Intensive Care Med (2014) 40:1390–1391
DOI 10.1007/s00134-014-3378-5

LETTER

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Effect of noninvasive proportional assist vs pressure support ventilation on neuroventilatory coupling in chronic obstructive pulmonary patients with hypercapnia

Accepted: 16 June 2014
Published online: 27 June 2014

Electronic supplementary material
The online version of this article (doi:10.1007/s00134-014-3378-5) contains supplementary material, which is available to authorized users.

Dear Editor,

Proportional assist ventilation (PAV) is a ventilated mode that provides the tidal volume (Vt) according to the patient's instantaneous ventilation demand, which may enhance comfort [1]. It has been suggested that a healthy subject's neuroventilatory coupling [the ratio between minute ventilation (VE) and neural respiratory drive] is better preserved with PAV, in comparison to pressure support ventilation (PSV) [2]. However, this theory has never been tested in patients with abnormal neuroventilatory coupling.

It is known that chronic obstructive pulmonary disease (COPD) patients suffer from dyspnea associated with impaired neuroventilatory coupling [3]. Compared with healthy subjects, patients with COPD have a much lower neuroventilatory coupling value (VE/RMS %) [4].

Interestingly, we find that patients with very severe COPD seem to prefer noninvasive PSV. Therefore, it is necessary to investigate this problem by comparing the effect of noninvasive PSV and PAV on neuroventilatory coupling of COPD.

Thirteen patients with very severe COPD and suffering from hypercapnia affected by exacerbation were recruited consecutively.

Neural respiratory drive was assessed by diaphragm electromyogram (EMGdi) recorded from a multipair esophageal electrode catheter, which is a reliable technique that has been recently used [4]. Raw signals of EMGdi were converted to root mean square (RMS), which is the index of the total of EMGdi power [5]. EMGdi was normalized to the largest value obtained from maximal maneuvers (RMS %) [4].

The ventilation was delivered by the same ventilator which can operate in noninvasive PSV and PAV (BiPAP Vision; Respironics USA); the "runaway" method was used to set volume assist (VA) and flow assist (FA), as described by Younes et al. [1]. The level of assistance applied was chosen to ensure the patient's comfort. A default level of 4 cmH_2O of expiratory positive airway pressure (EPAP) was applied to both modalities in each patient.

This was a controlled, randomized, cross-over study. After the baseline assessment of unassisted spontaneous breathing (SB), mask PAV and PSV were applied in random sequence, for 20 min each, with about a 10-min interval of SB between periods of assisted ventilation. Tidal volume (Vt), respiratory rate (RR), airway pressure, and EMGdi were measured. At each period the patient scored their dyspnea sensation with an arbitrary scale ranging from 0 (worst) to 10 (best).

The leaks were monitored on a computer screen during the procedure. No visible leak was detected.

Further details can be found in the electronic supplementary material.

Paired *t* tests were used to examine the difference of measured parameters during SB, PAV, and PSV (SPSS 13.0 software package). A *p* value less than 0.05 was considered significant.

Significant differences were observed in dyspnea score (PSV 7.46 ± 1.13 vs PAV 5.92 ± 0.95, $P < 0.01$) and the neuroventilatory coupling (VE/RMS %) between PSV and PAV (PSV 1.19 ± 0.58 L/% vs PAV 0.51 ± 0.21 L/% $P < 0.01$) (Table 1).

The most interesting finding is that the neuroventilatory coupling (VE/RMS %) during PSV is similar to that of a healthy subject during SB as reported by Luo et al. [4] (PSV 1.19 ± 0.58 L/% vs healthy 1.0 ± 0.7 L/% [4]). We speculate that the preference for noninvasive PSV may be related to sufficient improvement of the impaired

Table 1 Breathing pattern, mean peak airway pressure and the neuroventilatory coupling (VE/RMS %) with SB, noninvasive PAV and PSV

	Vt (mL)	RR (bpm)	Mean P_{peak} (cmH_2O)	VE/RMS % (L/%)
SB	466 ± 138	21 ± 3		0.29 ± 0.12
PSV	563 ± 96*	19 ± 3	16 ± 2	1.19 ± 0.58**
PAV	533 ± 102	18 ± 4	$13 \pm 3^{\Delta}$	$0.51 \pm 0.21^{\Delta}$

The data are presented as mean ± SD. VE = Vt × RR
Vt tidal volume, *RR* respiratory rate, *SB* spontaneous breathing, P_{peak} peak airway pressure, *VE* minute ventilation, *RMS* root mean square, *PAV* proportional assist ventilation, *PSV* pressure support ventilation
* $P < 0.05$, ** $P < 0.01$ PSV or PAV vs SB
$^{\Delta}$ $P < 0.01$ PSV vs PAV

neuroventilatory coupling in COPD patients.

The impaired neuroventilatory coupling of COPD patients with hypercapnia is significantly improved by noninvasive PSV compared with PAV.

Conflicts of interest All authors have no conflicts of interest to disclose and all made substantial contributions to the work.

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