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REVIEW

Proportional assist ventilation versus conventional synchronized intermittent mandatory ventilation in chronic obstructive pulmonary disease



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KEYWORDS

Proportional assist ventilation;
Synchronized intermittent mandatory ventilation;
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Abstract *Background:* Proportional assist ventilation (PAV) is a physiological ventilation mode with better patient ventilator synchrony. However its role in intubated patients with chronic obstructive pulmonary disease (COPD) is still not well defined.

Objective: To evaluate the efficacy of PAV mode in intubated patients with COPD exacerbation in comparison with conventional synchronized intermittent mandatory ventilation (SIMV) mode.

Patients & methods: Fifty COPD patients presented with hypercapnic respiratory failure who are intubated and ventilated were recruited to the study. After 12 h of assist-control ventilation, 25 patients shifted to SIMV mode (group 1) while the other 25 patients shifted to PAV mode (group 2). Vital signs, gasometric and mechanical parameters, duration of ventilation and intensive care unit (ICU) stay were measured.

Results: The successful outcome was achieved in 76.0% in group 1 versus 72.0% in group 2. Significant improvement in vital signs, gasometric and mechanical parameters was observed in all patients. Comparison between the two groups after 24 h of ventilation showed significantly higher values in the PAV group for respiratory rate, heart rate, and systolic blood pressure ($P < 0.001$). Significantly lower pH ($P < 0.01$), higher partial arterial carbon dioxide pressure (PaCO_2) ($P < 0.001$), significantly lower tidal volume, peak inspiratory pressure, auto-positive end expiratory pressure (auto-PEEP), missing efforts, inspiratory time over total time (Ti/Ttot), shorter duration of ventilation and ICU stay were observed in the PAV group ($P < 0.01$ for each).

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Conclusion: PAV can maintain improvement of clinical, gasometric and ventilator parameters in intubated COPD patients with the advantages of shorter duration of ventilation and hospitalization compared with SIMV.

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Introduction

Synchronized intermittent mandatory ventilation (SIMV) is a ventilation mode in which the ventilator breaths are synchronized with patient inspiratory effort [1]. SIMV, with and without pressure support has not been shown to have any advantages over continuous mandatory ventilation (CMV) as regards mortality [2] or weaning success [3]. Moreover, it has been shown to result in longer weaning times when compared to t-piece trials or gradual reductions in pressure support [4]. Some studies have shown an increase in patient work of breathing when switched from CMV to SIMV [5,6], and others [7] have demonstrated that SIMV mode has potential detrimental effects on respiratory drive and respiratory muscles.

Proportional assist ventilation (PAV) is a new mode of assisted ventilation which, reduces the inspiratory effort needed to overcome respiratory system elastance (Ers) and resistance (Rrs), by applying pressure in proportion to volume (volume assist, VA) and flow (flow assist, FA) [8]. Thus, it should be possible to reduce the elastic and resistive work of breathing performed by the patient [9]. Through, unloading the respiratory muscles PAV mode returns the relationship between the inspiratory effort and ventilatory output (i.e. volume and flow) back toward normal [10]. This would be beneficial in certain circumstances where respiratory impedance is increased (restrictive or obstructive lung disease) as well as conditions where the ability of the respiratory muscles to generate pressure is impaired (neuromuscular disease).

In comparison with other forms of assisted ventilation, PAV is considered the unique mode that can regulate the amount of ventilatory support provided in proportion to the identified abnormalities in respiratory function without affecting the breathing pattern [11]. Therefore, it is more physiological and improves patient ventilator synchrony. However its role in intubated patients with acute exacerbation of chronic obstructive pulmonary disease (COPD) is assessed in few studies and not well identified.

Patients and methods

Fifty patients with acute exacerbation of COPD with hypercapnic respiratory failure and respiratory acidosis were included in the study after failure of a trial of non-invasive ventilation. Written consent was taken from the patients' relatives. They underwent endotracheal intubation (ETI) and received invasive mechanical ventilation via Puritan Bennett, 840 ventilator (Tyco, Gosport, UK) in a tertiary hospital in the period from November 2011 to January 2013.

Volume assist-control mode (AC) was adjusted to all patients. After 12 h on AC, those patients were classified into two groups: group 1 (G1) 25 patients shifted to SIMV volume control mode and group 2 (G2) 25 patients shifted to PAV mode. Both groups were matched as regards age, sex, body mass index (BMI) and pre-morbid FEV1.

The following settings were adjusted in SIMV: tidal volume (VT) 8 mL/kg; respiratory rate (RR) 8–10 breath/min; peak inspiratory flow 60 L/min; adjust flow wave form to square form; inspired oxygen fraction (FiO₂) is adjusted to obtain oxygen saturation by pulse oximetry (SpO₂) >90%; positive end expiratory pressure (PEEP) 5 cm H₂O. Pressure support (PS) is adjusted to equal plateau pressure minus PEEP value to avoid fluctuation in positive pressure when shifted from mandatory to spontaneous breaths.

The following settings were adjusted in PAV mode: Volume assist (VA), flow assist (FA), and % of set that was adjusted at 80% of set VA and FA and decreased to 50% after 24 h. VA and FA corresponded elastance and resistance respectively. Elastance and resistance calculated automatically; FiO₂ was adjusted to obtain SpO₂ >90%; PEEP is set to 5 cmH₂O. In both groups, the following parameters were monitored and recorded after 2, 6, and 24 h ventilation: Heart rate (HR), systolic blood pressure (BP), RR, VT, minute ventilation (VE), peak airway pressure, missing efforts, auto-PEEP, and arterial blood gases (ABGs). Auto-PEEP was measured by using the expiratory pause button of the ventilator during SIMV. On the other hand, in the PAV group we shifted to volume control

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