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Title
RESPIRATORY AND HEMODYNAMIC EFFECTS OF NO DURING ACUTE FAILURE OF CHRONIC RESPIRATORY INSUFFICIENCY

Authors JN. DRAULT, F. SAULNIER, N. BELLO, A. DUROCHER

The vasodilator effect of breathing NO on the arterial pulmonary circulation is well known in many cases of arterial pulmonary hypertension. The aim of this study is to evaluate the respiratory and hemodynamic effects of NO in patients with chronic obstructive pulmonary disease (COPD) and acute respiratory failure (ARF)

Patients and methods : 9 patients (mean age 62±10 years) with COPD and pulmonary hypertension are studied. They have ARF and controlled ventilation. Respiratory and hemodynamic data are collected before NO inhalation after 15 minutes of NO inhalation (40 ppm) and 30 minutes after the end of NO breathing. Statistic analysis use ANOVA.

Results :

	Before NO	During NO	Control after NO	
$\overline{PAP}$ (mmHg)	31±8	25±7*	31±7	*
CI (l.min-1.m-2)	4,7±1	4,8±0,8	4,6±1	p<0,05
PVR (Dyn.sec.cm-5.m-2)	385±124	288±115*	398±142	
SVR (Dyn.sec.cm-5.m-2)	1567±370	1548±345	1586±358	
RVEF %	36±9	40±10*	35±9	
P. peak. (mBar)	35±10	32±10*	34±11	
PaO2 (mmHg)	98±16	84±11*	95±21	
PaCO2 (mmHg)	37±16	34±5	34±4	
QS/QT (%)	16±10	22±9	18±9	

$\overline{PAP}$: mean pulmonary arterial pressure - CI : cardiac index - PVR : pulmonary vascular resistances - SVR : systemic vascular resistances - RVEF : right ventricular ejection fraction - Ppeak : peak airway pressure

Conclusion : Inhalation of 40 ppm of NO during ARF of COPD has a pure arterial pulmonary vasodilator effect with an improvment of right ventricular function. There was a small bronchodilator effect. There was a decrease of PaO2 and VA/Q mismatching probably due to excessive arterial pulmonary vasodilatation in patients whose previous hypoxemia was corrected by controlled ventilation.

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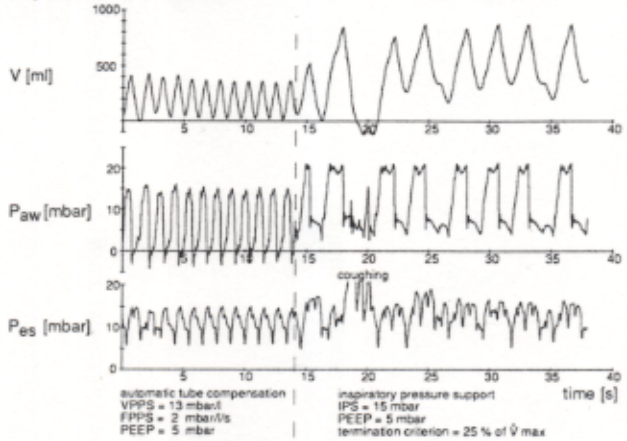
TREATMENT OF PATIENT-VENTILATOR-DESYNCHRONISATION WITH AUTOMATIC TUBE COMPENSATION (ATC) AND PROPORTIONAL ASSIST VENTILATION (PAV)

B. Fabry, J. Guttmann, L. Eberhard, G. Wolff

Patient-triggered inspiratory pressure support (IPS) is a popular mode for assisting spontaneous breathing. In weaning patients with respiratory failure using IPS, we found, however, that more than 50 % of the patients displayed desynchronisation, i. e. the ventilator did not detect and consequently did not support all the patients' efforts to breathe. The reasons for desynchronisation are 1) a prolonged ventilator response delay (e. g. due to trigger mechanisms), 2) an imperfect criterion for the termination of pressure support, and 3) dynamic hyperinflation (e. g. due to expiratory flow limitation). Reasons 1) and 2) can be rectified with Proportional Assist Ventilation (PAV). Expiratory flow limitation can be reduced with a mode compensating for the flow-dependent resistance of the endotracheal tube. We combined PAV with ATC in a modified demand flow ventilator and applied this mode in a patient displayed desynchronisation. Under IPS the respiratory rate measured at the ventilator was 20/min, however, the patient attempted to breathe 50/min. Under PAV with ATC each breathing effort was supported by the ventilator. The figure shows volume, airway pressure and esophageal pressure of this patient in both modes.



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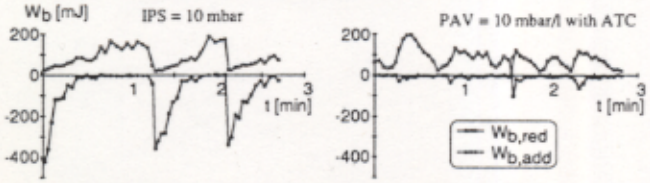
ADDITIONAL AND REDUCED WORK OF BREATHING UNDER AUTOMATIC TUBE COMPENSATION (ATC) WITH PROPORTIONAL ASSIST VENTILATION (PAV)

B. Fabry, J. Guttmann, L. Eberhard, G. Wolff

Background: In weaning patients from mechanical ventilation, patient-triggered Inspiratory Pressure Support ventilation (IPS) is commonly used. Several methods have been documented on how to find the optimal level of inspiratory pressure support. **Problem:** The flow-dependent resistance of the endotracheal tube (ETT) can seriously hinder inspiration and expiration. The pressure drop across the ETT (ΔP_{ETT}) can be larger than the IPS causing additional ventilatory work. **Methods:** To compensate for the resistance of the endotracheal tube during inspiration and expiration we modified a demand-flow-ventilator as follows. 1) Tracheal pressure (P_{trach}) was calculated at a rate of 500 Hz by measurement of flow and pressure at the outer end of the ETT and using coefficients describing the flow-dependent ETT resistance. 2) The calculated tracheal pressure was then fed into the ventilator which then controlled tracheal pressure at a target tracheal pressure. With our modified ventilator we were able to apply a volume Proportional Assist Ventilation (PAV) of the tracheal pressure (ATC with PAV). **Investigation:** In 10 intubated patients breathing spontaneously under IPS and ATC with PAV, we determined additional and reduced work of breathing from pressure difference between measured P_{trach} and PEEP. Additional work arises if P_{trach}<PEEP: $W_{b,add} = \int (P_{trach}\text{-PEEP})dV$; and the patient's work of breathing is reduced if P_{trach}>PEEP: $W_{b,red} = \int (P_{trach}\text{-PEEP})dV$. **Results:** During IPS, enormous additional work can arise, depending on the breathing effort of the patient. Unfortunately, reduced work decreases with increasing breathing effort. During ATC with PAV, reduced work increases with increasing breathing effort. Additional work remains negligible. The figure gives an example of a patient (intubated with an ETT of 7.5 mm ID) who displayed variable breathing effort. **Conclusion:** ATC with PAV is a suitable mode for avoiding additional work of breathing, especially in patients with variable or high breathing effort.



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EFFECT OF AIRWAY PRESSURE REDUCTION ON EXTRAVASCULAR LUNG WATER

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Ventilation with high peak airway pressures (Peak-AP) can produce severe respiratory deterioration, with an increase in extravascular lung water (EVLW). It is therefore possible that mechanical ventilation with high pressures can contribute to lung damage in patients with Adult Respiratory Distress Syndrome (ARDS). This deterioration will often not be recognised, due to the severe pulmonary injuries that these patients already have.

OBJETIVE: To determine if a reduction of over 20% in peak airway pressure (Peak-AP) can affect the volume of EVLW.

MATERIAL AND METHODS: 31 patients on mechanical ventilation and who meet the usual criteria for Adult Respiratory Distress Syndrome (ARDS). The study was performed within the first 72 hours after the diagnosis of ARDS. The patients' EVLW was determined in two situations, 1) during controlled mechanical ventilation with positive end expiratory pressure (CMV-PEEP), and 2) 6 hours after reducing the Peak-AP by at least 20% using inverse I/E ratio of 2/1 (IRV-2/1). EVLW was determined by double dilution method.

RESULTS: The study was abandoned in 9 patients for various reasons. In the 22 patients that completed the procedure, the Peak-AP fell from 48.4 ± 9 cmH_2O during CMV-PEEP to 36.3 ± 9 cmH_2O during IRV-2/1 ($p<0.001$), while the EVLW was similar in both situations, 17.2 ± 4.1 ml/kg during CMV-PEEP, and 16.9 ± 4.5 ml/kg during IRV-2/1. Cardiac output, pulmonary artery pressure, systemic artery pressure and PaO2/FiO2 ratio showed no variations on changing the ventilation pattern.

CONCLUISION: The reduction of Peak-AP over 6 hours in patients with ARDS produced no significant changes in EVLW.

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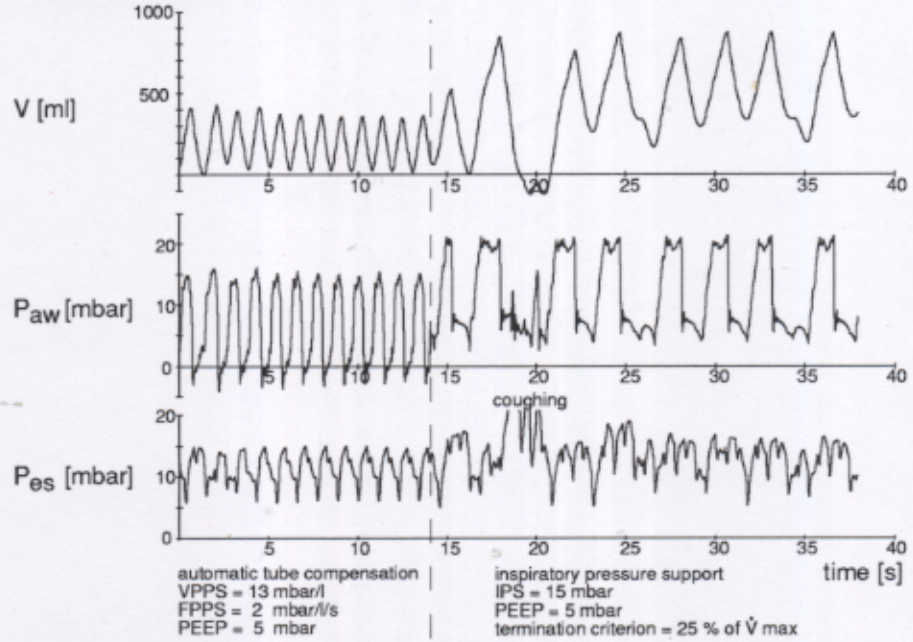

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