOTHERAPY ON CONTINUOUSLY MONITORED HAEMODYNAMICS IN CRITICALLY ILL PATIENTS

RS Gill, JV Pappachan, MA Young, BL Taylor, GB Smith

OBJECTIVES: To monitor cardiovascular parameters continuously in stable, sedated critically ill patients during normal chest physiotherapy (CP).
DESIGN: Observational study.
SUBJECTS: 9 ventilated patients with arterial and pulmonary artery catheters (mixed venous/continuous cardiac output) in situ.
METHODS: Heart rate (HR), mean arterial blood pressure (MAP), central venous pressure (CVP), continuous cardiac index (CCI), continuous vascular resistance (CSVRI), mixed venous (S_vO_2) and arterial (S_aO_2) saturation were recorded prior to (Pre), every minute during (D) and immediately after (Post) routine CP [oxygen F_IO_2 = 1.0, postural drainage, vibration, percussion and bagging/tracheal suction]. The type and extent of CP or the decision to terminate it was determined by the physiotherapist.
RESULTS & STATISTICAL ANALYSES: Mean age and APACHE II scores were 59.3 years and 22.2, respectively. No patient required early termination of CP. Patient parameters were analysed using a MANOVAR with post hoc Bonferroni correction for time (see table) and type of CP. Results are presented as means ± sem (*p<0.01, †p,0.05)).

Table: Cardiorespiratory parameters during CP, analysed over time.

	HR	MAP	MPAP	CCI	CSVRI	S_vO_2
Pre	109 ± 4.3	72 ± 1.5	32 ± 6.1	4.8 ± 1.0	1193 ± 68	71 ± 2.1
D	107 ± 2.1	79 ± 0.7*	30 ± 3.0	5.0 ± 0.5	1351 ± 34†	76 ± 1.1
Post	108 ± 4.1	74 ± 1.4	40 ± 5.8	4.4 ± 0.9	1212 ± 65	77 ± 2.1
P =	0.08	0.001	0.36	0.85	0.04	0.15

Bagging/tracheal suction produced significant ($p<0.05$) rises in MAP, CSVRI and S_vO_2. Postural drainage increased MAP significantly ($p<0.05$).

CONCLUSION: CP is well tolerated in stable critically ill patients. CP manoeuvres do not appear to alter right heart filling pressure or cardiac index to a significant degree. The rise in MAP and vascular resistance result from patient movement and patient stimulation. Elevations in S_vO_2 were due to an increased inspired oxygen tension.

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600

Hemodynamic Changes in a model of Central Apnea in Humans.

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Objective: There are few data describing hemodynamic response to central apnea.**Design:**The present study was designed to investigate the cardiovascular changes in a model of central apnea, in brain dead patients. **Subjects:**We studied five intubated and mechanically ventilated patients (mean age 63±6 years), previously diagnosed as having brain death, in whom we induced apnea by turning the ventilator off for 2 min, then apnea was interrupted by 1 or 2 breaths. **Method:** Via a catheter in radial artery, multiparameter intravascular sensor was passed for continuous monitoring of arterial blood gases, temperature and blood pressure simultaneously. An opticath, balloon- thermistor tipped 7F catheter was passed via the subclavian vein into the pulmonary artery for measurement of right atrial pressure (RAP), pulmonary arterial pressure (PAP), pulmonary artery wedge pressure (Pwp), cardiac output (CO), and continuous monitoring of $S\bar{v}O_2$. Lead II of the stadard electrocardiogram was monitored troughout the experiment. Measurements were taken at specified times, pre-apnea (baseline), late apnea (last 30 sec of disruption of ventilation), postapnea (first 15 sec following the end of apnea) and recovery (5 min after the ventilation was resumed). Four to five cycles were allowed before tripple measurements were taken. **Results**: During late apnea, SaO_2 and $S\bar{v}O_2$ decreased by 16%. $PaCO_2$ rose 15% compared with baseline($p<0.05$), CO increased by 13% ($p<0.05$) while oxygen delivery (DO_2) and oxygen consumption (VO_2) were unchanged. Blood pressure and systemic vascular resistances(SVR) decreased by 13%($p<0.05$) and 35%($p<0.01$) respectively while there was no change in heart rate. Mean PAP, Ppw and pulmonary vascular resistances (PVR) increased by 22%, 26% ($p<0.01$) and 6% respectively. There were no significant differences between baseline and post-apneas or recovery values.
Conclusions:-The absence of central sympathoadrenal response in our model of apnea, leads to the predominance of local vasodilator induced by hypercapnia and/or hypoxia, resulting in decrease of SVR and blood pressure. -Cardiac output increases during apnea, although heart rate remains unchanged, probably because of the fall in SVR. -The rise in PVR possibly due to hypoxic vosoconstriction, leads to increase of mean PAP.-$S\bar{v}O_2$ decreases because of decreased SaO_2, while the DO_2 and VO_2remain unchanged.

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609

COMPARISON OF PEAK TRACHEAL PRESSURE UNDER PROPORTIONAL ASSIST VENTILATION WITH AUTOMATIC TUBE COMPENSATION (ATC/PAV) AND UNDER INSPIRATORY PRESSURE SUPPORT (IPS)

C Haberthür, B Fabry, D Zappe

OBJECTIVES: As an inherent disadvantage the widely used mode IPS leads to a pressure load at the end of inspiration. The aim of this study was to compare peak tracheal pressure in intubated, spontaneously breathing patients under IPS and under the new mode "Proportional Assist Ventilation, PAV" in combination with "Automatic Tube Compensation, ATC" under comparable conditions of work of breathing. As the mode PAV comprises both flow-proportional pressure support (FPPS) and volume-proportional pressure support (VPPS), we investigated ATC with FPPS and ATC with VPPS separately.
SUBJECTS AND METHODS: We investigated 8 patients (age 56 ± 14 years; 5 patients with acute respiratory insufficiency and 3 patients after heart surgery). In the mode ATC/FPPS additional work of breathing (W_{add}; mainly caused by the flow-dependent endotracheal tube resistance) and reduced work of breathing (W_{red}; pressure support effectively delivered to the patient) were calculated automatically breath by breath. Then, to compare work of breathing between the 3 modes the difference between W_{red} and W_{add} was calculated. In the mode ATC/VPPS and in the IPS mode pressure support was automatically adjusted in such a way that W_{red}-W_{add} was identical in all 3 modes. Respiratory rate (RR) and minute ventilation (V_E) were calculated and tracheal pressure was continuously measured by means of a thin catheter placed into the endotracheal tube. To avoid time dependent bias we switched 5 times between the 3 modes every 30 to 60 seconds.
RESULTS:

	PEEP [mbar]	W_{red}-W_{add} [mJ/L]	RR [min^{-1}]	V_E [L/min]	Ptrach,max# [mbar]	
IPS	7 ± 2	158 ±102	22 ± 5	12.7 ± 3.3	9.0 ± 2.7	
ATC/VPPS	7 ± 2	130 ± 97	24 ± 6	12.8 ± 3.8	8.3 ± 3.2	**
ATC/FPPS	7 ± 2	134 ± 120	25 ± 6	12.1 ± 3.3	4.8 ± 2.3	*

mean values ± SD; # above PEEP; *: p = 0.026; **: p < 0.001

CONCLUSIONS: i) The mode "Automatic Tube Compensation with Flow Proportional Pressure Support (ATC/FPPS)" produced by far the lowest peak tracheal pressure. ii) Peak tracheal pressure in the modes "IPS" and "ATC/VPPS" were similarly high.

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616

A Comparative Study Examining The Inspiratory Muscle Work Across A Continuous- Flow and Flow-Triggered CPAP Circuit.

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Previous investigators have compared the inspiratory muscle work of breathing in intubated patients during demand-flow, flow-by, and continuous flow continuous positive airway pressure (CPAP) systems provided by conventional ICU ventilators. They found that the work imposed by the latter two were equal and significantly less than the former. The purpose of the present study was to determine whether the adjustable flow-triggered CPAP circuit provided by the BIPAP S/T-D 30 (Respironics), a new ventilator commonly used in non-invasive ventilatory support , would be equally effective.
We studied five (5) patients, three with COPD suffering an acute exacerbation, one with pneumonia complicating muscular dystrophy, and the last with hypercapnic respiratory failure of unknown etiology.
CPAP was either supplied by a continuous-flow circuit (Down's Flow Generator No.9250)(CF) or via the BIPAP (FT). During the study, four (4) separate 10-minute trials, two CF and two FT, were performed in random order. Between each trial the patient was rested for ten minutes on the mode of ventilatory support which had originally been chosen by the treating physician. Flow was measured with a heated pneumotachograph and airway opening pressure was monitored just proximal to the pneumotachograph. Oxygenation was maintained above $Sa0_2$>90% and monitored throughout the study with pulse oximetry.
Group mean data ±SE are provided below. Breathing pattern did not change. Moreover, none of the indices assessing the impedance of the inspiratory circuit, in particular the work across the inspiratory circuit and the fall in airway opening pressure at the onset of inspiratory flow (Δ Pao), differed between the two inspiratory circuits.

	CF	FT	P
Work(cmH_20*L)	0.76 ± 0.11	0.97 ± 0.11	NS
Tidal Volume(L)	0.25 ± 0.02	0.25 ± 0.02	NS
Frequency(/min)	28 ± 3	27 ± 3	NS
V_T/Ti(L/sec)	0.37 ± 0.03	0.36 ± 0.03	NS
Δ Pao(cmH_20)	2.8 ± 0.4	2.6 ± 0.3	NS
Circuit Resistance(cmH_2O/L/sec)	3.4 ± 0.4	3.6 ± 0.3	NS

We conclude that the TF circuit provided by the BIPAP S/T-D-30 machine imposes no additional inspiratory work when compared to a CF circuit.

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639

ACUTE LUNG INJURY FOLLOWING A COMA : FACTORS OF SEVERITY.

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Objectives: to search for factors predicting the severity of the acute lung injury complicating a coma which requires mechanical ventilation (MV).

Methods: We have studied retrospectively on the ten past years the records of patients ventilated for a coma (Glascow Coma Scale [GCS] $\leq$ 7) lasting more than 48 hours, without extra-cranial injury and with normal lungs (normal Chest X-Ray, PaO2/FIO2 > 300) at institution of MV (baseline). The appearance of the lung injury was assessed from the daily measurement of the Murray score during the first eight days on MV, and its severity was judged by the maximum value of Murray score: Δ max Murray = Murray max. - Murray (baseline). Moreover, a nosocomial pneumonia was diagnosed on the basis of the criteria of the Consensus Conference of Chest 1992.

Results: 44 patients were studied, with 72% of head-trauma. The mean duration of the coma (GCS $\leq$ 7) was 5,5 $\pm$ 2,2 days, and the duration of MV was 17,3 $\pm$ 15 days.

The course of the Murray score was as follows:

days on MV	day 1	day 2	day 3	day 4	day 5	day 6	day 7
mean value	0,28	0,58	0,68	0,8	0,92	1,05	1,04
extremes	0 - 1	0 - 1,66	0 - 2,33	0 - 2,33	0 - 3	0 - 2,66	0,33 - 2,33

Four patients developed an ARDS (Murray score > 2,5), with one death attributable to refractory hypoxemia.

The severity of the lung injury was significantly correlated with:

(1) the duration of the coma ($p < 0,01$)

(2) the depth of the coma (function of the GCS) after 48 hours on MV:

days on MV	day 1	day 2	day 3	day 4	day 5	day 6	day 7
p	NS	NS	< 0,05	< 0,01	< 0,05	< 0,05	< 0,02

NS : not significant.

(3) the occurence of a nosocomial pneumonia (NP):

	NP + (n = 18)	NP - (n = 26)	p
Δ max Murray	1,38 $\pm$ 0,77	0,88 $\pm$ 0,48	< 0,05

Conclusion: The severity of the lung injury secondary to a coma seems to be correlated to the duration and the depth of the coma, as well as to the occurence of a nosocomial pneumonia.

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646

Effect of kinetic therapy on arterial blood oxigenation in patients with acute postoperative respiratory failure.

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The AIM of the study was to assess the influence of kinetic therapy (KT) on the dynamics of the blood gasometry in patients with acute respiratory failure (ARF) after open-heart surgery.

MATERIALS AND METHODS. KT (positive pressure ventilation in supine and prone position) was provided in twenty three patients with postoperative ARF. In 17 cases KT was employed during controlled mechanical ventilation (CMV) and in 6 - during noninvasive nasal or face mask ventilation . ARDS as a component of multiorgan failure (MOF) followed by postcardiotomic shock syndrome was the reason of ARF in 11 pts, excessive blood loss and haemorrhagic shock in 4 pts and anaphyla tic shock - in 2 pts. All of them recieved CMV with FiO_2 50-55% during 3-8 days before KT. Indications for KT in the patients with assisted ventilation were: hypoventilation and microatelectasis of lower basal parts of lungs - in 3 cases; weanin from prolonged CMV - in 2 cases, survived ARDS; and left ventricular failure with interstisial pulmonary oedema - in 1 case. Blood gasometry was evaluated in the supine position, every hour during ventilation in prone position and one h ur after returning the patient to the supine position. Duration of prone position ventilation varied from 4 to 12 hours.

RESULTS. Before the initiation of the KT the patients on CMV had low oxygenation index ($OI=PaO_2/FiO_2$) with mean value 174 $\pm$ 12. During the first hour of CMV in prone position OI increased to 257 $\pm$ 41 (149%, $p<0.05$) from the basal level. Prone position ventilation during more than 4 hours followed by furthermost increase of OI to 283 $\pm$ 22 (174%, $p<0.05$). After the overturn to the supine position stable improved values of OI were noted (mean 229 $\pm$ 18, 147% from the basal level, $p<0.05$). In patients with prone position on the supporte mask ventilation 54% decrease of Qs/Qt was noted ($p<0.05$). In all cases after overturn from the supine to prone position significant increase of PaO_2 was noted (48% in CMV and 31% in mask ventilation group, $p<0.05$). Changes of $PaCO_2$ were not noticeable.

CONCLUSION. In the patients with postoperative respiratory failure kinetic therapy significantly improves arterial blood oxigenation in case of CMV as well as assisted mask ventilation.

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650

EFFECTS OF DIFFERENT METHODS OF WEANING ON THE OXYGEN COST OF BREATHING.

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OBJECTIVES. To estimate the effects over the work of breathing of different methods during weaning from mechanical ventilation (SIMV, PSV, CPAP), analyzing the changes in oxygen consumption (VO_2), carbon dioxide production (VCO_2) and oxygen cost of breathing (O_2CB).

DESIGN. A prospective, interventional, repeated measures study

SUBJECTS. Eight patients (6 males and 2 females), mean age 59±11 years ,mean SAPS II 43±13 were included. Patients fulfilled criteria for weaning and to be enrolled in the study required:. a toracopulmonar compliance >30 ml./mbar, and haemodynamic, respiratory, and metabolic stability 60 minutes before the study period. Exclusion criteria were: age under 18 and COPD.

METHODS. Pulmonary mechanics calculations, in control ventilation, were made. CPAP of 5.1±0.4 cmH_2O and FiO_2 of 0.39±0.03 were mantained along the study. Haemodynamic, respiratory and metabolic (VO_2 and VCO_2 by indirect calorimetry) parameters were measured during each modality. Assist mode measures were considered basal. The order of application of the weaning modalities was randomized. O_2CB was calculated as the difference between VO_2 in each modality and the corresponding in the assist mode.

RESULTS AND STATISTICAL ANALYSES. ANOVA for repeated measures and Neuman-Keuls test were applied. A $p<0.05$ was considered significant. Values of parameters studied in each mode are show ed in the table:

	ASSIST	SIMV	PSV	CPAP	
Exp. vol. (L/min)	9±1.9	9.6±1.7	10.6 ± 1.9^a	10.5 ± 1.9^a	p < 0.05
RR. (r../min)	15±4	$25\pm4^{b,c}$	21 ± 3^b	$28\pm5^{b,c}$	p < 0.001
Vd/Vt (%)	27±7	40 ± 13^b	42 ± 12^b	42 ± 15^b	p < 0.05
pH art. (mmHg)	7.41±0.1	$7.38\pm0.1^{a,c}$	7.41±0.1	$7.38\pm0.1^{a,c}$	p < 0.05
pO_2 art. (mmHg)	113.3±33	117.7±24	105.1±18.3	99.9 ± 21^a	p < 0.05
pCO_2 art. mmHg)	31.1±3	34.2 ± 5^a	31.9 ± 5.8^a	$34.6\pm5.5^{a,c}$	p < 0.05
VO_2 (ml/min/m^2)	144±18	151 ±16	144±16	144±19	NS
VCO_2 (ml/min/m^2)	121±13	117 ±13	114±13	123±20	NS
CVO_2 (ml/L)	0	6.2±14	-0.7±15	-0.5±10	NS

[a]p<0.05vs assist;[b]p<0.01 vs assist;[c]p<0.05 vs PSV;[d]p<0.05 vs SIMV

CONCLUSIONS. Although there was a slighty higher O_2CB in the SIMV mode,we did not find significant differences, according tothe small sample size.

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651

TOTAL BODY OXYGEN CONSUMPTION MEASUREMENT IN MECHANICALLY VENTILATED PATIENTS. COMPARISON BETWEEN 2 METHODS.

P Revuelta, F Frutos, P Garrido, C Núñez, JM Lorenzo, L Tamayo

OBJECTIVES. **1.)** To compare calculated total body oxygen consumption (VO_2) by the thermodilution Fick method (VO_2Fick) with indirect calorimetry measurement (VO_2M), in mechanical ventilated patients. **2.)** Assessment of repeatability of the 2 methods.

DESIGN. A comparative, prospective, non interventional, paired sample data study.

SUBJECTS. Fourteen mechanically ventilated patients (7 males and 7 females) with a mean age of 51.9 ± 15.6 years (range 17-77) were included in the study. 8 postoperative cardiac and 6 septic patients. All patients had a pulmonary thermodilution catheter and were ventilated in the assist/control mode. FiO_2 was 0.46 ± 0.11 (0.31 - 0.78) and the level of applied PEEP was always below 7.5 mbar. Central temperature was 37.8 ± 0.9°C (range 35.2 - 39.7) .

METHODS. Thirty-eight simultaneous measurements by the two methods were made, 18 in the postoperative cardiac and 20 in the septic group. VO_2 Fick was calculated at the beginning and at the end of the measurement period, as the product of the cardiac output (CO) and the arteriovenous oxygen content difference ($a\text{-}vDO_2$), considering the mean of the 2 calculations as the true value. Thermodilution CO, was calculated as the mean of 5 measurements of 10 ml DW5% (0° C-5° C) injections, randomly distributed along the ventilatory cycle. VO_2M was performed by a metabolic card (Deltatrac MBM - 100, Datex). For assesment of repeatability, 14 paired of repeated measurements performed by each method were used. Repeatability of CO and arterial and mixed venous oxygen contents was also studied.

RESULTS AND STATISTICAL ANALYSES. Student's t-test for paired data, Bland and Altman tests and Pearson's correlation coeficient were applied. VO_2 Fick values (320.7±87.5 ml./min.) were higher than VO_2M (276.3±65.0 ml./min.), the mean difference or bias (44.4±59.4 ml./min.) being significant ($p<0.001$). Mean difference was more pronounced in septics (56.2±68.5 ml./min., $p<0.005$ vs. 31.3±45.7, $p<0.01$).There was an acceptable degree of correlation (r 0.73, $p<0.001$) between methods. Precision, expresed by coincident limits (mean difference±1.96 standard deviation) was poor (-72.0 to 166.2 ml./min.). Differences tended to increase with higher VO_2 values(septics). VO_2M had a better repeatability (±2%) than VO_2 Fick (±9%). CO, arterial and mixed venous oxygen content repeatability were ±6.4%, ±0.54% and ±2.9% respectively.

CONCLUSIONS. 1)VO_2Fick overestimated (16.4±21%) total body VO_2 in comparison with VO_2M 2) VO_2Fick precision was poor, being even worse in septic patients. 3) Poor repeatability of VO_2Fick was mainly due to CO variability.

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677

WEANING FROM PROLONGED MECHANICAL VENTILATION USING A NON-MONITORED GENERAL WARD

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OBJECTIVE - The aim of this study was to evaluate the possibility of weaning ventilator-dependent patients, using a general ward and portable ventilators.
DESIGN - Prospective record (group A = 12 patients under BiPAP in general ward) versus historical control patient group (group B=19 patients fully ventilated in ICU).
METHODS - During a two years period, stabilised ventilator-dependent tracheostomized patients were transfered from ICU to a medical general ward for attempted weaning. We used BiPAP Ventilation (Respironics Inc) via tracheostomy canula. They were monitored with pulse oximetry. We analised the length of stay in ICU and in general ward, the complications and mortality rate of these patients. Finally we compared these results with a historical control group, fully ventilated in ICU using conventional ventilators (Servo 900 C Siemens), in controlled or supported modes. Patients of both groups had chronic lung disease, the majority COPD.
RESULTS AND STATISTICAL ANALYSIS:

	Group A	Group B	p
ventilation mode	BiPAP trach. canula	Servo vent. 900C, trach. canula	
n	12	19	
age (average+stddev,years)	63.5 ± 7,8	70.4 ± 9.2	0.04
length of stay in ICU (average+stddev, days)	30.8 ± 17.3	54.2 ± 28	0.014
mortality rate	41.7%	63.2%	n.s.

In Group A, all patients were well adapted and no changes on the ventilatory support mode were needed. Five patients died. Survivors average ventilation time in general ward was 32 days (total ventilation time - 239 days). Three patients were successfully weaned at discharge from hospital. All the others were discharged to a local hospital or enrolled to an home ventilatory assistance.
Mortality rate was not significantly different in this group, when compared with the historical group.
CONCLUSION: Selected ventilator-dependent patients with chronic lung disease, can be safely supported and eventually weaned at lower levels of care. Use of a general ward allows ICU decompression and cost savings.

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684

CHANGES IN THE RESPONSE TO INHALED NITRIC OXIDE IN PATIENTS WITH ACUTE RESPIRATORY FAILURE.

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Objectives: It has been suggested that abrupt cessation of treatment with inhaled nitric oxide can cause an acute reduction in arterial oxygen tension, far greater than the improvement in arterial oxygen tension seen when treatment was started. This study was performed to determine changes in the response to inhaled nitric oxide with time.
Design: Open observational study.
Subjects: We studied 17 adults and children (children 2 days-4years n=4, adults 21-79 years n=13) receiving inhaled nitric oxide as treatment for acute respiratory failure.
Methods: A baseline PaO_2 measurement was performed and nitric oxide commenced at 40ppm, a second measurement was performed 10 minutes later to assess the response. Every day for the duration of treatment with nitric oxide a blood gas sample was taken whilst on nitric oxide, then the nitric oxide was stopped and after 10 minutes another sample was taken and the nitric oxide recommenced. The inspired oxygen fraction was kept constant during the test.
Results: Figure 1 shows the results of the study. Using paired "t" tests the changes on day 0 could not be distinguished statistically from the changes on any other day.

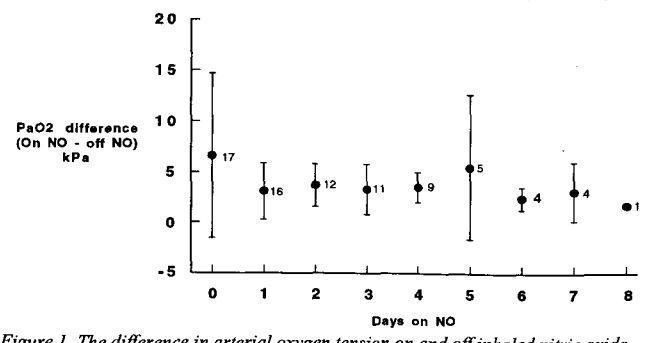

Figure 1. The difference in arterial oxygen tension on and off inhaled nitric oxide treatment (mean, SD and number of patients). Nitric oxide treatment started on day 0.

Conclusion: These results do not support the hypothesis that patients become "dependent" on inhaled nitric oxide, but because of the small number of cases studied here acquired dependence as a rare event in some individuals cannot be excluded.

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688

EFFECT OF COLLOID HYPERVOLEMIA ON PULMONARY MICROVASCULAR PRESSURE AND LUNG WATER

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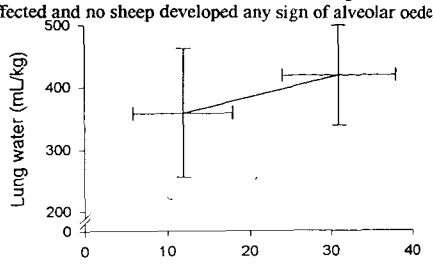
OBJECTIVES: To measure lung water and pulmonary microvascular pressure (Pmv) before and after a rapid volume expansion with dextran 3% in conscious sheep.
DESIGN: Conscious sheep were studied before and immediately after an intravenous infusion of isotonic dextran 3 %, in a volume equal to 70 mL/kg body weight, administrated during 30 minutes.
SUBJECTS: Six conscious sheep, 73 (10) kg, in habitual environment.
METHODS: Mean pulmonary and wedge pressures were measured via a pulmonary artery catheter. The Gaar equation was used to calculate Pmv. Lung water was measured using the heavy water - indocyanine green double indicator dilution method.
RESULTS AND STATISTICAL ANALYSES: In response to the volume expansion Pmv increased from 12 (6) to 31 (7) mmHg ($P = 0.002$) and lung water increased to 117 % over baseline ($P = 0.1$) (Fig.). Arterial oxygen tension was not affected and no sheep developed any sign of alveolar oedema.



Values are means (SD). Paired T-test was used to compare values before and after volume expansion.

CONCLUSIONS: The increase in Pmv caused a small but insignificant increase in lung water. This result is identical with data presented in another study in the conscious sheep where Pmv was raised by congestion due to vascular obstruction (1). The elevated lung water indicates a resetting of the Starling equation at a new level.

1. Erdmann AJ, Vaughan TR, Brigham KL, Woolverton WC, Staub NC. Effect of increased vascular pressure on lung fluid balance in unanesthetized sheep. *Circ Res* 1975; 37: 271-284

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715

~~THE VARIATION OF VENTILATORY PATTERN AND MECHANICS AFTER~~ SWITCHING FROM SUBOPTIMAL TO OPTIMAL LEVEL OF PRESSURE SUPPORT.

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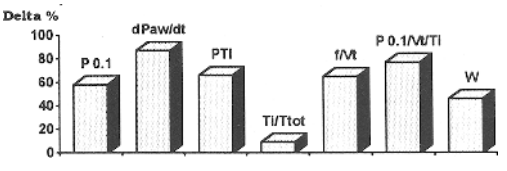
The use of PSV became widespread not only as weaning tool but as ventilatory support in patients with acute respiratory failure (ARF). However precise algorithm for the manage-ment of patients on PSV is lacking. The aim of this study was to evaluate the ventilatory parameters that reliably reflect the adequacy of the PS level adjustment.
We have studied 17 ARF patients during the adjustment of PSV level on Puritan-Bennett 7200 Ventilator. Respiratory mechanics, ventilatory pattern and gas exchange have been measured with an esophageal balloon, differential pressure transducer, PTG and gas analyzer. We sought for minimal but sufficient assisting pressure (patient' respiratory comfort, hemodynamic stability, best gas and ventilatory values) without changes in PEEP and F_IO_2 (level PS_e) and then switched to approximately 5 cm below this optimal level (level PS_e-5). The insufficient PS level has not been met in 2 pts , who were successfully weaned. Main results of 15 pts in whom PSV was prolonged are summarized in the chart.

Changes of respiratory parameters at insufficient level of pressure assistance vs optimal level (%).



Compared to the optimal level of PS, ventilation at insufficient level ($\Delta PS = -4.8 \pm 1.1$ cm H_2O) leads to elevation of respiratory drive and impedance of respiratory system, to deterioration of ventilatory pattern and to excessive energy expenditure. Changes of these parameters precede to blood gas disturbances and patient respiratory discomfort. The monitoring of mentioned parameters is useful for readjustment of ventilator settings on course of disease and changes of state of respiratory system. However the further research is necessary to develop an algorithm for PSV optimization .

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723

RESCUE VENTILATION THROUGH SMALL DIAMETER AIRWAYS

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It is well known that Entotrachial Intubation (E.T)is unpossible in a number of cases. Since it is also known that the complication rate of emergency tracheostomy is unacceptably high, other forms of emergency airways are investigated. The aim of our study was to test the efficacy and the safety of different forms of ventilatory support applied through narrow (< 4mm I.D) airways. In an experimental model, we serially fixed :a) a 4 mm I.D uncuffed mini- tracheostomy (Portex),and b) a 1,8 mm I.D metal Injector (Vygon) ,3 cm above the carina of a lung simmulator ("test lung" Drager). The lung's compliance and the airways' resistance were adjusted at 100ml / cm H2O and 2 cm / lt.sec^{-1}. The upper airways of the lung simmulator were left open to the air. We subseqently tested the maximal tidal volume (T V max) and the maximal minute ventilation (MMV) given through these airways by the following ventilatory devices: 1) The UV-2 (Drager) conventional ventilator (C.V) in the IPPV mode(TV=1000ml,Flow=2lt/sec,RR=14/sec I:E ratio=1:2 PEEP=0), 2) The Broomsgrave (Penlon) High Freqency Jet Ventilation (HFJV) in a mode that gave zero autopeep for the given lung compliance and resistance (RR=100,Pdr=40psi,I:E ratio 30%), 3) A auto-reexpansive 2lts Ambu Bag (A.B) used on a maximal mannual effort. Results are shown in the following table.

Ventilatory device	Mini- T. V max (ml)	Tracheostomy M. M. V (lt/min)	Metal T. V max (ml)	Injector M.M.V (lt/min)
C. V	0	0	0	0
HFJV	1600	72	1200	54
A.B	700	12	50	0.6
P values	p<0.001	p<0.005	p<0.0001	p< 0,0001

Conclusion.HFJV is highly effective in delivering large volumes even through small airways. For the same reason it is the most dangerous mode if applicated in patients with obstructed airways.

725

RESCUE VENTILATION IN ARDS WITH BRONCHOPLEURAL FISTULA

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Bronchopleural fistula is an extreme form of pulmonary barotrauma in mechanically ventilated ARDS patients, leading to severe oxygenation and ventilatory failure. Aiming to salvage 3 patients with severe ARDS,complicated by bronchopleural fistula and pre-terminal ventilatory failure ,unresponding to conventional ventilation (C.V),we used a combined ventilation (CBV) consisted of Low Frequency Conventional Ventilation (LFCV) ,superimposed on High Frequency Jet Ventilation (HFJV). All the patients characterized by: ALI score =4, PaO_2/ FiO_2< 60 , $PaCO_2$ >80mmHg ,PH < 7,2 , Minute Lost Ventilation (MLV) >6 lts / min, C_L < 20 ml/cm H_2O ,Raw <12 cm H_2O/lt.sec^{-1} and spent more than 4 hours on Combined Ventilation. The ventilators used for the study were the UV-2 conventional ventilator (Drager),and the Broomsgrave HFJV (Penlon). A plastic collective bag and a Wright spirometer was used to measure the air leaking (MLV). The combined mode of ventilation was used as follows: CV mode: IPPV,RR=4-6/min, TV=600ml,Flow=1lt/sec,I:E=1:2,PEEP=0.HFJV mode: RR=120,Pdr=40psi, I:E =60% .The conventional ventilator's pressure interrupting alarm was adjusted at 35 cm H_2O ,and the HFJV's mean airway pressure interrupting alarm was adjusted at 20 cm H_2O. ECG,$SpaO_2$,BP was also continously monitored. As test variables were used the pre- and post-CBV values of PaO_2, $PaCO_2$,MLV, Ppeak and Pmean airway pressures. Student t-test was used for statistical evaluation. Results are shown in the following table.

Variables	pre- C.B.V	post- C. M. V	p values
PaO_2	47,2+48	96,5+17,3	<0,01
$PaCO_2$	100,9 +28	61 +48	<0,01
Ppeak	45,2+12,6	23,9 +49,8	<0,001
Pmean	25,8 +5	16,8 +11,5	<0,001
M.M.V	18,5 +15	2,87 +0,98	<0,001

Conclusion :The combination of HFJV and LFCV could be used effectively as an alternative mode of rescue ventilation in extreme forms of ventilatory failure as is the bronchopleural fistula in ARDS patients.

730

TRANS-TRACHEAL OPEN VENTILATION (TOV) THROUGH AN UNCUFFED MINITRACHEOTOMY TUBE.

C Gregoretti, P Navalesi, G Foti, M Turello, P Musto.

Objective: 1) To demonstrate the efficacy of TOV in reducing patient's inspiratory effort. 2) To compare the effects of AC/PCV or PSV by endotracheal intubation (EI) and TOV on blood gases, inspiratory effort and respiratory rate (f).**Design**: Clinical study **Subjects**:Group 1: 13 spontaneous breathing patients (SB), already minitracheostomized (Mini-Trach ® I.D. 4mm) for sputum retention, with post extubation respiratory distress.*Group 2*: 17 intubated and ventilated patients for acute respiratory failure.**Methods**:. Tracheal pressure (Ptr) was measured during EI and TOV in both groups. In *group 1*, the AC/PCV level during TOV was titrated in order to reduce their inspiratory effort. In *group 2* patients underwent mini-tracheotomy (I.D. 4 or 5 mm tube) and were ventilated through it by titrating the AC/PCV level to achieve the same end-inspiratory EI-Ptr values. PEEP was never used because of very low EI end expiratory-Ptr levels (1,6± 2 cmH20). Data was collected during both EI and SB,after 1-h and again 24-h later during TOV. **Results**: °values are mean ± S.D. § vs S.B. significantly different(p< 0.05). # vs EI significant ly different (p< 0.05)

	Group 1			Group 2		
Parameters°	SB	TOV 1h	TOV 24h	EI	TOV 1h	TOV 24h
Pa02/Fio2	243+106	250,3+88	313,8+66	251,5+79	255+ 111	265+75
PaC02mmHg	41,9+12,1	35,9+ 8,7	35,3+8	37,5+6,2	35,6+5,8	36,3+2,7
AC/PCV - PSVcmH20	-	53,2+19	50,3+20	14+4,4	66,6+19,3	61+17,4
PEEPcmH20	-	0	0	2,4+2,5	0	0
End-expiratory -Ptr cmH20	-	0,46+ 0,77	0,3+ 0,6	1,6+2	0,25+ 0,68	0,43+ 0,5
End-inspiratory -Ptr cmH20	-	13+4,7	11,4+3,7	12,9+4,4	12,7+4	11,6+3,4
f/min--1	31,3+7,7	22,7+5,6	20,4+5,8	20,7+6	19,5+4,5	17,2+3,8
VpescmH20 /sec/min	329,6+ 93	95,3+44,7 §	72,3+21 §	136,1+88	110,2+30	82,5+25 #

Conclusion: 1) TOV can maintain both blood gas exchange and inspiratory effort at levels comparable to those obtained during EI. 2)TOV is suitable for long term ventilation.

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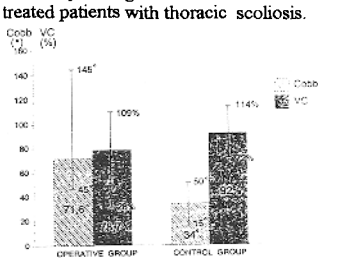
731

OXYGEN UTILIZATION IN SURGICALLY TREATED THORACIC SCOLIOSIS WITH RESPECT TO DEGREE OF SCOLIOTIC CURVE

K Šakić,M Pećina,Š Šakić

i) OBJECTIVES:A severe scoliosis which affects the mid and upper thoracic spine causes a low vital capacity and low Pa O2.In this study,we compared preoperative pulmonary function with it in the immediate postoperative period.
ii) DESIGN: Spinal corection and fusion is often performed in the belief that improves respiratory function or et least that it prevents from deteriorating.
iii)SUBJECTS:Operative group of 60 patients had undergone anterior aproach-ventral derotative spondilodesis for an average scoliotic angle (Cobb) of 72 degree and control group of 30 patients non-operatively treated had an average Cobb angle of 34 degree.
iv)METHODS:Lung function in both groups of patients were tested on a Godart expirograf and results of vital capacity expressed in percentage of the references values of the CECA(1971).Blood gas analysis were tested before and after operation,and first postoperative day(1PD).The PaO2 values were calculated in percentages of the referencePaO2 values determined by Sorbini's. method.
v)RESULTS AND STATISTICAL ANALYSIS:The incidence of chance in scoliotic angle before surgical correction and incidence of vital capacity(% of predictable values) were in negative correlation (P>o,o5) are shown in Fig.1.A general increase of PaO2 in correlation of haemoglobin and hematocrit (P>o,o5)after operation are shown in Fig2.
vi)CONCLUSION:Improvement in PaO2 in patients with a number risk factors are results of good surgically correction of (52 %) thoracic scoliotic angle and used close monitoring in imediate postoperative period,extending 24 to 48 hours or longer as necessary.Changes in arterial PO2 is useful index of alveolar function in surgically treated patients with thoracic scoliosis.



. 1 Preoperative Cobb angle and vital capacity in operatively corrected thoracic scoliosis and non-operatively scoliosis (control group)

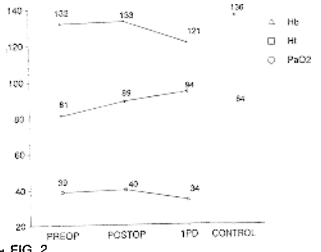


FIG. 2 Preoperative and postoperative analysis PaO_2

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732

ANALYSIS OF COST IN A MULTIDISCIPLINARY ICU OF A LEVEL II HOSPITAL.

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OBJETIVES: To analyse the cost evolution in a multidisciplinary ICU in the last 3 years.
DESIGN: Restrospective study of analytical accounting of costs related to clinical procedures in a 12-bed ICU of a 450-bed teaching hospital (population ascribed 400.000 inhabitants), from 1993 - 1995.
SUBJECTS: All acute coronary, medical and surgical patients admitted to our ICU during the study period. The ICU staff is composed by 6 critical care physicians at full time, 29 registered nurses, 22 no registered nurses.
METHODS: We have analyzed total charges, costs of personnel, farmacy, consumables, laboratory, and radiology, number of patients, mean ICU length of stay, APACHEII, and mortality rate.
RESULTS: Results are showed in the table .Costs have been reported in US $.

YEAR	1993	1994	1995
TOTAL PATIENTS	357	464	510
MEAN STAY	7.93	6.01	5.9
MEAN AGE	56.1	58.0	59.8
APACHE II (no coronary patients)	17.6± 82	16.8±7.6	18.5±7.8
MORTALITY RATE	17.65%	13.58%	14.31%
GLOBAL COST	3,694,168	3,724,944	3,827,224
COST PER PATIENT	10,347	8,028	7,504
COST PER STAY	1,304	1,335	1,271
PERSONNEL COST	42.73%	47.33%	49.94%
PHARMACY COST	455,091	433,463	437,269
CONSUMABLE COST	213,847	180,492	178,876
RADIOLOGY	93,976	119,024	121,728
BIOCHEMICAL EMERGENCY LAB	88,208	71,104	75,184
BIOCHEMICAL GENERAL LAB	57,064	52,544	46,784
HEMATOLOGY LAB	69,448	74,080	46,784
BLOOD DERIVATES	84,928	64,280	71,904
PATHOLOGY LAB	60,792	54,760	66,552
MICROBIOLOGY LAB	93,448	93,936	42,552

The personnel, pharmacy, consumables, laboratory and radiology costs are 75-80% of total expenditures. There has been an increase of personnel charges because of an increase of ICU staff (11.6% and 8.4%). Pharmacy, consumables, and laboratory costs have decreased. Radiology and total costs have increased slightly (0.8% and 2.7%)
CONCLUSIONS: The participation of physicians in resource management and control allows to stabilize total ICU cost, nevertheless, a relative increase in the number of admitted patients.

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739

~~PERMISSIVE HYPERCAPNIA : EFFECTS ON HEMODINAMICS,~~
GAS EXCHANGE AND OXIGEN CONSUPTION.

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OBJECTIVES: The aim of the study is to evaluate the effects of permissive hypercapnia on hemodinamics, gas exchange,and oxigen variables in patients with Acute Respiratory Distress Sindrome (ARDS)
DESIGN: Prospective study.
SUBJECTS : Ten mechanically ventilated patient.
METHODS : The hypercapnic state was induced in 12 hours so to allow a progressive metabolic compensation. All patients were ventilated in pressure control with inspiratory/espiratory of 1,5-2/1 and FiO2 = 0.7 ; Tidal Volume(Vt) was titrated to have a plateau pressure equal or lower than 25 cmH2O , no Vt lower than 7 ml/Kg are been used. All patients were monitored with pulmonary artery catheter. Measurements were performed at baseline ,before starting limitation in pressure, after 12, 24, 36, 72 hours.Patients were sedated and paralized . The protocol of the study was approved by Hospital Ethics Commitee and informed consent was obtained from patients nearest relatives.
RESULTS: Vt was reduced from 768.75± 65.12 to 547.50± 56.51 ml (mean ± SD), plateau pressure reduced (37.14± 5,5 to 25 ± 3.3 cmH2O),PaO2 increased (68± 18 to 75± 23 mmHg) PaCO2 increased (37.7 ± 5.2 to 56.88 ± 2.53 mmHg), pH decreased (7.41 ± 0.08 to 7.29 ± 0.04), Sistemic Vascular Resistence decrease (944.62 ± 158 to 604.87 ± 165..57), DO2 increased (814.37 ± 197 to 1051.75 ± 168.76) VO2 increased (170± 23.2 to 205± 25) , OER decreased (0.4± 0.1 to 0.3± 0.15). All results are reported as mean ± SD and were analized by a one-way analysis of variance for repeated measures (ANOVA)
CONCLUSION : These data confirm that permissive hypercapnia togheter with limitation of pressure in ARDS patients might be beneficial on hemodinamic and tissue hypoxia. This probably is result in rise of CO obtained reducing intrathoracic pressure and of compensatory changes that cronic hypercapnia induce. Acute hypercapnia shows side effects such as a drop in MAP and decrease of PO2 that might be dangerous for these patients. Infact our better results were in data after 72 hours of treatment.
At the end we want underline that mortality in study patients,has been lower (20%) than other ARDS treated with convetional ventilation in our ICU

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745

PRODUCTION OF NITRIC OXIDE BY THE LOWER RESPIRATORY TRACT IN INTUBATED PATIENTS.

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OBJECTIVES:Most of the exhaled nitric oxide (NO) is derived from the oro- and nasopharynx. Using a new chemilumenescence device with extreme sensitivity, we measured how much NO is produced in the lower airways in two groups of intubated patients when the upper airway NO is excluded by endotracheal intubation.,
DESIGN: prospective.
SUBJECTS:. Group A (n=7) consisted of 'long-term intubated'(10-83 days) patients on an ICU; group B (n=7) of essentially healthy patients about to undergo elective, non-lung surgery in the operating theatre. Both groups were ventilated with an average FiO_2 of 0.36.
METHODS: The concentrations of NO were measured, using a chemilumenescence technique, as one minute mean values in the inspiratory and expiratory limbs of standard ITU ventilators. The analyser (CLD 780 TR, ECO Physics, Dürnten, Switzerland) had a high degree of accuracy to 0.05 parts per billion (ppb) i.e. 50 parts per trillion, for an integration time of one minute. The gas supply to the ventilators was passed through a zero air generator PAG003 (ECO-Physics) essentially removing the background contamination of NO in the pipeline gas.
RESULTS AND STATISTICAL ANALYSIS: Data are presented as means ± SD. Statistical analysis was performed with the Mann-Whitney-Wilcoxon test for two independent samples. P<0.05 was taken as significant. The net production of NO (net NO) was calculated as individual minute volume (MV) x exhaled NO - individual MV x insp NO (nanolitres/minute).

		Group A	Group B
NO-Concentration	insp.	0.40 ± 0.16	0.47 ± 0.14 (p >0.3)
[ppb]	exp.	0.85 ± 0.16	1.66 ± 0.50 *(p<0.01)
Mean MV	litres/min	11.33±3.04	6.56±0.75 * (p <0.02)
MV x exhaled NO	nl/min	9.71±3.56	10.75±2.89 (p>0.5)
Net apparent NO production ie. net NO x individual MV	nl/min	5.17±2.83	7.70±3.35 (p >0.2)

CONCLUSION: The concentration of NO produced in the lower airway is in the 0.16-2.3 ppb range. Therefore special devices are necessary to measure these low concentrations. Further, the apparent difference seen in exhaled NO concentration between long and short term intubated patients no longer exists when the individual minute volume is taken into consideration i.e. when seen as production per minute rather than crude concentration.

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751

EFFECTS OF INVERSE RATIO VENTILATION ON PULMONARY EPITHELIAL PERMEABILITY AND GAS EXCHANGE IN OLEIC ACID INDUCED LUNG INJURY

U Ludwigs

Objective; To compare pressure controlled inverse ratio ventilation (PCIRV) with conventional ventilation (VCV PEEP) at equal end-expiratory alveolar pressure. The primary focus of the study was on pulmonary epithelial permeability and gas exchange.
Methods; Randomised animal study in 24 New Zealand White rabbits. The following interventions were carried out: A (6 + 6 animals): Ventilation with PCIRV or VCV PEEP for 6 h at equal end-expiratory alveolar pressure levels of 5 cm H_2O followed by induction of lung injury (i. v. injection of oleic acid 0.15 ml/kg). B (6 + 6 animals): Induction of lung injury followed by 6 h ventilation with either PCIRV or VCV PEEP.
Measurements and results; After 1 h ventilation in group A, mean airway pressure was 11.9 ± 4.4 with PCIRV and 8.3 ± 1.0 cm H_2O with VCV PEEP (p<0.05). Forty minutes after oleic acid injection, PaO_2/FIO_2 was 24 ± 10 kPa with PCIRV and 44 ± 15 kPa with VCV PEEP (p<0.05). Mean airway pressure was higher (12 ± 2 vs. 9 ± 2 cm H_2O, p<0.05) and peak airway pressure was lower (14 ± 2 vs. 9 ± 4, p<0.05) with PCIRV. After 6 h ventilation in group B, PaO_2/FIO_2 was 17 ± 5 kPa with PCIRV and 43 ± 8 kPa with VCV PEEP (p<0.01). Systemic blood pressure was lower with PCIRV (64 ± 7 vs. 74 ± 7 mm Hg, p<0.05) and mean airway pressure was higher (17 ± 2 vs. 10 ± 2 cm H_2O, p<0.005).
In group A, [^{99m}Tc]DTPA lung clearance curves were monoexponential with both PCIRV (T½ 21 ± 8 min.) and VCV PEEP (T½ 126 ± 59 min., p<0.005) until injection of oleic acid. In the VCV PEEP, an increase in clearance rate was observed within 60 s of oleic acid injection (T½ 13 ± 9 min). Fifteen min after oleic acid injections, T½ had decreased to 38 ± 17 min. In PCIRV, oleic acid injection did not alter clearance rate, although the elimination pattern changed from single- to multi-compartment type. In group B, clearance curves were monoexponential with both modes. No difference in clearance could be demonstrated (PCIRV T½ 25 ± 9 min, VCV PEEP T½ 36 ± 16 min).
Conclusions; The lower PaO_2 with PCIRV must be interpreted with caution. The finding may reflect differences in the effect of oleic acid injection in the two ventilatory modes. It is also possible that external PEEP is more effective than PCIRV in increasing PaO_2, either because of a better ventilation / perfusion match or for other reasons. The clearance results imply that PCIRV causes an alteration in lung epithelial or membrane function. This is most likely caused by the large time adjusted lung volume produced by pressure control in combination with prolonged inspiration. It remains to be established if these findings are relevant with regard to ventilator associated lung injury in man.

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765

POST-PNEUMECTOMY COMPLICATIONS IN AN I.C.U.

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OBJECTIVES: analyse post-neumectomy complications during the stay in an ICU and preoperatory data capable of predicting complications.
DESIGN: we checked in a retrospective study the medical and surgical complications presented after pneumectomy (PN). We compared complicated and uncomplicated patients in order to select preoperative pronostic data.
SUBJECT: 61 consecutive patients (60 male) of 60,295 ± 8,87 years old, pneumectomized for pulmonary neoplasm, during 3 consecutive years and admitted to a polivalent ICU in an University Hospital. 70,5 % were COPD and 73,8 % were smokers 3 months before. 30 pneumectomys (49,2 %) were right .
METHODS: preoperative medical complications reviewed were acute miocardial infarction (AMI), arrhythmias that required treatment, pneumonia, lobar atelectasis (that required intervention), ARDS and mechanical ventilation > 48 hours. Surgical complications reviewed were: postoperatory haemorrhage that required intervention, persistent air leak (PAL), bronco-pleural fistula (BPF), injuries of the recurrent nerve (IRN) and pleural empyema. Preoperative data considered to be predictive were: age, cardiopaty, EKG disturbances, COPD, diabetes mellitus, TNM, right or left PN and respiratory functional tests (FVC, FEV_1, FEV_1/FVC, FEF_{25-75}, MVV and PEF). The qualitative and quantitative variables were analysed by the Chi-squared and the t-test for independent samples, respectively.
RESULTS AND STATISTICAL ANALYSES: the mean stay was 3,49 ± 6,40 days, with 39,3 % morbility and 3,3 % mortality. 6,6 % presented BPF, 4,9 % PAL, 3,3 % haemothorax , 4,9 % pneumonia, 4,9 % atelectasis, 1,6 % IRN , 3,3 % empyema, 3,3 % ARDS , 3,3 % sepsis and 33 % arrhythmias, being atrial fibrillation (AF) the most frequent (18 % of all the cases). One patient (1,6 %) presented AMI. 4,9 % needed reintervention and 6,6 % reintubation . No preoperatory data were predictive of complications.
CONCLUSIONS: 1.- The mean mortality and morbility of our patients is comparable with data published in the literature. 2.- The most frecuent medical complications were cardiologic, and within them AF. 3.-The most frecuent surgical complications were BPF and PAL. 4.- No differences were found comparing complications resulting from right and left PN. 5.- None of the parameters previously studied were capable of selecting patients susceptible of complications.

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766

THE PROTECTIVE EFFECT OF POSITIVE END EXPIRATORY PRESSURE (PEEP) AGAINST ASPIRATION PAST THE TRACHEAL TUBE CUFF IN A BENCHTOP MODEL

P J Young, M Rollinson, G Downward, S Henderson

OBJECTIVES: High volume low pressure (HVLP) tracheal tube cuffs were assessed in a benchtop model with regard to leakage of fluid from above the cuff, to the model trachea below.

DESIGN: A variety of ventilatory modes were simulated using a mechanical lung, an intubated model trachea, and a ventilator.

METHODS: A range of HVLP tubes were sequentially tested in the model trachea at 0 - 10 cm H2O of PEEP, and during spontaneous, intermittent positive pressure, and pressure support ventilation, by measuring the pressure head of fluid that can be prevented from leaking down folds within the cuff wall, to the trachea below. The effects of tracheal suctioning were also assessed.

RESULTS AND STATISTICAL ANALYSES: 5 pressure heads were recorded by a blind observer for each level of PEEP and ventilator setting, and means and standard deviations calculated. PEEP was effective in preventing the leakage of fluid past the cuff, but rapid aspiration (0.21 (0.05) - 0. 40 (0.10) ml/s at pressure heads of 1 - 4 cm H2O) occurred when PEEP was removed. Tracheal suctioning caused large negative tracheal pressures and more rapid aspiration. Aspiration of this nature occurred with all HVLP cuffs tested.

CONCLUSION: In this model, at risk times exist when pressure profiles across the ETT cuff are such that flow of fluid within the cuff wall channels to the trachea below is likely. PEEP is protective in this model, and allows the accumulation of a reservoir of fluid above the cuff. If PEEP is removed, and particularly during tracheal suctioning, then any fluid above the cuff rapidly and completely drains through the cuff wall folds to the model trachea below. At risk times include 1. Loss of PEEP. 2. Negative tracheal pressures (during suctioning and spontaneous respiratory efforts). 3. Loss of cuff pressure.

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782

INHALED NITRIC OXIDE (NO) IN LIFE-THREATENING HYPOXEMIC PATIENTS.

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Objective: Inhaled NO improves hypoxemia and pulmonary hypertension without systemic effects in patients with acute respiratory distress sindrome. However, the usefulness of NO in patients with tissue hypoxia and life-threatening hypoxemia has not been stablished. The aim of our study was to evaluate the hemodynamic and gasometric effects of inhaled NO in these circunstances.
Design, subjects and methods: We prospectively studied 8 mechanically ventilated patients, whith severe hypoxemia (PaO_2< 60 mmHg despite FiO_2=1 and optimal PEEP), *Lung Injury Score* 3.01±0.1 and lactic acidosis. Inhaled NO was administered at 10 ppm (NOX4000, Air Liquide). Global hemodynamics and blood gas analysis were determined before and 20 minutes after beginning NO treatment. Data are presented as mean ± SE. Student's T test for paired data was used for comparisons.
Results: Relevant changes are shown in the table:

	mPAP mmHg	PaO_2 mmHg	StO_2 %	SvO_2 %	Qs/Qt %	DO_2 mlO_2/min	O_2ER %
BASAL	32±2	50±2	82±2	54±3	52±2	621±89	34±3
NO	27±2	61±3	88±2	62±3	47±2	711±90	30±3
p	<.05	<.01	<.01	<.01	<.01	<.05	<.05

PAPm: Mean pulmonary arterial pressure, StO_2 y SvO_2: Arterial and mixed venous oxygen saturation, Qs/Qt: Intrapulmonary shunt, DO_2: Oxygen delivery, O_2ER: Oxygen extraction ratio.

NO inhalation had no effect on cardiac output and other systemic hemodynamics.

Conclusion: In patients with life-threatening hypoxemia NO inhalation cause: 1)Improvement of oxygenation and selective pulmonary vasodilatation; 2)Increment in oxygen delivery to the tissues without changes in systemic hemodynamics. Therefore, inhaled NO could be useful as a support treatment of these patients.

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783

SHORT-TERM EFFECTS OF PRONE POSITION IN CRITICALLY ILL PATIENTS WITH ACUTE RESPIRATORY DISTRESS SYNDROME.

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Changing position from supine (S) to prone (P) is an emerging therapy to improve gas exchange in patients with acute respiratory distress syndrome (ARDS). **Objective and Design**: to evaluate the acute effects on gas exchange, hemodynamics and lung mechanics when changing from S to P position in critically ill patients with ARDS. **Subjects**: we prospectively studied 23 patients (age 56±17 y) who met ARDS criteria and had a Lung Injury Score > 2.5 (3.25±0.3). **Methods**: the turn from S to P was done in a protocolized manner based on impaired oxygenation. We measured gasometric and hemodynamic variables in all patients and calculated respiratory system compliance (Crs) in 16 patients in supine and after 60 to 90 minutes in prone position. **Results**. Prone position was remarkably well tolerated and clinically relevant complications or events were not detected during the turn from S to P and afterwards. PaO_2/FiO_2 dramatically improved from 78±37 mmHg in S to 115±31 mmHg in P position (p<0.001) whereas intrapulmonary shunt decreased from 43±11 % to 34±8 % (p<0.001). Global hemodynamics were not affected with the turn. Crs slightly improved from 24.7±10.2 ml/cmH_2O in S to 27.8±13.2 ml/cmH_2O in P (p<0.05). An improvement in PaO_2/FiO_2 more than 15 % in prone with respect to supine positin was found in 16 patients (responders). Comparison of relevant clinical data before the study between responders (R) and nonresponders (NR) could be observed in the table.

	LIS	PEEP cmH_2O	ARDS onset,d	PaO_2/FiO_2 mmHg	$PaCO_2$ mmHg	Crs ml/cmH_2O
R (n=16)	3.2±0.3	10.6±4	11.8±16	70±23	70±27	25.2±11
NR (n=7)	3.3±0.3	10±2	32.8±42	99±53	64±9	23.2±9
p value	ns	ns	<0.01	<0.01	<0.01	ns

A *post hoc* analysis revealed that Crs improved only in the responder group (25.2±10.9 ml/cmH_2O in S vs 29.4±14.2 in P, p<0.05). **Conclusion**: turning critically ill severely hypoxemic patients from supine to prone position is a safe procedure and is a useful therapeutic alternative to improve oxygenation without impairing hemodynamics. These data suggest that prone position should be done early in the course of ARDS.

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785

THERAPEUTIC POSTURAL CHANGE: PRONE POSITION

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INTRODUCTION: Prone position (PP) is a recognized treatment to improve oxygenation in critically ill patients with acute respiratory distress syndrome. However, PP is restricted in many centers due to its complexity. Bearing in mind this practice needs an organized nursing action, the objective of the present study is to evaluate our experience with this position change and to analyze clinical complications during the process of turning.
MATERIAL AND METHODS: SUBJECTS: We have studied 20 patients who met ARDS criteria and a *Lung Injury Score* ≥ 2,5 from December 1993 to April 1996. All patients were ventilated in volume assist/control mode and had: arterial line, nasogastric tube and several venous accesses. A thermodilution Swan-Ganz catheter was placed in 11 patients. The oxygenation was monitored by continuous pulse oximetry.
The turn was done by a team of 4-5 persons. PP was applied on the prone restricted manner, that is with the entire body in contact with the bed. The head, arms and legs were placed in physiologic positions. Data is expressed as mean ±SD and comparisons were done using a student's T test for paired data.
RESULTS: Relevant complications (extubation, or withdrawal of catheters) were not observed during the turn and afterwards.A total of 39 turns were performed in these 20 patients without complicacions.
The position change to PP originated an improvement in oxygenation as shown in the table:

	PaO_2/FiO_2 mm Hg	$SatO_2$ %	mSAP mm Hg	HR min^{-1}
Supine P	92±45	91±6	78±15	104±24
Prone P	138±70	95±4	76±13	106±22
p	<0,001	<0,001	NS	NS

CONCLUSION: Prone positioning is a safe procedure to be incorporated into the rutine daily nursing care in severely hypoxemic patients. A team of 5 nurses is enough to perform the turn from supine to prone position.

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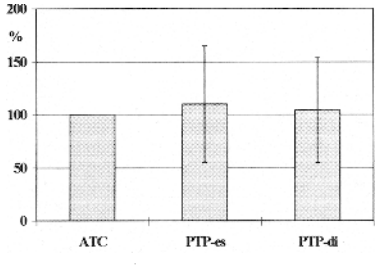
799

ESOPHAGEAL AND TRANSDIAPHRAGMATIC PRESSURE-TIME PRODUCT: ARE THERE DIFFERENCES BETWEEN "ELECTRONIC EXTUBATION" AND REAL EXTUBATION IN PATIENTS ?

D Zappe, C Haberthür, B Fabry

OBJECTIVES: Our new ventilatory mode Automatic Tube Compensation (ATC) completely compensates for the flow-dependent resistance of the endotracheal tube. We hypothesise that ventilatory work under ATC is nearly the same as after real extubation. To test our hypothesis we compared the pressure-time product of esophageal pressure (PTP-es) and transdiaphragmatic pressure (PTP-di) as an estimate of the patient's ventilatory work performed under "electronic extubation" and after real extubation.
DESIGN: Prospecive study in an Intensive Care Unit of an University Hospital.
PATIENTS AND METHODS: We investigated 8 patients after cardiac surgery (7M/1F, 59 ± 11 years) during spontaneous breathing under ATC and immediately after extubation. Duration of intubation was less than 24 h in all patients. Esophageal pressure (Pes) and gastric pressure (Pga) were continuously measured using two thin latex balloons mounted on a nasogastric catheter. Catheter position was checked by means of the airway occlusion technique. All measurements were carried out in a semi-recumbent position of the patient. Transdiaphragmatic pressure (Pdi) was calculated as the difference Pga - Pes. Values of PTP-es and PTP-di were calculated by means of numerical integration and were averaged out over 5 consecutive breaths.
RESULTS: We did not find any significant difference between PTP-es and PTP-di under "electronic extubation" using ATC and PTP-es and PTP-di after real extubation. (In the figure mean values of PTP-es and PTP-di after real extubation are expressed in per cent. Values under ATC are set to 100 %.)



CONCLUSIONS: Under the ventilatory mode ATC the intubated, spontaneously breathing patient after cardiac surgery has to perform the same ventilatory work as after real extubation. ATC is therefore a suitable mode to evaluate the patient's ability to breathe without ventilatory support after extubation.

800

VENTILATORY DRIVE AND BREATHING PATTERN FOR PREDICTING OUTCOME OF A WEANING TRIAL.

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Traditionally used predictors of the outcome of weaning from mechanical ventilation (MV) have a low sensitivity and specificity. It has recently been shown that an index of rapid shallow breathing: frequency/tidal volume (f/VT), is superior to other commonly used parameters. Recent studies have also shown high levels of ventilatory drive ($P_{0.1}$) in patients who fail a weaning trial (WT), however its predictive power,as well as that of the breathing pattern (BP) have not been established.
We evaluated the accuracy of $P_{0.1}$, BP, f/VT and other conventional indices used to predict the outcome of WT in 37 consecutive patients (17 men), mean age: 72 ± 13 years. The range of MV duration was 1 to 34 days (mean: 5.6 ± 6 days). Underlying conditions were: COPD with acute respiratory failure in 7 patients, acute lung injury in 10, cardiogenic pulmonary edema in 8, neurologic or neuromuscular disorders in 4, and miscellaneous causes in 8. Measurements were performed at the first attempt of weaning and after 30' of spontaneous breathing through a T-piece. Measurements included flow, volume, $P_{0.1}$, Ti, Ttot, VT/Ti, Ti/Ttot, "effective respiratory system impedance" ($P_{0.1}$/VT/Ti), inspiratory pressure per breath (Pi), PImax, Pi/PImax and PaO_2/FIO_2. Eighteen patients were succesfully weaned (Group 1) and 19 required reinstitution of MV (Group 2). Results are shown in Table.

Variable	Group 1 (X ± SD)	Group 2 (X ± SD)	p value
VE, $L.min^{-1}$	8.6 ± 2.3	11.1 ± 3.9	0.02
f, $breath.min^{-1}$	26 ± 6	34 ± 9	0.003
f/VT	82 ± 33	121 ± 72	0.08
Ti, sec	0.96 ± 0.3	0.66 ± 0.2	0.0002
Ttot, sec	2.35 ± 0.6	1.99 ± 0.7	0.01
VT/Ti, $L.sec^{-1}$	0.37 ± 0.1	0.55 ± 0.2	0.005
$P_{0.1}$, cmH_2O	2.8 ± 1.0	5.8 ± 2.8	0.0003
$P_{0.1}$/VT/Ti, $cmH_2O.L^{-}$	7.7 ± 3	11.6 ± 6	0.02
Pi, cmH_2O	15 ± 6	22 ± 10	0.01

We conclude that patients who fail a WT have an increased ventilatory drive, reflected in a high $P_{0.1}$ and VT/Ti, probably due to an increased workload, as suggested by the high "effective impedance" and Pi observed in this group. In addition, under the conditions of our study, $P_{0.1}$ and BP appear to be superior to the rapid shallow breathing index in identifying patients at risk of failing a weaning trial. DIUC 9402-J.

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808

ARDS MORTALITY IS RELATED TO INITIAL PATHOLOGY.

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AIMS:Study ARDS mortality with regard to its etiology. Look for respiratory, hemodynamic and biological factors associated with mortality.
Retrospective analysis, consecutive patients admitted between 91 and 95. Patients (Pts) divided in 6 etiologic groups, survivors (S) and non survivors (NS).
Parameters studied : Respiratory, hemodynamic and biological, Apache II, OSF Murray daily from day 1 (D1) to 7.
RESULTS are expressed in mean ± SD and given in the table.

	n	Apache II	OSF	Murray	PaO_2/FiO_2 D1	Mortality (%)
All Pts	135	23,2±8,0	1,97±1,1	2,49±0,48	101,5±49,1	51,1
Pneumonia	38	21,5±8,7	1,5±0,8	2,47±0,4	103,9±43,0	44,7
Sepsis	35	24,9±6,7	2,2±1,3	2,48±0,44	99,2±44,2	44,1
Hematologic malignancies	31	25,8±7,3	2,2±0,9	2,4±0,5	115,7±61,6	77,4
Trauma	11	22,2±8,5	2,5±1,2	2,78±0,82	84,6±55,4	54,5
Acute pancreatitis	11	21,4±9,9	1,8±1,2	2,7±0,33	100,2±53,1	33,4
Aspiration	9	19±5,5	1,37±0,9	2,61±0,31	75,3±30,4	33,3
S	66	20,6±7,2	1,5±0,9	2,41±0,45	103,5±41,9	
NS	69	25,5±8,0	2,4±1,1	2,57±0,5	99,5±55,7	p<0,001 S vs/vs NS

Respiratory and hemodynamic parameters were not different between S and NS on D1 nor between the different etiologies. On D1, urea and creatinin were higher in NS Vs S. Platelets were lower in NS Vs S. From 91 to 95, mortality rate was reduced by 30,5 % despite increased AII.
CONCLUSIONS:Respiratory and hemodynamic parameters are not predictive of mortality on D1. Mortality is mainly related to the underlying pathology, severity scores and renal failure on D1. New therapies in ARDS should not use historical groups.

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809

ARDS IN HEMATOLOGIC MALIGNANCIES : SHOULD ICU ADMISSION BE RESTRICTED ?

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Mortality rate of patients (pts) with hematologic malignancies (H) admitted in ICU for ARDS was compared with non hematologic ARDS (NH). Prognosis factors associated with survival were evaluated.

Retrospective analysis of all ARDS admitted between 91 and 95 in our 7 beds unit. Parameters studied:diagnosis, type of hematologic malignancies,PaO_2/FiO_2, PaO_2/FiO_2/PEEP, $PaCO_2$, pHa, compliance, CI, DO2, PAP, SVR, PVR, urea, creatinin, WBC, platelets, bilirubin. Apache II, OSF and Murray daily from day 1 to day 7. Comparaison between H and NH, survivors (S) and non survivors (NS).

RESULTS are expressed in mean ± SD and one given in the table. Severity scores, day 1 PaO_2/FiO_2 and mortality rate were assessed for the H, NH, S and NS groups.

	H	NH	S	NS	P(SVsNS)
n	31	104	7	24	
AII	25,8±7,3	22,5±8,0	22,6±4,8	26,6±7,6	
OSF	2,2±0,9	1,91±1,11	1,7±0,8	2,3±0,9	
Murray	2,4±0,5	2,51±0,46	2,3±0,4	2,5±0,5	
PaO_2/FiO_2	115,7±61,6	97,7± 44,6	125,4±50,1	112,3±66,0	
Urea(mg/dl)	119,4±62,4	86,2±70,9	70,9±17,8	134,1±63,8	<0,05
Mortality(%)	77,4	43,3			

Mortality was 77,4% in H VS, 43,3 % in NH (p<0,05). Hemodynamic and respiratory parameters were not different between S and NS. Urea and creatinin were higher in NS Vs S on admission. Bacteriologically proven infection on admission was 95,8 % in NS Vs 57,1 % in S (p<0,01). PaO_2/FiO_2, pHa, static compliance and total bilirubin became significantly different between S and NS after day 4.

CONCLUSIONS:ICU mortality rate in patients with ARDS and hematologic malignancies reach 80 %. The type of hematologic malignancy has no prognostic value. Bacteriologically proven infection and renal failure are associated with a 100 % mortality rate. ICU supportive therapy in hematologic patients with ARDS should be maintained for at least 4 days before withholding therapy.

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817

EFFECTS OF AUTOMATIC TUBE COMPENSATION (ATC) AND INSPIRATORY PRESSURE SUPPORT (IPS) COMPARED TO CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) IN HEALTHY VOLUNTEERS

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Objectives: To investigate the breathing pattern and the transdiaphragmatic pressures for ATC, IPS and CPAP during spontaneous breathing through an endotracheal tube (ETT).

Design: Study of different modes of assisted spontaneous breathing in healthy volunteers.

Methods: 5 healthy volunteers were investigated breathing spontaneously through an 8.0 mm ID ETT connected to an Evita 1 (Dräger. Lübeck, FRG) ventilator at CPAP 0 mbar, IPS 5 and 10 mbar and ATC in randomized order. Those modes were compared to breathing at CPAP 0 mbar through a mouthpiece as control. ATC was delivered by an externally controlled Evita 1 ventilator, adjusted to compensate for the ETT resistance during inspiration (ATCin) or during in- and exspiration (ATCinex). Flow and airway pressure were measured between the ETT and respiratory tubing. Gastric (Pga) and esophageal pressure (Pes) were obtained using a double ballon gastric tube (#332684, Rüsch, Kernen, FRG). Transdiaphragmatic pressure (Pdi) was calculated as Pes-Pga. The pressure time product (PTP) was calculated as the area un der the Pdi-time curve during inspiration. The begin and the end of inspiration were determined manually from zero flow points.

Results: The results for the different modes are summarized in the table:

	control	CPAP	ATCin	ATCinex	IPS 5	IPS 10
VT(ml)	882±277	938±220	903±177	898±209	1017±203	1336±305
f(1/min)	14±5	13±4	13±5	14±5	12±5	13±5
VE(L)	11,5±4,2	11,9±3,6	11,7±4,4	11,7±4,1	11,9±3,5	16,2±2,9
Ti/Ttot	0,40±0,07	0,43±0,05	0,43±0,04	0,45±0,06	0,39±0,05	0,45±0,04
Pdi(mbar)	9,2±5,3	10,8±5,4	7,8±3,0	7,0±2,4	7,1±2,5	4,2±1,5
PTP(mbar*s)	11,3±7,1	14,8±10,4	12,1±7,6	10,5±4,6	8,6±2,3	7,05±3,1

Conclusion: In the investigated volunteers all forms of pressure assist reduce the tube related resistive workload. In contrast to IPS, the new mode automatic tube compensation does not lead to increased tidal volumes compared to control values. Therefore, ATC might contribute to a reduction of the risk for overinflation.

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821

RESPIRATORY SYSTEM MECHANICS BY LEAST SQUARES FITTING (LSF) IN DIFFERENT RESPIRATORY DISEASES.

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Compared to conventional techniques used to measure total respiratory mechanics, the LSF method provides advantages such as no need for hold maneuvers and no need for particular flow patterns. The reliability of the LSF method has been so far demonstrated in patients with normal lungs, while it is poorly known in patients with respiratory diseases.

Methods We studied 20 mechanically ventilated patients: of these, 4 were affected by COPD, 8 by ARDS and 8 were obese patients with no active lung disease. Total respiratory system mechanics was measured on each patient from recordings of 3 respiratory cycles obtained during paralysis and CMV. The LSF method provided data for compliance (CrsLSF) and resistance (RrsLSF) of total respiratory system by multiple linear regression analysis of airway pressure, flow and volume changes applied over the entire breath. Total respiratory resistance (Rrs), interrupter resistance (Rintrs), dynamic respiratory compliance (Crsdyn) quasistatic respiratory compliance (Crsqs) were measured with the constant flow, end-inspiratory occlusion method. CrsLSF was compared with Crsdyn and Crsqs, while RrsLSF with Rrs and Rintrs.

Results *Means±sd*

Patient's Pathology	CrsLSF - Crsdyn (mL/cmH2O)	CrsLSF - Crsqs (mL/cmH2O)	RrsLSF- Rrsint (cmH2O/L/s)	RrsLSF- Rrs (cmH2O/L/s)
ARDS	1.94 ± 2.34	.11 ± 1.58	3.52 ± 2.67	.72 ± 1.45
COPD	.71 ± 7.18	-6.92 ± 6.68	6.3 ± 1.23	2.11 ± 1.93
OBESITY	2.92±3.68	-4.07±3.16	5.35 ±2.62	.81±2.04

On average, the lowest differences between CrsLSF and both Crsdyn and Crsqs, as well as between RrsLSF and both Rrsint and Rrs were found in ARDS patients, while the highest ones in COPD patients. Both in ARDS and in obese patients, RrsLSF agreed better with Rrs than with Rrsint, while CrsLSF was intermediate between Crsqs and Crsdyn.

Conclusions. The LSF method appears a reliable alternative to the constant flow, end-inspiratory occlusion method both in ARDS and in obese patients. In COPD patients the LSF method appears to work less well, although this latter result must be confirmed with further data.

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822

EFFECTS OF INHALED NITRIC OXIDE IN LEFT VENTRICULAR FAILURE WITH PULMONARY HYPERTENSION.

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Inhaled NO has been suggested for the evaluation of reversible pulmonary vasoconstriction in heart transplant candidates. Unlike intravenous vasodilators, inhaled NO is a selective pulmonary vasodilator and, hence, its use is not limited by systemic hypotension. However, the hemodynamic effects of inhaled NO in heart failure has not been thoroughly investigated.

Methods. We studied 7 patients with refractory heart failure and severe pulmonary hypertension referred for heart transplantation. Standard hemodynamics were performed during inhalation of NO at 2 increasing doses (3 and 10 ppm) and, then, during administration of intravenous sodium nitroprusside (SNP). Reference measurements were obtained before inhaled NO administration and 30 min after SNP discontinuation.

Results. *means±sd * p: <.005: 2-ways ANOVA and ScheffeF- test vs 0 start*

	PAPm (mmHg)	PVR (dyne•s•cm-5)	PCWP (mmHg)	CO (L/min)	SVR (dyne•s•cm-5)
0 start	42±8	458±233	25±6	3.2±.9	2080±839
NO (3 ppm)	40±6	266±101 *	30±6 *	3.2±.7	1966±539
NO (10 ppm)	38±6	219±72 *	30±6 *	3.2±.8	2019±591
SNP	25±6 *	251±79 *	12±5 *	4.4±1 *	1244±355 *
0 end	42±6	433±200	26±6	3.1±.8	2170±828

Pulmonary vascular resistance (PVR) significantly decreased at 3 ppm NO with no further significant decrease at 10 ppm NO. Mean pulmonary pressure (PAPm) was unaffected by inhaled NO, but pulmonary capillary wedge pressure significantly increased at 3 ppm NO, with no further increase at 10 ppm NO. In NO inhalation, cardiac output (CO), mean systemic arterial pressure (APm) and systemic vascular resistance (SVR) did not change. Compared to inhaled NO, NPS did not further decreased PVR, but significantly decreased PAPm and PCWP. NPS administration significantly increased CO and it significantly decreased SVR and APm.

Conclusions. In patients with left atrial hypertension, NO doses as low as 3 ppm can induce an acute increase in left atrial pressure. This effect can be reversed by SNP, which exerts a beneficial effect on left ventricular performance by inducing systemic arterial vasodilation.

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852

EFFECTS OF PROPORTIONAL ASSIST VENTILATION ON BREATHING PATTERN AND INSPIRATORY EFFORT IN COPD

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OBJECTIVES: Proportional assist ventilation (PAV) was designed to reduce the inspiratory effort used to overcome respiratory resistance (Rrs) and elastance (Ers) by separately applying pressure in proportion to flow (flow assist, FA) and volume (volume assist, VA). The aim of this study was to determine the effects of systematically varying the level of combined FA and VA on breathing pattern and effort in stable patients with severe COPD.

DESIGN: Physiological comparison of spontaneous breathing and PAV trials.

SUBJECTS: 6 stable patients with severe COPD (FEV_1 = 0.93±0.11 L).

METHODS: Flow, volume, esophageal pressure (Pes), and transdiaphragmatic pressure (Pdi) were measured during randomized trials of spontaneous breathing and combined FA and VA varying from 20-80% of Rrs and Ers, respectively.

RESULTS: Representative results are provided below. Compared to spontaneous breathing (control), PAV produced little change in breathing pattern. However, inspiratory effort was significantly reduced with increasing levels of PAV, as indicated by the pressure-time integral (∫ P) of Pes and Pdi.

CONCLUSION: PAV can significantly reduce inspiratory effort without altering breathing pattern in stable ambulatory patients with severe COPD.

	CONTROL	PAV 20-40%	PAV 60-80%
V_T (L)	0.67 ± 0.10	0.74 ± 0.14	0.64 ± 0.09
RR (min^{-1})	16.6 ± 0.6	15.2 ± 1.0	17.7 ± 0.7
$\dot{V}_E$ (L/min)	11.0 ± 1.1	10.9 ± 1.6	11.4 ± 1.7
∫ Pes (cmH_2O/min)	131 ± 13	114 ± 16	67 ± 12
∫ Pdi (cmH_2O/min)	168 ± 24	127 ± 19	87 ± 29

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858

COMPARISON OF HIGH FREQUENCY PERCUSSIVE VENTILATION AND CONVENTIONAL VENTILATION AFTER INHALATION INJURY: FINAL RESULTS

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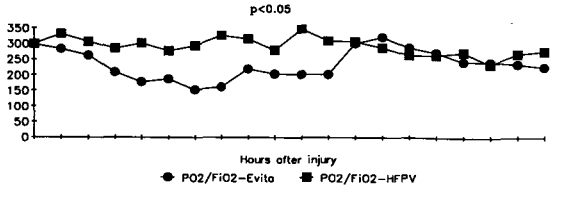
Many patients (pts) require artificial ventilatory support after inhalation injury which is responsible for severe acute respiratory failure.

High Frequency Percussive Ventilation (HFPV) combines conventional ventilatory cycles with high frequency percussions (400 to 900 cycles/min). HFPV is a recent alternative to conventional ventilation (CV).

35 pts requiring artificial ventilation after severe inhalation injury were randomised: group I (17 pts - mean age 41.3 ± 22 - Burn surface area: 46.2 ± 22.3%) under CV (Evita, Dräger) and group II (18pts - mean age 41.3 ± 15 - BSA: 51.7 ± 21.3%) under HFPV (VDR4, Percussionaire Corp.).

Current ICU parameters were studied every two hours for 5 days: blood oxygenation (PaO2, PaCO2 ...), ventilatory (FiO2, Peak Inspiratory Pressure ...) and hemodynamic data (HR, Mean Arterial Pressure, CVP ...).

A statistical analysis (Wilcoxon test) demonstrated a significant higher PaO2/FiO2 in group II ($p<0.05$) from day 0 to day 3.



No sigificant difference was observed with the other parameters.

This observation suggests that HFPV could allow to ventilate at lower FiO2 and improve blood oxygenation during the acute phase after inhalation injury reducing toxicity risk related to high FiO2. Further studies are necessary to confirm these results and evaluate the possible implications on mortality after smoke inhalation and for other ICU pts.

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861

PREDICTORS OF MORTALITY IN SEVERE COMMUNITY-ACQUIRED PNEUMONIA: A THREE-YEAR STUDY IN PATIENTS ADMITTED TO BARAGWANATH ICU

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INTRODUCTION

Severe community-acquired pneumonia (SCAP) requiring admission to the ICU is associated with significant mortality despite advances in antimicrobial therapy and intensive care management. Several studies have identified clinical, laboratory and radiographic features as markers of severity. Many of these are not appropriate to the patient population admitted to Baragwanath ICU with SCAP, e.g., underlying heart/lung disease, malignancy .

AIM

To characterise the epidemiology, determine the outcome and identify features associated with poor outcome in severe community-acquired pneumonia in adult patients admitted to Baragwanath ICU.

METHODS

A retrospective analysis of the records of all adult patients admitted to Baragwanath ICU January 1992-December 1994 with SCAP.

RESULTS

115 patients were included in the study (M:F 2:1). The mean age was 37.9 yr (range 12-73 yr). 37 patients required mechanical ventilation prior to or within the first hour of ICU admission and of these 84% died, compared with 32% mortality in patients who were breathing spontaneously on admission. Overall, the mortality rate was 39%. The admission parameters with the best predictive power for outcome were heart rate >120/min, Glasgow Coma Scale <15 and rapid arterial blood lactate >1.5 mmol/l. Overall, 24 hr APACHE II score was the best predictor of outcome. A potential causative organism was identified in 41% of cases. *Streptococcus pneumoniae* was the most common organism identified.

CONCLUSION

Early identification of patients with SCAP is important so that prompt ICU management may improve outcome. We identified in our patient population three variables, easily measured on admission, with predictive power for outcome: heart rate, Glasgow Coma Scale and rapid arterial lactate. The mortality rate in this study compares with other South African and British studies which also identified *S pneumoniae* as the most common causative organism.

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