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Mini Review

Non-invasive Ventilation in Acute COPD Exacerbation: Pressure Support Versus Volume Assured Pressure Support Modes

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Abstract

The purpose of this review is to analyse the use of conventional pressure control ventilation (BiPAP S/T) versus average volume-assured pressure support ventilation (AVAPS and iVAPS in acute hypercapnic respiratory failure due to COPD exacerbation in the light of current research. Although intelligent or hybrid modes seem not to be superior to pressure control non invasive ventilation in COPD exacerbation, there are however some groups (COPD- obstructive sleep apnea overlap syndrome, patients with COPD and morbid obesity) that could benefit. As most data are on chronic respiratory failure more clinical trials are required in this direction.

Keywords: *Acute Exacerbation of COPD (AECOPD); Pressure Control Mode; Pressure Assured Control Modes; iVAPS; AVAPS*

Introduction

Chronic obstructive pulmonary disease (COPD) is a prevalent and debilitating respiratory condition with an important mortality, being ranked as the 4th leading cause of death worldwide [1-3]. Exacerbations (AECOPD) are acute events that appear in the natural history of COPD contributing to its high mortality [1]. Data show that 2.5% up to 24.5% of AECOPD patients die during hospitalisation and up to 8% in the following month after discharge [4]. In patients with severe exacerbation, with hypercapnic respiratory failure and respiratory acidosis (ph: 7.25- 7.35) noninvasive ventilation is a well established therapy, alongside optimal medical and oxygen therapy. It has been shown to reduce intubation rate, hospital length of stay and hospital mortality [5,6]. Current evidence supports the use of pressure control or pressure support modes in acute respiratory failure due to COPD exacerbation [5-7]. As 20% of patients are intubated requiring invasive mechanical ventilation with the associated risks, other modes have been evaluated in order to prevent treatment escaladation [7]. The purpose of this review is to analyse the use of pressure control ventilation versus hybrid/intelligent ventilation modes [average volume-assured pressure support (AVAPS) and intelligent volume-assured pressure support (iVAPS)] in acute hypercapnic respiratory failure due to COPD exacerbation in the light of current research. Bilevel positive airway pressure spontaneous/timed mode (BiPAP S/T) is a pressure control ventilation mode where the ventilator applies a fixed level of pressure (within a range of minimum and maximum of IPAP settings) and has a back up rate and a fixe inspiratory time [4]. Once breath is initiated, pressure rises depending on the settings to a pressure plateau where it is held for the duration of inspiration. When inspiratory flow falls below a certain level, usually 25% of peak inspiratory flow that marks the end of inspiration. Therefore is the patient that determines respiratory frequency and timing of each breath. If the patient fails to make the required respiratory efforts the ventilator sets in and completes the respiratory rate. Tidal volume is variable from breath to breath [4,8]. Volume assured pressure support modes (iVAPS and AVAPS) are new spontaneous dual modes using

closed loop technique to obtain targeted tidal volume or alveolar ventilation by adjusting pressure support from one respiratory cycle to other [8]. Average volume-assured pressure support (AVAPS) maintain a tidal volume equal to or higher than the targeted tidal volume by changing pressure support with every breath between the minimum and maximum IPAP settings. As it averages tidal volume over several minutes, it can adjust the pressure support in function of the patient's efforts. If patient effort decreases, AVAPS will increase, increasing tidal volume; if patients' effort increases AVAPS will decrease [6,8]. Intelligent volume-assured pressure support (iVAPS) targets the alveolar ventilation by estimating the dead space using patients' height [6]. By targeting alveolar ventilation, iVAPS maintains ventilation according to the patient's metabolic needs, decreasing the risk of inefficient ventilation with changing respiratory rate [5]. iVAPS seems to be more physiological and adapted to the mechanism of acute respiratory failure in COPD (alveolar hypoventilation). This leads to impaired removal of carbon dioxide and consequently, hypercapnia. Hypercapnia, decreases the ratio between bicarbonate ions (HCO_3^-) and arterial carbon dioxide ($PaCO_2$), leading to acidaemia. There is however a limitation of this modes. In patients with lung disease in general, and COPD in particular dead space is increased and it's bigger than that estimated by the height. Even more, if patient tidal volume is higher than the targeted one the support is reduced [6].

Intelligent ventilation modes are used for some years now in chronic conditions and in certain subgroups (restrictive disorders) have been prove to be superior to conventional pressure-support NIV [10]. In stable COPD existing data are inconsistent. While there are some studies that found no relevant improvements in prognosis, others reported small improvements in prognosis together with improved quality of life [8].

In acute COPD exacerbation hybrid modes seem to have some benefices compared with conventional nonnvasive ventilation, but more data are required. In 2013, Briones and colab [8] comparing benefits of using NIV with AVAPS versus conventional NIV in acute hypercapnic respiratory failure found a statistically significant difference in patients from VAPS group in terms of consciousness, $PaCO_2$ levels and peak inspiratory positive airway pressure. Nevertheless there were no significant differences in terms of length of hospital stay or NIV duration between the 2 groups. Hussien, in a prospective randomized controlled trial revealed that the intelligent ventilation mode (iVAPS) was not inferior to standard PS ventilation when considering improvement of respiratory rate, pH, hypercapnia, and oxygenation [7]. We have to consider though, that in first study the patients were with hypercapnic encephalopathy, therefore with higher $paCO_2$ values which could explain the significant difference in analyzed parameter. In the Hussien study patients had lower $paCO_2$ value, therefore less severe. Shaaban et al concluded in their ERS Congress presented research [11] that patients ventilated with AVAPS showed more rapid and steady improvement of clinical parameters and less duration on NIV [11]. All studies had small number of patients.

In our experience, NIV- pressure controlled- BIPAP ST in the first choice in acute hipercapnic respiratory failure with respiratory acidosis secondary to COPD exacerbation. We switch to hybrid modes (AVAPS) if the patient does not tolerate the ventilator or if it does not improve clinically. NIV with AVAPS is the first choice in AECOPD in patients with either sleep apnea or morbid obesity where in our opinion is superior to conventional non invasive ventilation. In the end, our feeling is that the best ventilation mode, considering the international recommendations, is the one that you are familiar with as experience is a key factor in NIV success. We use iVAPS, we good results in stable restrictive patients (neuromuscular or thoracic cage deformation) not in acute exacerbation.

Conclusion

As a conclusion, although intelligent modes have not be demonstrated to be superior to classic NIV COPD exacerbation, worth a trial in certain situation as it could provide a better adaptation to the patient's own ventilatory pattern and needs, which vary.

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