P1

PREVENTION OF PULMONARY ASPIRATION BY MEANS OF ENDOSCOPIC BLOCKAGE WITH FOLEY TUBE
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Pulmonary aspiration of gastric matter is a serious complication that occurs during anesthesia induction in patients with an extended history of emergency surgery. "Full stomach". The severity of it depends on the volume and pH of the aspirated fluid. The mortality rate is 20-60%.

Numerous techniques have been described dealing to avoid this complication. Our study evaluates the effectiveness of the endoscopic blockage (EB) with Foley tube (F-T) in preventing the pulmonary aspiration.

24 patients subjected to emergency surgery were analyzed. We introduced the F-T through the nose till it reached the nasopharynx. The inflation of the balloon was made till the tube was proven to be fixed or till the patients referred retrosternal pain. After the anesthetic induction and tracheal intubation we proceeded to verify radiologically the effectiveness of the EB by introducing 20 ml of iodine contrast in the esophageal gape by direct laryngoscopy and by the torus x-ray centered at the mediastinum while the patient's bed was elevated to 45°.

The median age was 60.3 ± 11. The efficiency of the EB was complete in 16 patients (66.6%), almost complete in 6 (25.8%) and ineffective in 2 (8.3%). In 6 radiography revealed a discrete protrusion or the wall caused by introducing 20 ml of iodine contrast. In 20 patients we used F-T nF14 with the inflating volume of 5.6 ml and in 4 the F-T nF18 with the inflating volume of 11.3 ml. We didn't obtain correlations between the effectiveness of the blockage with the tube's caliber and the inflating volume. Tolerance was excellent.

We consider that even though the technique is not all that efficient it is possible yet to obtain a high percentage of complete EB, which combined with its simplicity and excellent tolerance, accounts for its unique advantage in the field of emergency surgery.

P2

THE PROGNOSTIC VALUE OF CONTINUOUS SvO2 MONITORING BY FIBEROPTIC OXIMETRY IN SINGLE LUNG TRANSPLANTATION. A PILOT STUDY IN PIGS
K.S. Flos, L. Goudeis, D. Dougan*, T. Tassoudis, O. Parnoni

The improvement of prognosis in human lung transplantation the last decades and the extension of new techniques for assessment of lung preservation, which lead to achieve-5 changes and sternum for a successful and well functioning transplant, increased the interest in evaluating possible applications of modern methods used in critical care monitoring in lung transplanted patients (Lang JS, Naik N, Kheroogi K, Cardiovasc Pathol, Kastharnes SH, Cooper JD 1 J Thorac Cardiovasc Surg 91:333-342 1999).

The present experimental study was carried out in order to evaluate the effectiveness of continuous oxymetry monitoring. In comparison to other means of cardiorespiratory and respiratory monitoring, both during and after single lung transplantation operations.

Materials and Methods: The study consisted of four experiments where each of four healthy pigs were used as single lung donors for a second group of healthy pigs (n=4) 66 properly prepared in the same way (subcutaneous placement of arterial, central-venous pulmonary and PA lines, volume-controlled O2-air ventilation, constant PA-anaesthesia, coagulopathy). The results were evaluated statistically, and controlled by calculation of results.

RESULTS: A significant fall of cardiac index (CI), a tremendous rise in pulmonary vascular resistance index (PVR) and a decline in DO2 after clamping (step 2) were observed. Then the systemic and pulmonary blood flow reached baseline values after unclamping (step 3.4). The continuous fiberoptic oxygen sensor monitoring failed to express the above described DO2 and CI changes. CI and DO2 correlated better in each phase with CI (r=0.76, p<0.02).

DISCUSSION: Continuous SvO2-monitoring in this specific operative modal of single lung transplantation proved to be unstable. Furthermore occlusion of a part of PA and PV makes the interpretation of SvO2 difficult. A possible vascular endotoxemia dysfunction in isolated lung is difficult to be assessed with SvO2-monitoring alone.

P3

BEDSIDE PERCUTANEOUS DILATIONAL TRACHEOSTOMY WITH ENDOSCOPIC GUIDANCE: EXPERIENCE IN 61 ICU-PATIENTS.
W.B. Winkler, R. Karkini, O. Seelmann*, J. Havelke, J. Slany

Standard surgical tracheostomy is increasingly replaced by translaryngeal tracheostomy. This prospective trial was performed to assess the feasibility of endoscopic-guided percutaneous dilational tracheostomy (EB) on bedside at our ICU using the Ciaglia technique. Over a 22 month period 62 procedures were undertaken in 61 patients with respiratory failure.

All PDT were performed successfully. Paramedian puncture was observed by endoscopy in 1/62 (16%) procedures and was corrected by repeated puncture. Perioperative procedure related complications occurred in 4 of 61 patients (6,6%) and included 2 minor bleedings, one inflammatory infiltration and one superficial lesion of the posterior tracheal mucosa. The bleedings did not require transfusion. The inflammation receded under antibiotic treatment, the mucosal injury without special therapy. Long-term follow-up revealed stomal granulation in 3 patients including one at tracheal site which required repeated microlaryngoscopic laser treatment in a decannulated patient.

To date 10 patients were decannulated with no further complications. To facilitate weaning from tracheostomy Ministrach was used in 3 patients in order to warrant suction.

Our study showed that PDT is a simple bedside procedure associated with a low perioperative and long-term complication rate. PDT seems to be an appropriate alternative to standard surgical tracheostomy. Tracheoscopic guidance is recommended to increase safety of tracheal puncture and dilatation procedure.

P4

THE VALUE OF RESPIRATORY SLEEP STUDIES IN THE MANAGEMENT OF RESPIRATORY FAILURE
H. Becker, J. A. Peter, W. Pitzer, H. Schneider, P. V. Wichert

Respiratory failure is a main cause of death in patients (PTS) suffering from neuromuscular disease and kyphoscoliosis. As sleep leads to depression of regulatory mechanisms of breathing we studied the value of sleep studies in the management of respiratory failure.

5 consecutive pts (4f,1m; age 18-55 years) with akute respiratory failure after an operation (4) or pneumonia (1) were seen in our hospital, because weaning was only successful for 1-2 days and reintubation had been necessary several times. Three pts were suffering from kyphoscoliosis and two from benign muscular dystrophy, causing restrictive lung disease (VC 25-54% of predicted value).

Mean PO2 was 49,6 (34-64) and CO2 62,6 (50-88) mmHg during wakefulness. The prognostic value of continuous SvO2 monitoring by fiberoptic oximetry in single lung transplantation. A pilot study in pigs.

In all pts repetitive central hypoventilation of up to 45 minutes with a decrease of arterial oxygen saturation (SvO2) with 4% during sleep in the spontaneously breathing pts. The severity of it depends on the volume and pH of the aspirated fluid. The mortality rate is 20-60%.

All PDT were performed successfully. Paramedian puncture was observed by endoscopy in 1/62 (16%) procedures and was corrected by repeated puncture. Perioperative procedure related complications occurred in 4 of 61 patients (6,6%) and included 2 minor bleedings, one inflammatory infiltration and one superficial lesion of the posterior tracheal mucosa. The bleedings did not require transfusion. The inflammation receded under antibiotic treatment, the mucosal injury without special therapy. Long-term follow-up revealed stomal granulation in 3 patients including one at tracheal site which required repeated microlaryngoscopic laser treatment in a decannulated patient.

The value of respiratory sleep studies in the management of respiratory failure.
NON-INVASIVE EVALUATION OF RESPIRATORY MUSCLE OXYGENATION IN MECHANICALLY VENTILATED PATIENTS BY NEAR INFRARED SPECTROSCOPY (NIRS)

De Blasi R.A.*, Conti G.*, Mattia C.*, Mega A.M.*, Ferrari M.* and Gasparetto A.*

The evaluation of muscle oxygenation by NIRS has been extensively described. The occurrence of haemoglobin desaturation during ischemia and muscle exercise was previously evaluated on human forearm (De Blasi et al., Biochem Int, 1991). Recently optic fibers were applied on the intercostal space of patients with heart failure demonstrating the possibility of monitoring the respiratory muscle desaturation during an exhausting exercise by NIRS (Mancini et al., J Am Coll Cardiol, 1991). No technique is presently available to assess the adequacy of respiratory muscle O2 supply to the patient with respiratory failure and assisted mechanical ventilation at different levels of pressure support in order to verify if the muscle desaturation was related to the work of breathing.

Fig.1 shows a representative trend of Hb saturation during an exhausting exercise by NEAR INFRARED SPECTROSCOPY (NIRS); inadequate respiratory muscle O2 supply was related to the work of breathing.

OXYGENATION IN MECHANICALLY VENTILATED PATIENTS BY NON-INVASIVE EVALUATION OF RESPIRATORY MUSCLE OXYGENATION

FERRARI M. and GASPARETTO A.

PULMONARY NEUTROPHILS SEQUESTRATION DURING INTRA-ABDOMINAL SEPSIS ARE RELATED TO BACTEREMIA

G. CAPELLEREA*, S. LIAU*, T. WINTON, J. MARSHALL, W. DEHAJO, P. BARALE*, P. R. WALKER

In a previous investigation we demonstrated that rats, under anesthesia, placed on a ventilator, 48 h after a sham operation, had significantly less neutrophils in the lung when compared to non-operated rats. In the present investigation, we have examined the sequestration of neutrophils in rats 48 h after cecal ligation, a 22 gauge puncture was realized. The animals received through the inferior vena cava (IVC) or the portal vein (PV) 500,000 units of heparin and 5 mg of podophyllin chloride/100 g of body weight. GdCl induce a reticulo-endothelial system blockade. As shown with endotoxins, neutrophils accumulation was transferred by the thoracic lymph. Whereas the release of pancreatic enzymes subsided over time, ongoing activation of neutrophils occurred in the peritoneal cavity and outside the pancreas.

When all the animals were analyzed using the positive blood culture (PBC) as a criteria, we found an increase in the lung dry/wet ratio in the PBC group (p<0.05). Neutrophil activity was significantly increased in this group at 24 h.

| Blood cultures | IVC* | PV | C |
|----------------|-----|----|---|
| 10             | 5   | 9  | 10|

In our model of peritonitis we have demonstrated an increase in positive blood cultures using a reticuloendothelial system blockade. As shown in endotoxemia, bacteria induce neutrophil accumulation. These sequestration could explain the relationship between sepsis and lung damage.

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RESPIRATORY FAILURE AND ACUTE PANCREATITIS: THE ROLE OF PANCREATIC AND NEUTROPHILIC ENZYMES

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Respiratory failure (RF) is the major threat of the early phase of severe acute pancreatitis (SAP). RF has been ascribed to the transfer, notably lymphatic, of toxic substances issued from the pancreatic area. Besides its therapeutic value,��除性of the thoracic lymph (TDD) provides the unique opportunity to identify potential mediators of lung injury during SAP and to study their kinetics. TDD was carried out in 28 patients (22 males, mean age 52±15 years) with RF (mean PaO2/FiO2 ; mean 80 sliding 63 mm Hg) during the early phase of SAP (mean Ranson score ± SD : 6±1; mean Apache II score ± SD : 16 ±4). The delay between onset of symptoms and ICU admission was 3.5±2 days. Ethiology of SAP was alcohol abuse in 21 patients. All patients were mechanically ventilated. Criteria for adult respiratory distress syndrome were met by 13 patients (46%). All but 2 patients (93%) survived. The mean duration of TDD was 6±19 days with a mean volume of drained lymph of 9±8 ml. Samples of plasma (PL) and lymph (LY) were simultaneously drawn on the 1st and last day of TDD. All patients were mechanically ventilated. Criteria for adult respiratory distress syndrome were met by 13 patients (46%). All but 2 patients (93%) survived. The mean duration of TDD was 6±19 days with a mean volume of drained lymph of 9±8.1 ml. Samples of plasma (PL) and lymph (LY) were simultaneously drawn on the 1st and last day of TDD and were assayed for immunoreactive trypsin (IRT; normal value: 284±100 ng/ml), granulocyte elastase (ELA; normal value < 32 ng/ml) and neutrophil myeloperoxidase (MPO; normal value : 332±82 ng/ml). Results are expressed as mean ± SD and a p value <0.05 was considered significant.

| FIRST | LAST |
|-------|------|
| IRT   | MPO  | ELA  |
| 115±2*| 105±2*| 269±12*|
| 500±46| 11±4*| 162±120|
| PL    | 4§*  | 57±4*| 265±4*|
| 131±92| 693±53| 132±137|

* compares lymph with plasma; * compares 1st and last day of TDD. Substantial amounts of pancreatic and neutrophilic mediators of lung injury are transferred by the thoracic lymph. Whereas the release of pancreatic enzymes subsided over time, ongoing activation of neutrophils occurred in and outside the pancreas.
P9

CLINICAL AND RADIOLOGICAL EXAMINATION COMPARED WITH COMPUTED TOMOGRAPHY IN THE MECHANICALLY VENTILATED PATIENT. 

F. Bringetanz, G. Dicus, E. Rivera, F. Fernández, M. Mucida and J.M. Boch.

Conventional clinical examination using chest auscultation and inspection (A/I) along with bedside radiology (1-ray), are the normally accepted methods for the morphological evaluation of the pleura and lungs in the patient on mechanical ventilation (MV). Both methods provide limited information in this situation. On the other hand, computed tomography of the chest (CTC) provides very reliable images. This study's objective is the evaluation of the efficacy of clinical (A/I) and radiological (1-ray) examination at the bedside comparing it with CTC as an ideal reference method.

We studied 23 patients, aged 64±5.3 and APACHE II score of 19.3±5.2 who were on MV for acute respiratory failure. A/I examination of the anterior and posterior sections in each bed-thorax evaluated the increase and decrease in respiratory sounds transmission (Vt 10 ml/kg), and/or the presence of crackles and/or thoracic asymmetry, and these were compared with simultaneous chest 1-ray and CTC findings for pulmonary condensation, collapse, pleural effusion and pneumothorax. The three tests were carried out separately by different specialists.

In pleural pathology: of 8 cases of anterior pneumothorax (identified by CTC), none were detected by 1-ray (0/8, P0.05) and A/I was positive in 3 cases (7/37.51). Of the 21 cases of pleural effusion (by CTC) 12 were positive by 1-ray (12/21, 57.1%) and 15 by A/I (15/21, 71.4%). In pulmonary pathology: 25 cases of segmental condensation (CTC), 14 only identified 16 (16/25, 64%) and 20 of 7 cases, 1-ray identified 6 (6/7, 85.7%) and A/I 7 (7/7, 100%).

In conclusion, chest 1-ray and clinical methods are neither very sensitive nor specific with a high incidence of false negatives in the evaluation of pleural and pulmonary pathologies in the ventilated patient, with CTC being the reference technique.

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P10

FOLLOW UP OF ARDS - SURVIVORS BY CLINICAL INVESTIGATION AND HIGH-RESOLUTION COMPUTED TOMOGRAPHY.

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While patients during ARDS are meticulously monitored with respect to their respiratory function and thoracic imaging, the respiratory status of this patient population after surviving ARDS has received less attention. In order to point out any correlation between severity of ARDS and health-status of survivors, 12 patients (age mean 21, range from 7 to 69 years) were investigated 12 ± 4 months after dismissal from ICU. We discriminated moderate from severe ARDS by following parameters: chest-x-ray, P3O2/F5O2, PEEP, and compliance (JF Murray: Am Rev Resp Dis 136:720, 1988). 7 patients with an Index < 2.5 entered group I for moderate and 5 patients with > 2.5 group II for severe ARDS.

Our clinical index consisted of following parameters: age, duration of stay at ICU, number of additional organ failures, sepsis, degree of diagnostic and therapeutic efforts as pulmonary artery catheter, hemofiltration, prostaglandine-therapy and inversed ratio ventilation. In the follow up study pulmonary findings were documented and scored (Pistoleto et al.: Intens Care Dig 7:2-4, 1988) by high-resolution computed tomography (HRCT). Furthermore cardiac state (ECC, NYHA, LOWN), degree of dyspnea and state of social reintegration were investigated, spirometry, blood gas analysis and a check-up of neuromuscular function were performed.

No correlation was seen between Murray-index representing severity of ARDS and our follow up index (hyp.-test for HO 0.86) including HRCT-index (hyp.-test for HO 0.065).

In conclusion, neither the severity of ARDS nor the pulmonary structure as assessed by HRCT determine the health status of ARDS-survivors.

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P11

PULMONARY VASOCONSTRICTION IN RESPIRATORY DISTRESS IN PIGS.

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Vasocstriction was studied in experimentally induced respirato-ry distress (RD). Eighteen pigs were anesthetized with pentobarbi- tol, paralyzed with d-tubocurarine and mechanically ventilated at a rate of 12 per minute and an F5O2 of 0.6. In six animals RD was induced by a pair of lung lavages followed after one hour by another pair (group L). In a second group (n=6) a series of 0.1 ml oleic acid injections were given (group OA). A third control group (C, n=6) was ventilated for about 8 h. A similar 1-ray which was stable for 4-6 hours was induced in groups L (53±13 mmHg) and OA (57±8 mmHg). Pulmonary arterial pressure (P2) was significantly higher in group OA compared with group L: 36±2 mmHg vs 31±6 mmHg respectively (p<0.01). The animals were killed with pentobarbital. As a measure of muscular vasoconstriction medial thickness (MT) as percentage of external diameter of muscular pulmonary arteries was determined in various parts of the lungs. In group L MT was 7.7 ± 2.9 % and in group OA it was 8.1 ± 3.2 % (NS). In group C P2 was 284±21 mmHg, P2 was 14±4 mmHg and MT was 3.8±1.7 %. All these variables were different at p<0.01 from group L and OA. MT in corresponding lung regions was not statistical different between group L and OA, implying a severe but similar degree of muscular vasocstriction. As P2 was higher in group OA we concluded that besides muscular vasocostriction other factors such as vasodilatation and compression by lung edema were involved in the development of pulmonary hypertension after oleic acid.

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P12

CENTRAL VASCULAR SURGERY AND PULMONARY VASCULAR INJURY.

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Ischaemia and reperfusion of the lower body during central vascular surgery may release proinflammatory mediators that lead to a pulmonary vascular injury. We therefore studied transvascular protein transport in the lung in 25 consecutive patients undergoing elective cardiac vascular surgery (with aortic cross-clamping; Group 1, n=19) or reconstruction of the femoral artery (Group 2, n=6). Transvascular protein transport was measured one day before (preop) and after surgery (postop), by recording kinetics of intravenously injected 67-Gallium-transferrin and 99m-Technetium-erythrocytes in blood (sampling) and in the lung (external detection with a probe). A protein leak index (P II, 103 min-1) was calculated.

In Group 1, the mean (±SD) P II rose from 96±128 preop to 342±174, 3 hours postop (p<0.005, n=12). In a second series of Group 1 patients (n=9) the P II was 97±42 preop and 115±40 (p=0.05) 24 hours postop. For Group 2, the P II was 111±30 preop and 130±22 postop (p<0.05).

Hence, transvascular protein transport in the lung increases about three-fold following surgery with aortic cross-clamping. However, the phenomenon is transient. No increase is observed following peripheral vascular surgery. Hence, ischaemia and reperfusion of the lower body may result in release of proinflammatory mediators, that transiently increase permeability of the pulmonary vasculature.

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HAEMODYNAMIC EFFECTS OF HYPERINFLATION
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Chest hyperinflation (HI) is a commonly used ICU procedure during which alterations in heart rate and blood pressure are frequently seen. However, the relationship between tidal volumes and inspiratory pressures generated by HI and changes in cardiac output (CO) have not been elucidated. Cardiovascular derangements during 6 HI using a 2 litre rebreathing bag and a flow rate of 15 litres O2/min were thus studied using continuous beat-by-beat oscoephagel Doppler monitoring of CO (ODM, Deltex, UK). A pressure transducer placed at the end of the catheter recorded on a chart recorder the peak inspiratory pressure (PIP) during (i) mechanical ventilation and (ii) HI. The tidal volumes (TV) generated by HI were measured with a spirometer. The nurses performing the HI were kept blinded to those additional measurements. Fifteen mechanically ventilated patients (age range 19-87 y) were studied on 17 occasions before, during, and at 1, 5, 10 and 15 mins after HI.

| pre HI | during HI | 1 min | 5 min | 10 min | 15 min |
|--------|-----------|-------|-------|--------|--------|
| CO     | 7.0±0.1   | 6.2±0.3 | 6.4±0.2 | 6.5±0.3 | 6.6±0.4 |
| Ht     | 90±6      | 92±5   | 90±6   | 90±5   | 92±6   |
| mean BP| 77±3      | 79±4   | 75±5   | 75±3   | 77±3   |

Significant (>10%) falls or increases in BP (n=6) were both associated with falls in CO: a good correlation (r=0.64) was seen between the %change in CO (range +5 to -26%) and the %rise in tidal volume (range -33 + 117%). There was no correlation (r=0.04) between the %fall in CO and the %increase in PIP (range -30 to +167%). Neither the presence of intrapulmonary pressure (n=4) nor the need for increased ventilatory support (n=9) was related to a fall in CO during HI.

Falls in CO, which may take up to 15 minutes to recover, are related to the degree of HI but not to the peak inspiratory pressure generated. As HI is poorly assessed by the operator, a volume limiting device in the circuit may prove beneficial.

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ACUTE RESPIRATORY FAILURE INDUCED BY ALVEOLAR HEMORRHAGE IN HEMATOLOGICAL PATIENTS.
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Several different life-threatening pulmonary complications are common in hematological patients which could be transferred into ICU. These are dependents upon multiple factors including the type of disease, the nature and the time course of treatment, and the presence or absence of neutropenia. At the onset of the disease, acute respiratory failure (ARF) is infrequent. In these cases, an infection or a hyperleukocytic reaction are generally found. In the former situation, chemotherapy are postponed. In the latter, cytapheresis are performed.

Five patients (1 female) aged 47±16 were admitted in ICU for ARF. Underlying diseases were: acute leukemia (3) and non-Hodgkin lymphoma (2). Initial physical examination revealed a systolic blood pressure at 137±10 mmHg, a heart rate at 74±16 bpm/min, a respiratory rate at 35±5 breath/min and a cutaneous temperature at 37.2±0.4 °C. Two patients had episodes of hypoxemia. Arterial blood gas determination with oxygen supplementation revealed a pH of 7.4±0.1, PO2 of 46±5.6 kPa, P50 of 2.5±1.6 kPa. Platelet counts were under range in 4 cases and intravascular coagulation was found in 3 cases. In all cases, chest radiograph showed bilateral infiltrates. In 4 cases, bronchoalveolar lavage (BAL) fluids were bloody and negative for bacteria, virus, fungus and parasites. Clinical status and radiographic abnormalities rapidly worsened. In all cases, treatments were specific for hematological diseases associated with respiratory support (mechanical ventilation by orotracheal intubation in 4 patients and via a facial mask in one). In 4 cases, dyspnea, PaO2 and chest radiograph improved progressively and in these cases mechanical ventilation could be stopped. Two patients were discharged from ICU. The other 3 patients died because of the evolution of the underlying diseases.

In conclusion, DPAH is a life-threatening complication at the attack of hematological disease. The Occurrence of DPAH is a sign of serious and progressive diseases. DPAH diagnosis was made on the context, the hemoptysis and the bloody BAL fluid. A rapid specific treatment before results of BAL are essential for the improvement of ARF. The prognosis of this patients seem to be similar to those which have other complications leading to intensive care admissions.

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EFFECTS OF PEEP IN EARLY RESPIRATORY DISTRESS IN PIGS INDUCED BY LAVAGES AND OLEIC ACID ADMINISTRATION
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This study was aimed at the evaluation of variables during application of PEEP, which predict maximal oxygen delivery in early respiratory distress, and therefore indicate the "best" level of PEEP. Twentyfour pigs (9.4 ± 0.8 kg body weight) were anesthetized with pentobarbital sodium, paralyzed with tubocurarine, and mechanically ventilated at 10 per min with an FO2 of 0.6. Respiratory distress was induced in 12 animals by a standardized protocol of two pairs of lung lavages at one hour interval (group L), and in the other 12 by multiple small oleic acid injections of 0.1 ml (group OA). In both groups a stable PaO2 below 60 mmHg was established. Six animals of each group served as controls and revealed a stable hypoxaemia for 4-6 hours. In the remaining 6 animals of each group PEEP was increased in steps of 2 cmH2O from PEEP2 (PEEP of 2 cmH2O) up to PEEP12 and reset to PEEP2. Each level was maintained for 2 min. PaO2 increased in group L from 55 ± 14 mmHg to 218 ± 94 mmHg at PEEP2 and to 226 ± 45 mmHg. End-expiratory lung volume (VEE) increased in groups L from 12 ± 2 ml.kg-1 to 46 ± 9 ml.kg-1 and group OA from 16 ± 3 ml.kg-1 to 50 ± 3 ml.kg-1. Central venous pressure increased and cardiac output decreased linearly in both groups. "Best PEEP" was defined as a level where oxygen delivery (DO2) in five animals of group L and in four of group OA. Physiological dead space, arterial to end tidal CO2 gradient, total respiratory compliance and venous admixture did not correlate with DO2. We concluded that PaO2 and VEE were useful indicators of "best PEEP" in early respiratory distress.

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Guillain-Barre Syndrome in the ICU
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During the period 1990-1991, 14 patients (pts) with the diagnosis of Guillain-Barre syndrome (GBS) were admitted to our ICU because of respiratory failure. The presentation and the main symptoms of pts are summarized in the table below:

| Table I | Table II |
|---------|---------|
| Number of cases | 14 |
| Average age | 36.7 |
| Age range | 8-70 |
| Prior illness | 80.5% |
| Onset to maximal weakness | 7(50%) |
| Pharyngeal paresis | 9(64.2%) |
| Respiratory failure | Abnormal CXR |
| Average hospital | 45 days OA |
| Mortality | 2(14.2%) |

Our results suggest that the meticulous attention to small details of daily care is of greater importance in the care of GBS than any available treatment directed specifically at the disease. Plasmapheresis seems to have a beneficial effect on rate of improvement of Guillain-Barre syndrome.

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RESPIRATORY DISTRESS TREATED BY POSITIVE PRESSURE VENTILATION THROUGH A FACIAL MASK IN HEMATOLOGICAL PATIENTS

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Patients with hematological diseases need ventilatory support (RS) for acute respiratory failure (ARF). Unfortunately, the mortality rate of patients requiring mechanical ventilation (MV) in the ICU is high related to the neoplastic complications and to the degree of asplasia. In those patients, both endotracheal intubation and mechanical ventilation induce numerous complications. Therefore, there is a need for methods of ventilatory assistance that could obviate the necessity for intubation in hematological patients. Ventilation has been assisted non-invasively by means of positive pressure ventilation administered through a facial mask (FM). Inspiratory-pressure support (IPS) is a new method of partial ventilatory assistance in which constant positive pressure is applied during the patient's spontaneous inspiration. This mode of RS reduces respiratory muscle work. But this technique is difficult to use routinely because it requires numerous conditions including cooperation from patient and ability to tolerate FM. The aim of this study is to test IPS through a FM in hematological patients.

15 patients (7 females) aged 36 years and treated for acute leukemia (14) or myeloma (1) were prospectively ventilated through FM. The onset of ARF occurred in 4 cases just before the induction of chemotherapy, 7 during aplasia and 4 at the end of aplasia. The causes of ARF were alveolar hemorrhages (2 cases), infections (9), hemodynamic edema (2) and unknown (2). At the time of admission in ICU, respiratory rate (RR) was 33 breath/min and Pa02 less than 60 mmHg, while the PaCO2 was 56 mmHg. Envenom treatment with IPS was initiated at a level of pressure from 15 to 20 cm of water (Sceve ventilator type C, Siemens). The FIO2 was adapted to the result of Pa02 (40±FIO2<70%).

Out of 15 patients, 4 had immediate failure which resulted in endotracheal intubation in 3 hours. The causes of failure were: impossibility to adapt IPS to the patient (3) and cardiac arrest (1). 5 patients were ventilated during IPS (1 necrotic gas gangrene, 1 hemopergic (1) and impossibility to adapt IPS to the patient (3)). These 9 patients died. IPS was achieved in success with 6 patients who were discharged from ICU. In the 11 patients treated by IPS, the duration of the treatment period was from 3 to 24 h per day (mean 13 h) in number of days during which treatment was administered ranged from 1 to 16 (mean 5.4 days). RR decreased from 31 to 23, Pa02 increased (17.7 kPa); PaCO2 remained stable (4.2 kPa). Any hemodynamic change was noticed. Local tolerance of FM was excellent.

In conclusion, our results show that inspiratory pressure support delivered by a facial mask can obviate the need for conventional mechanical ventilation in hematological patients with severe respiratory distress. Services d’Anesthésie et d’Hématologie: Pavillons P et E, Hôpital Ed. Herriot, 69371 Lyon cedex 03, France.

P18

INVERSE RATIO VENTILATION: EFFECT ON END-EXPIRATORY LUNG VOLUME AND AUTO-PEEP

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We compared the effects of inverse ratio ventilation (IRV) and PEEP on dynamic hyperinflation and auto-PEEP in 9 patients with ARDS and 10 postoperative patients after coronary artery bypass (CABG). During volume controlled mechanical ventilation with constant tidal volume (12 ml/kg) and respiratory rate (12/min) two experiments were carried out: (1) with constant I:E ratio PEEP was increased in steps of 2 cmH2O from 0 to 12 cmH2O, and (2) with no PEEP I:E ratio was changed stepwise from 1:4 to 4:1. PEEPtot was measured while occluding the airway in end-expiration. Changes in end-expiratory lung volume (EELV) were measured with respiratory inductive plethysmograph. We found that, (1) changing PEEP from 0 to 12 and IRV from 1:4 to 4:1 caused similar increase in EELV in ARDS (379±69 ml and 390±83 ml), but in CABG the increase in EELV was greater with PEEP (1001±98 ml and 655±58 ml), (2) when compared at the same levels of PEEPtot the increase in EELV was similar with PEEP and IRV in both groups, (3) EELV increased significantly in ARDS with Te<2.5 s and in CABG with Te<2.0 s, and (4) peak inspiratory pressures were only marginally lower with the IRV (at EELV 150 ml with IRV 2:1 and PEEP 8, Peak 371±3 and 43±3 in ARDS). We conclude that the effect of reduced expiratory time on end-expiratory lung volume and pressure during volume controlled IRV is similar to the use of PEEP.

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PRESSURE CONTROL VENTILATION : WHAT THE BENEFITS?

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Pressure Control Ventilation seems to be able to improve gas exchange reducing the risks of barotrauma and hemodynamic deterioration. 10 patients with mild to severe respiratory failure (Pa02/FIO2 ratio:166±87; Static Compliance:33±13), previously sedated and paralyzed, were ventilated employing a randomized sequence of Volume Control Mode with equi-PEEP, inspiratory flow wave (VCMsq), Volume Control Mode with decelerating flow wave (VCMdec) and Pressure Control Ventilation (PCV), keeping constant respiratory rates, tidal volumes, inspiratory time (33%), FIO2 and PEEP. After 1 hour of each mode of ventilation on a full set of ventilatory, hemodynamic and blood gas measurements was obtained. The results are shown in the table. It has been suggested that the decelerating inspiratory flow curve could account for the better results during PCV. Our experience confirms the benefits of PCV and suggests we re-complex mechanisms, even not fully understood, as the comparison with VCMdec demonstrates.

| Parameters | VCMsq | PCV | VCMdec |
|------------|-------|-----|--------|
| Pai cmH2O  | 41±20 | 33±15 | 37±17 |
| PiFIO2cmH2O| 14±1  | 14±1  | 15±6   |
| CI l/min   | 4±1   | 4±1   | 4±1    |
| DCO ml/min | 703±256| 735±247| 706±248|
| PaO2 mmHg  | 60±21 | 73±20 | 69±18  |
| SaO2 %     | 90±7  | 90±5  | 90±7   |
| Compliance | 19±6  | 22±10 | 15±9   |
| p<0.05 vs VCMsq | *p<0.01 vs VCMdec |
| p<0.05 vs PCV | 1 p<0.01 vs VCMdec |
| p<0.05 vs PCV | 1 p<0.05 vs PCV |

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P20

INVERSED RATIO VENTILATION WITH REDUCED PEEP IN PATIENTS WITH ACUTE RESPIRATORY FAILURE

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In patients with acute respiratory failure reduction of PEEP is recommended to avoid barotrauma of the lungs. Twelve critically ill patients free of any factor known to alter chest wall mechanics were studied prospectively. Continuous positive pressure ventilation (CPPV) with an inspiratory : expiratory (I:E) ratio of 1:2 and a PEEP of 10 mm Hg and CPPV with an I:E ratio of 2:1 and reduction of PEEP to 5 mm Hg were administered to each patients in a random order for a 1 h period. Gas flow, tidal volume, tracheal pressure, blood gas concentrations and hemodynamic parameters were measured. Hemodynamic parameters remained unchanged in both ventilatory regimens. Inversed ratio ventilation with reduced PEEP tended to increase PaO2 and decreased PaCO2 significantly from 44.3 mm Hg to 35.1 mm Hg (p<0.05). Without significant changes in minute ventilation and tidal volume inversed ratio ventilation decreased mean inspiratory pressure from 34.5 mm Hg to 29.6 mm Hg and increased static respiratory compliance from 39 ml/mmHg to 53 ml/mmHg significantly.

We conclude that in patients with severe respiratory failure inversed I:E ratio ventilation is superior to ventilation with I:E ratio of 1:2 providing reduction in airway pressure and improvement in pulmonary gas exchange.

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**P21**

**INTEREST OF COMBINED HIGH FREQUENCY PERCUSSIVE VENTILATION DURING ACUTE RESPIRATORY FAILURE AFTER SMOKE INHALATION**

P. Reper', E. Marion', F. Van Hille', H. De Neef', W. Heymans', Y. Ysebaert', R. Van Hoof', A. Vanderkenel'.

Smoke inhalation injury and bacterial pneumonia represent some of the most important causes of mortality in burn patients.

We described eleven severely burned patients (mean Burn Surface Area 49±24%5%) with acute respiratory failure under conventional respiratory support (CRS) (Dräger UV 1-E 1/2 - Tidal Volume 10 to 20 ml/kg) 8 to 32 hours after inhalation injury.

High frequency percussive ventilation (HFPV) is a recent ventilatory mode, which combines advantages of conventional ventilation with some of high frequency ventilation (1); HFPV was initially instituted as salvage therapy achieving in each case a dramatic improvement (within 14 to 32 hours) of blood oxygenation, PaCO₂, and PaO₂/FiO₂.

| CRS | HFPV | p (Wilcoxon test) |
|-----|------|------------------|
| m PaO₂/FiO₂ | 85.7±21.6 | 303.4±5.3 <0.003 |
| m PaCO₂ mmHg | 54.4±6.2 | 34.3±4.6 <0.003 |
| m PEEP cmH₂O | 10.5±1.2 | 10.5±1.2 NS |
| m PIP cmH₂O | 50±6.8 | 30.6±5.2 <0.003 |
| PIP Peak Inspiratory Pressure, PEEP Positive End Expiratory Pressure |

Seven patients (63%) developed pulmonary infection during the acute phase, one patient died of multiple organ failure on day 25.

All other patients survived; two developed bronchiolitis obliterans symptoms before discharge.

This observation suggests that HFPV could improve pulmonary function and blood oxygenation in these catastrophic pulmonary failures after smoke inhalation.

Further studies are necessary to confirm this initial experience.

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**P22**

**EFFECTS OF HIGH FREQUENCY PERCUSSIVE VENTILATION ON HEMODYNAMICS AND BLOOD OXYGENATION IN CRITICALLY ILL PATIENTS**

P. Reper', E. Marion', F. Van Hille', Y. Ysebaert', M. Elsen', W. Heymans', R. Van Hoof', A. Vanderkenel'.

High frequency percussive ventilation (HFPV) is a recent ventilatory mode which combines advantages of conventional respiratory support with some of high frequency ventilation; high frequency oscillations (300 to 900 cycles/min) are associated with conventional cycles.

Nine severely burned patients (mean Burn Surface Area 37±12%) were studied under conventional ventilation (Dräger Evita) and under HFPV (at two different frequency rates: 600 and 900/min) (VDR4 - Percussionaire Corp. - USA) under constant FiO₂, and for periods of one hour (measurements every 30 minutes) in steady state.

Under HFPV, hemodynamic data are not significantly modified (heart rate (HR), cardiac index (CI), pulmonary wedge pressure (PWP), central venous pressure (CVP) and mean arterial pressure (MAP)). Peak inspiratory pressure (PIP) and conventional ventilatory frequency (CFV) were significantly lower under HFPV, blood oxygenation (PaO₂) and CO₂ elimination were significantly improved after one hour under HFPV. The oscillatory frequency rates don’t influence these constatations.

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**P23**

**USEFULNESS OF NON INVASIVE PRESSURE SUPPORT VENTILATION (NIPSV) BY MASK IN THE CARE OF TRAUMA PATIENTS WITH RESPIRATORY FAILURE (RF).**

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This five-year study evaluates physiological benefits in trauma patients with RF undergoing NIPSV. Patients were selected in three different centers from July 87 to July 91. The mean age was 39±19 years. Including criteria were PaO₂/FiO₂ less than 200 mmHg, clinical signs of respiratory fatigue, respiratory rate (RR) higher than 30 breaths/min, tidal volume (TV) less than 500 ml/kg or CO₂ retention during spontaneous or non invasive continuous flow CPAP. We performed 158 trials with 68 patients on NIPSV, Invasive PSV (IPSV) and spontaneous breathing (SB) recording gas exchange and respiratory pattern. Respiratory support was delivered by Siemens Servo Ventilator C in the PSV mode through endotracheal tube or face and nasal masks modified to allow nasogastric tube insertion and to improve long term tolerance.

Representative results (mean ±SD) are shown below.

| **SB** | **IPSV** | **NIPSV** |
|--------|----------|-----------|
| PaO₂/FiO₂ | 146±42 | 236±77 * | 276±107 | $ |
| PaCO₂ mmHg | 41.7±10.2 | 38.8±16.1 | 38.3±5.1 | $ |
| Ve mmHg | 17.4±17.1 | 24.2±25 | 14.7±16.3 | | |
| TV ml | 375.5±177.9 | 774.1±28 | 710.8±134 | | |
| RR c/min | 32.5±5 | 16.6±3.2 | 16.0±4.3 | | |
| PSV cmH₂O | 12.4±9.3 | 13.5±5.8 | | | |

One-way ANOVA: *P<0.05, SB vs. IPSV, $ SB vs. NIPSV

PaCO₂/FiO₂ increased significantly with both IPSV and NIPSV. The TV increased with a constant reduction in RR so that Ve and PaCO₂ remained constant. No difference between IPSV and NIPSV was found. Although not statistically significant the better oxygenation observed with NIPSV is likely due to a better stimulus for coughing, which might have increased alveolar ventilation. Mask ventilation was performed for an average 67±15 hours long period. Only eight patients treated with NIPSV required intubation. Three for mask intolerance, five for occurred septic syndrome. We conclude that NIPSV can safely substitute endotracheal intubation as a mean of delivering ventilatory support in most of conscious and collaborating trauma patients.

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**P24**

**NASAL POSITIVE PRESSURE VENTILATION FOR TREATMENT OF NOCTURNAL HYPOVENTILATION IN PATIENTS WITH SEVERE COPD**

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Patients with COPD and sleep related breathing disorders (SRBD) have often exacerbation of hypoxemia, to life-threatening levels that might be related to the higher mortality of these patients.

The hypothesis of this study was that specific treatment of sleep related alveolar hypventilation in patients with severe COPD improves respiratory function, daytime sleepiness (EDS) and reduces the individual risk.

6 patients, mean age 57 yrs, mean BMI 30.8 kg/m², with severe airway obstruction (FEV₁<1.5L), excessive daytime sleepiness (EDS) and alveolar hypventilation (mean daytime PaO₂ 57 mmHg PaCO₂ 49 mmHg) were hospitalized and treated by conventional regime (CR) of aggressive secretion clearance techniques, antibiotics, corticosteroids, bronchodilators, cardio-vascular support and supplemental oxygen. Respiration, SaO₂ and EEEG was recorded by standard polysomnography (PSG). Sleepiness was documented by means of a standardized questionnaire. Positive pressure ventilation (PPV) was established via nasal mask nasal using BipAP-ST (Respironics) or Bear 33 home ventilator.

During treatment with CR there was no significant improvement of both the # of apneas, hypopneas, oxygen desaturation, EEG-awrousal and daytime sleepiness (EDS). During treatment with nasal PPV there was a significant decrease of # of apneas (181±23) hypopneas (281±27), oxygen desaturation (434±32) and EEG arousal (243±31). The reported EDS was diminished with this regime.

In order to prevent life threatening events in patients with severe COPD it is important to record respiration during sleep. The application of nasal positive pressure ventilation reduces the risk of nocturnal hypventilation. We conclude that the interaction of sleep related breathing disorders with COPD is a main factor in the development of severe respiratory failure and may be responsible for the higher mortality in COPD patients with nocturnal hypventilation.
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PRESSURE CONTROLLED INVERSE RATIO VENTILATION IN OLEIC ACID INDUCED LUNG INJURY

Ulfrudgs, Christo Klengstedt, Svante Backlund and Göran Hodemister

Pressure controlled inverse ratio ventilation (PCIRV) has been proposed as an alternative ventilatory technique in severe lung injury. In order to clarify the effects of PCIRV and the relative importance of the components constituting this complex concept, a study has been carried out in animal model of lung injury.

Ten pigs (25 ± 4 kg) were anesthetized and mechanically ventilated. Lung injury was induced by injection of oleic acid (0.15 ml/kg) and became manifest within two h. Four ventilatory modes (volume controled zero PEEP (VCZ 1:2), volume controled 10 cm H2O PEEP (VCP 1:2), volume controled zero PEEP IE ratio 1:1 (VCZ 4:1) and pressure controled zero PEEP IE mode (PCZ 4:1)) were employed in random order. Central hemodynamics, respiratory mechanics and gas exchange were measured after a 30 minute stabilization period.

| VCZ 1:2 | VCP 1:2 | VCZ 4:1 | PCZ 4:1 |
|---------|---------|---------|---------|
| Paw (cm H2O) | 41 ± 8 | 44 ± 7 | 41 ± 7 | 36 ± 5 |
| Fw (cm H2O) | 11 ± 3 | 17 ± 2 | 22 ± 1 | 30 ± 5 |
| PRC (ml) | 207 ± 90 | 422 ± 149 | 373 ± 173 | 432 ± 164 |
| Pao2 (kPa) | 10.5 ± 6.9 | 14.8 ± 9.4 | 15.1 ± 14.4 | 21.6 ± 13.3 |
| COx (%) | 39 ± 24 | 23 ± 12 | 23 ± 12 | 17 ± 15 |
| DO2 (ml/min) | 300 ± 120 | 344 ± 71 | 295 ± 75 | 263 ± 25 |

N = 10. Mean values ± SD. Letters in superscript refer to analysis of variance between ventilatory modes after lung injury. Values in overlapping 95% Tukey intervals have identical superscripts.

In this model, PCIRV did lead to substantial improvements in gas exchange and respiratory mechanics compared to conventional volume controlled PEEP ventilation. The effects seem to be mediated principally by decelerating flow in combination with increased inspiratory time. PCIRV allows not only for reduction in Paw and minute ventilation but also for a decrease in inspired oxygen fraction. Evidently, in the light of new knowledge concerning lung injury caused by high Paw, large tidal volumes and/or high inspired oxygen concentrations, the beneficial effects of PCIRV are important and need to be investigated further in clinical studies on ARF.

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INTEREST OF COMBINED HIGH FREQUENCY PERCUSSIVE VENTILATION DURING ACUTE RESPIRATORY FAILURE AFTER SMOKE INHALATION

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Smoke inhalation injury and bacterial pneumonia represent some of the most important causes of mortality in burn patients.

We described eleven severely burned patients (mean Burn Surface Area 49.7 ± 24.2%) with acute respiratory failure under conventional support (Dräger UV I-1:2 tidal volume 10 to 20 ml/kg) 8 to 32 hours after inhalation injury.

High frequency percussive ventilation (HPFV) is a recent ventilatory mode which combines advantages of conventional ventilation with some of high frequency ventilation: high frequency oscillations (300 to 900 cycles/min) are associated with conventional cycles.

Nine severely burned patients (mean Burn Surface Area 37 ± 12%) were studied after conventional ventilation (Dräger Evita) and under HPFV (at two different frequency rates: 600 and 900/min) (VDR 4 - Percussionnaire Corp. - USA) under constant FIO2 and for periods of one hour (measurements every 30 minutes) in steady state.

Under HPFV, hemodynamic data are not significantly modified (heart rate, cardiac index, pulmonary wedge pressure (PWP), central venous pressure (CVP) and mean arterial pressure (MAP)). Peak inspiratory pressure (PIP) and conventional ventilatory frequency (CVF) were significantly lower under HPFV; blood oxygenation (Pao2) and CO2 elimination were significantly improved after one hour under HPFV. The oscillatory frequency rates don't influence these constatations.

This observation suggests that HPFV represents a useful ventilatory mode which allows to ventilate at lower FIO2, and under lower ventilatory pressures with an excellent hemodynamic tolerance.

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EFFECTS OF HIGH FREQUENCY PERCUSSIVE VENTILATION ON HEMODYNAMICS AND BLOOD OXYGENATION IN CRITICALLY ILL PATIENTS

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This observation suggests that HPFV represents a useful ventilatory mode which allows to ventilate at lower FIO2, and under lower ventilatory pressures with an excellent hemodynamic tolerance.

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CICLIC VARIATIONS OF CO2-END TIDAL DURING VENTILATION WITH TWO LEVELS OF CPAP (BIPAP).

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In last year we have started to use the mechanical ventilation mode called BIPAP (Ventilation with two CPAP levels) as a method to ventilate and "weaning" patients. In this report we show the results of monitoring tidal volumes, expired CO2 and CO2-ET with this technique.

Twelve patients were included, 9 men and 3 women, whose mean age was 45 ± 8.4 years. The mean period under mechanical ventilation was 7 ± 3.2 days. The previous static compliance was 44 ± 18.3 ml/cm H2O.

The setting of the volumetric ventilator -EVITA, Dragger Corporation- was established as follows: P1 12, P2 38.1 ± 12.5, T1 6 seconds, T2 6 seconds. Expirated CO2 was measured with two capnographs: DATEX MODEL cd-101 and OHMEDA model OXICAP. Data are expressed as mean and standard deviation.

Results:

1.- The employment of BIPAP produced the following values of CO2-ET: With P1 27.6 ± 10.74 mm Hg was obtained and with P2 30.11 ± 12.54 mm Hg. The tidal volumes ranged with both pressures from 205 ± 93.1 ml to 259 ± 159.5 ml. The difference between paco2 and co2-ET was 9 ± 7.6.

Conclusions:

During mechanical ventilation with BIPAP mode, periodic changes are produced in CO2-ET in coincidence with the oscillations of pressures. Since the difference between paco2 and co2-ET are minimal, we think this parameter could become into a guide of the ventilatory situation of patients in weaning phase by BIPAP method.

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MONITORING MEAN AIRWAY PRESSURE DURING HYPERVENTILATION (Combined P29-CM2): How informing is it? 

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During clinical application of hybrid ventilation, (combined High Frequency Jet Ventilation/HFJV and Conventional Mechanical Ventilation-CMV), the main concerns are those of monitoring the altered intrapulmonary pressures (Pp) and intravascular pressures (Paco2). The HFJV Ventilator's safety control system is based on monitoring the mean airway pressure (Pm), which has been suggested as a reliable index of both Pp and Paco2. Methods: In order to test the hypothesis that the Pm is not an accurate monitor of Pp and Paco2 under variable conditions of low compliance(CL) and airway resistance(Rn), we studied in a lung model the effects of changes in CL and Rn, on Pm,Paco2 and Pp under constant ventilatory settings. We used the Fresenius Bronnwege Jet ventilator, the Drager OT-2 conventional ventilator and the Drager long simulators with an endotracheal tube Bi-lo Jet Muellerclift 8.0 mm ID, which incorporates ameans with a distal opening for measuring the airway pressures. Pm and Paco2 were recorded. The HFJV was set at a driving pressure of 40 psi. Inspiratory time and 100/80/min respiratory rate (RR). These settings were chosen as they resulted in a maximal jet P>300 mHg for a mean airway pressure (Pm)>10cmH2O. The CL was set at a flow of 11/sec, 6-8/ml tidal volume (TV)-50ml, and a PEEP. Our results showed that for C1<10cmH2O and Rn>100cmH2O/ml/sec, the maximal jet pressure was 350mHg and Pm=400mHg. The Pn increased up to 400mHg, are the Pp reduced down to 130mHg and Paco2 decreased to 10mmHg. On the contrary by decreasing the C1 from 100 to 15cmH2O the Pp increased up to 400mHg and Paco2 increased from 14 to 40mmHg. This study has shown that Pm is not a stable monitor of the intrapulmonary volumes and alveolar pressures during hybrid ventilation under conditions of variable CL and Rn.

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INFLUENCE OF PRESSURE LIMITED AND VOLUME LIMITED VENTILATION ON INTRACRANIAL PRESSURE IN HEAD INJURED PATIENTS

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Introduction:

Head injured patients with intracranial hypertension must be treated by intubation, respiratory support and sedation. Dramatic results in prevention and treatment of respiratory complications and ARDS were obtained by using pressure limited ventilation. This study compares the influence of pressure and volume limited ventilation on intracranial pressure (ICP) and cerebral perfusion pressure.

Patients and Methods:

18 patients admitted to ICU after a severe head injury (GCS<5), SAH (H&H IV-V) or ICH (Fishar 3-4) had a continuous and simultaneous monitoring of ICP and CPP. All patients were treated with intubation, sedation and mechanical ventilation. They were divided into two groups; (A) the initial respiratory support was a pressure limited ventilation (PLV) and (B) a volume limited ventilation (VLV). Every 24 hours the ventilation design was changed from PLV to VLV and vice versa, unless pulmonary complications made a PLV necessary. All patients were sedated.

In the long term follow-up there was no significant increase or decrease of ICP after the change from VLV to PLV (p>0.01) and vice versa. We measured ICP and CPP. Only immediately 1-3 hours after the change we show an increase of the maximum pressure border in PLV ICP there was an increase of about 20% in ICP which always became stabilized to the previous values within half an hour.

Conclusion:

A pressure limited ventilation does not induce a significant and persistent increase of ICP. Thus, all advantages of PLV may be gained even in neurotraumatized patients without influencing the most important monitoring parameter (ICP and CPP) in these patients.

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PRESSURE SUPPORT VENTILATION BY FACIAL MASK IN IMMUNOCOMPROMISED PATIENTS WITH RESPIRATORY FAILURE

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Immune compromised (IC) patients, with acute respiratory failure (ARF), require endotracheal intubation and mechanical ventilation (MV) 2 have a very poor prognosis. The aim of this prospective study was to evaluate the efficacy of a non invasive ventilatory assistance pressure support by means of a face mask (PSFM) in IC patients with ARF. Methods: ARF was defined by a respiratory rate (RR)>25/min and Pa02/F102<250 mmHg at room air or Pa02/F102<250 mmHg and PaCO2>50mm/Hg. Results: 19 IC patients (13 AIDS 6 neutropenics with hematological malignancies) were included in the PSFM group (PSFM) and 19 patients were not ventilated by PSFM (PSFM) in IC patients with ARF. METHODS: ARF was defined by a respiratory rate (RR)>25/min and Pa02/F102<250 mmHg at room air or Pa02/F102<250 mmHg and PaCO2>50mm/Hg. Patients were divided into two groups: (a) the initial respiratory support was a pressure limited ventilation (PLV) and (B) a volume limited ventilation (VIVAL). Every 24 hours the ventilation design was changed from PLV to VLV and vice versa, unless pulmonary complications made a PLV necessary. All patients were sedated.

In the long term follow-up there was no significant increase or decrease of ICP after the change from VLV to PLV (p>0.01) and vice versa. We measured ICP and CPP. Only immediately 1-3 hours after the change we show an increase of the maximum pressure border in PLV ICP there was an increase of about 20% in ICP which always became stabilized to the previous values within half an hour.

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A MORPHOLOGICAL STUDY OF PRESSURE CONTROLLED INVERSE RATIO VENTILATION IN OLEIC ACID INDUCED LUNG INJURY

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Pressure controlled inverse ratio ventilation (PCIRV) has been proposed as an alternative ventilatory technique in severe lung injury. In order to clarify the morphological effects of this ventilatory mode, it has been investigated in an animal model of acute respiratory failure (ARF). A morphological analysis supplemented by computerized tomography has been performed and PCIRV has been compared with conventional PEEP ventilation.

Six pigs (25 ± 2 kg) were anesthetized and mechanically ventilated. Lung injury was induced by injection of oleic acid (0.15 ml/kg) and became manifest within two h. Four ventilatory modes (volume control zero PEEP (VCZ 1:2), volume control zero PEEP/VCP 1:2, pressure control PEEP/E ratio 1:2 (VCZ 1:2)); volume control zero PEEP/E ratio 4:1 (VCZ 4:1) and pressure control zero PEEP/E ratio 4:1 (PCZ 4:1)) were employed in random order. Respiratory mechanics, gas exchange and central hemodynamics were measured and structure and density of the lungs studied by CT scanning (Somatom HX, Siemens Elema). A transverse scan just above the level of the diaphragm was obtained during four seconds in end-expiratory apnea. Mean density expressed as Hounsfield units (HU) and proportion of atelectatic and poorly aerated lung was then calculated. Venous admixture was strongly correlated to the magnitude of atelectatic lung regions (r=0.86). Mean density during VCZ 1:2 (316 HU) was approximately 40% of that registered during ventilation with VCZ 1:2 (369 HU), VCZ 4:1 (400 HU) and FCZ 4:1 (411 HU). No statistically significant differences between the latter three modes were observed. The proportion of poorly aerated regions (<200 to 100 HU) was about 14% with VCZ 1:2 and 30% in the other ventilatory modes. The quantity of atelectatic area (CT+100 to 100 HU) was 44% with VCZ 1:2 and considerably smaller with VCZ 1:2 (24%), VCZ 4:1 (29%) and FCZ 4:1 (32%). Thus, during VCZ 1:2, almost 60% of the lung area was poorly aerated or atelecatic. The three other modes resulted in superior aeration with corresponding percentages of 3% (VCZ 4:1) and 32% (PCZ 4:1). PCIRV led to a reduction in atelectasis and poorly aerated lung regions. These effects correlate to the magnitude of venous admixture and are of the same magnitude as seen with conventional PEEP ventilation and seem to be related to the presence of positive end-expiratory pressure.

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GAZOMETRIC, HEMODYNAMIC AND METABOLIC EVALUATION OF INTERMITTENT MANDATORY VENTILATION (IMV) AND PRESSURE SUPPORT VENTILATION (PSV). P. Matte, L. Jacquet, R. Ceriani, R. Geenen.

IMV and PSV are currently used techniques to wean patients from ventilator. A possible superiority of one mode has not been investigated, especially with regard to global oxygen consumption (V02). We studied 26 patients (pts), the day after coronary bypass surgery (CBS). For half the pts, ventilator was set at IMV 12/min, IMV 6/min, PSV 20 cm H2O and PSV 10 cm H2O with an end-expiratory pressure at 5 cm H2O and a I/E of 0.21. For the other half, ventilator setting were used in the reverse order. Hemodynamic data were collected with a thermoladiation Swan-Ganz catheter; oxygen consumption was measured by indirect calorimetry (Deltatrac-Datex). Results were as follows:

| Parameter          | IMV 12 | IMV 6 | PSV 20 | PSV 10 |
|--------------------|--------|-------|--------|--------|
| R.F. (breath/min)  | 12.5±1 | 16.3±4| 16.5±4 | 15.2±3 |
| Minute volume (1/min) | 3.23 | 3.95 | 3.34 | 3.41 |
| Tidal volume (ml)  | 88.1±6 | 13.95 | 11.53 | 10.00±0.10 |
| pH                 | 7.4±0.03 | 7.39±0.03 | 7.49±0.06 | 7.49±0.02 |
| pCO2 (mmHg)       | 36.2±34 | 38.1±14 | 32.9±7 | 37.3±8 |
| pO2 (mmHg)        | 68.4±23 | 64.8±23 | 55.1±4 | 50.8±4 |
| HR (beats/min)    | 142.8±11 | 133.5±12 | 135.5±12 | 138.2±12 |
| COP (mmHg)        | 10.6±17 | 113.5±16 | 113.5±16 | 113.5±16 |
| pCO2 (mmHg)      | 80.6±19 | 76.0±15 | 78.0±17.6 | 75.5±14.6 |
| V02 (ml/min/m2)  | 124.8±3 | 131.5±3.1 | 88.1±12 | 90.2±13.3 |
| VCO2 (ml/mirVm2)  | 1.5 | 1.5 | 1.5 | 1.5 |
| R.R./min          | 12.5±2 | 13.5±2 | 14.5±2 | 15.5±2 |
| pH                 | 7.40±0.04 | 7.43±0.05 | 7.47±0.09 | 7.47±0.09 |
| Pa02 mmHg         | 88.3±17 | 85.2±15 | 87.1±18 | 87.1±18 |
| p02 (mmHg)       | 98.8±19 | 94.1±19 | 93.1±17 | 93.1±17 |

Ventilation with a pressure support at 20 cm H2O is associated with a significant hyperventilation (hypocapnia, respiratory alcalosis and increased CO2 production) and a lower cardiac index. Oxygen consumption is also higher, especially if compared to IMV 12. IMV 6 and PSV 10 cm H2O have roughly the same metabolic and hemodynamic effects. High level of PSV should be avoided to weak patients from ventilator early after uncomplicated coronary surgery.

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INFLUENCE OF THREE LEVELS OF PRESSURE SUPPORT (PS) ON MEASURED V02 (VCO2) AND RESPIRATORY PARAMETERS. J. Waksler, L. Palavicino, A. Doumac, P.F. Laterrre, M. Reinaert

Spontaneous breathing with PS seems to be the best method of weaning. The aim of this randomized study is to compare the effects of three levels of PS (0-15, 30 cm H2O) on V02, pH, PaCO2, PaO2, Respiratory Rate (RR), Minute Ventilation (MV), Heart Rate (HR), and mean blood pressure (BP) in 20 patients during the weaning after abdominal surgery.

The results are reported on the table.

| Parameter          | P.S. 0 | P.S. 15 | P.S. 30 | P.S. 30 |
|--------------------|--------|---------|---------|---------|
| V02 (ml/min/m2)   | 157±26 | 142±23  | 142±21  | NS      |
| R.R./min          | 23.5±10| 18.7±7  | 13.9±5  | NS      |
| N.V./min          | 11.1±3 | 13.8±4  | 14.7±5  | NS      |
| PaCO2 (mmHg)      | 36.1±4 | 36.5±4  | 30.9±7  | NS      |
| pH                 | 7.40±0.04 | 7.43±0.05 | 7.47±0.09 | 7.47±0.09 |
| PaO2 mmHg         | 82.4±17 | 85.2±15 | 87.1±18 | 87.1±18 |
| H.R./min          | 94.8±19 | 94.1±19 | 93.1±17 | 93.1±17 |

At the level of 15 cm H2O of PS, a significant decrease in V02, RR and RR was observed. At level of 30 cm H2O, the same phenomenon was observed but in non significant way. The increase in MV produced a significant respiratory alkalosis.

Conclusion: In this study, the level of 15 cm H2O of PS seems to be optimal. The decrease in V02 could be the reflect of a reduced respiratory work. At a level of 30 cm H2O of PS, no complementary benefit is observed. Furthermore, respiratory alkalosis is often induced.

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EXTERNAL HIGH FREQUENCY OSCILLATION IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE. Sh. Spitzer, G. Fink

Experimental studies increasing ventilation by high frequency oscillation of the thorax demonstrated improved gas exchange during experimental bronchoconstriction. The Hayek oscillator (HO) is a relatively new modality of an external high frequency oscillation ventilator which controls both phases of respiration. We studied the effect of external high-frequency oscillation using the HO on 10 patients with severe COPD. The HO generated frequencies from 60 to 140 cycles/min at an amplitude of 36 cm H2O (-26 to +10) and at an I/E ratio of 1:1. The results show that the HO is a powerful ventilator, reducing PetCO2 by 8.2 to 9.1 mmHg and increasing oxygen saturation by 2 to 2.87% in the various frequencies. The rate of elimination of CO2 and the levels of PetCO2 achieved within a short time were far superior to those reported with other external ventilators. It was concluded that the HO can be effectively used in severe COPD and respiratory failure for:

1. The elimination of CO2 retention
2. Giving assisted ventilation, replacing intubation and conventional mechanical ventilation
3. Giving relief to fatigued muscles in short session use

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"ABNORMAL" FLOW, AIRWAY PRESSURE, AND CAPNOGRAPHY WAVEFORMS DURING NORMAL AIRWAY PRESSURE RELEASE VENTILATION

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Airway pressure release ventilation (APRV) is based on intermittent time-cycled release of continuous positive airway pressure (CPAP) to a lower pressure level. APRV augments ventilation by passive lung deflation from a baseline lung volume established by CPAP and is designed to allow unrestricted spontaneous breathing throughout the ventilator cycle. As a result extraordinary gas flow (V), airway pressure (Paw), CO2 concentration/(CO2) waveforms are observed during routine monitoring. This waveform may not be interpreted correctly by monitors or by physicians not familiar with APRV. This study describes such "abnormal" V, Paw, and CO2 waveforms observed during uncomplicated APRV.

Ten pigs weighing 25-30 kg, were anesthetized with pentobarbital (7 mg/kg/h), and then tracheotomized. The pigs remained in the supine position and spontaneous breathing was augmented by APRV using a commercial available ventilator (PPG, IRSA). Gas flow was measured with a pneumotachograph between the endotracheal tube and the ventilator's Y-piece. Paw and CO2 fractions were measured at the endotracheal tube. All signals were sampled by an A/D board installed in a computer (IBM P/S2 70) operating under custom designed software. Digitized signals were stored in real-time for computer-aided off-line analysis. To study V, Paw, and CO2 pattern during different APRV settings, CPAP varied from 5 to 15, release pressure was 0 cm H2O. Release time varied from 1 to 2 s, CPAP time from 2 to 4 s.

The figures show examples of "abnormal looking" V, Paw, and CO2 waveforms recorded during APRV. Fig. 1 shows spontaneous breathing during the CPAP release period that is merged with CPAP restoration. Fig. 2 shows CPAP restoration immediately followed by a spontaneous breath. In both cases the presence of two major expiratory flow waves (e, e') for each inspiration (i) is noticeable. First expiratory flow (e) is due to CPAP release, the second (e') results exclusively from expiration of a tidal volume due to spontaneous breathing. The inspiratory flow wave (i) combines spontaneous inspiration and CPAP restoration components.

Figs. 1-2

"Abnormal" V, Paw, and CO2 waveforms are frequent observed during normal APRV. These waveforms provide important clinical information, but differentiation of mechanical and spontaneous components may not be easy for unexperienced clinicians and respiratory monitors. Knowledge of what is, and is not normal, is necessary for appropriate application and monitoring of APRV.

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A STUDY OF THE DETERMINANTS OF CENTRAL VENOUS CO2 TENSION (PvCO2) IN SEPSIS. I. Giovannini**, C. Chiarla*, G. Boldrini**, M. Castagneto*.

Data from 260 measurements in 72 critically ill septic pts were used to assess determinants and correlates of PvCO2. Arterial and central venous blood gas analyses were associated with determination of pulmonary shunt (Qs/Qt), ventilation/perfusion ratio (Va/Qr), O2 consumption (VO2), respiratory quotient (RQ), cardiac index (CI), O2 extraction (O2Ex) and other indices. Venousarterial CO2 concentration difference (v-aDCO2, ml/100ml) was calculated by an original model (Perspectives in Critical Care 2:139, 1989) with the specific quantification of its Haldane component (HALD = O2 - linked CO2 exchange, % of total v-aDCO2).

Regression analysis showed that arterial CO2 tension (PaCO2) was the main determinant of PvCO2 and explained 90% of its variability (r2= 0.9, p < 0.0001). At any given PaCO2, PvCO2 was principally set by HALD, v-aDCO2 and central venous pH, which explained together 89% of the variability of the PvCO2-PaCO2 gradient (meq/l): (PvCO2-PaCO2) = 38.1/HALD+1.5(v-aDCO2)-8.6(pH) (r2= 0.89, p < 0.0001). HALD was inversely related to Va/Qr and RQ, directly related to VO2, O2Ex and CI, and showed a complex relationship to Qs/Qt. Changes in Va/Qr, RQ and VO2 explained together 80% of the variability of HALD (r2= 0.89, p < 0.0001). The level of PvCO2 depends on PaCO2 and on the balance between CO2 exchange and transport, which may be affected by metabolic acidosis, changes in CO2-binding properties of blood, and specific cardiopulmonary interactions. This is relevant for defining the correct implications of altered PvCO2 levels in clinical settings.

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COMPARISON OF HEMODYNAMIC AND OXYGEN TRANSPORT RESPONSE TO HASTASTARCH AND MODIFIED FLUID GELATIN IN CRITICALLY ILL PATIENTS

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The effects of rapid (< 10 minutes) infusion of 500mls of modified fluid gelatin (group A) or hydroxethylated starch (group B) were compared in a prospective non-randomized, non-crossover study of patients suffering from acute hypovolemia whilst being mechanically ventilated for acute respiratory failure on an intensive care unit. Haemodynamic and oxygen transport variables were determined at baseline, 15 minutes and 30 minutes, in summary, in both groups there were significant increases in pulmonary artery wedge pressure, stroke volume and cardiac index. In neither group did heart rate decrease. In group A oxygen delivery increased but in did not in group B. This was due to greater haemodilution in group B.