



# Non-invasive positive pressure ventilation with average volume assured pressure support may benefit patients with acute hypercapnic respiratory failure

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## INTRODUCTION

Acute respiratory failure is a commonly encountered entity in the emergency department and intensive care unit. Non-invasive positive pressure ventilation (NIPPV) has dramatically changed the management of acute respiratory failure, particularly when chronic obstructive pulmonary disease (COPD) or congestive heart failure is the underlying etiology.<sup>1,2</sup> In the case of hypercapnic respiratory failure due to COPD, the NIPPV augments the ability of the patient to ventilate by assisting with the work of breathing and therefore increasing tidal volume and ensuring a minimum respiratory rate. Traditional settings for a bilevel positive airway pressure ventilator (BPAP) include an inspiratory positive airway pressure (IPAP) and an expiratory positive airway pressure. Adjustments in the IPAP change the tidal volume delivered for a given breath. The difference between IPAP and expiratory positive airway pressure is the driving pressure, which, in combination with respiratory rate, determines a patient's ventilation. The limitations of this device are that it requires frequent attention from the physician or respiratory therapist in order to assure that a patient has an adequate tidal volume. Factors that may influence adequate tidal volumes are dynamic and include level of consciousness, position, and lung compliance. If any of these factors change during a patient's hospital course, it may reduce the tidal volume and thus ventilation, which can be deleterious to the patient if unrecognized or underrecognized.

## BPAP WITH AVERAGE VOLUME ASSURED PRESSURE SUPPORT VERSUS TRADITIONAL BPAP

A potential solution to these problems is BPAP with average volume assured pressure support (AVAPS). While traditional BPAP requires the operator to set a pressure and time with volume as the dependent variable, BPAP with AVAPS allows the operator to set a desired volume and time with pressure as the dependent variable. The ventilator achieves this by administering breaths with increasing pressure until the desired tidal volume is achieved. A pressure limit can be set, which is typically 20 cm H<sub>2</sub>O, as higher pressures are more likely to overcome the lower esopha-

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geal sphincter and result in vomiting and aspiration. In the case of hypercapnic respiratory failure secondary to COPD, this has the advantage of ensuring a driving pressure without further operator input despite dynamic clinical circumstances.

## BPAP WITH AVAPS IN HYPERCAPNIC ENCEPHALOPATHY

BPAP with AVAPS has been shown to improve the overall functionality of patients with chronic hypercapnic respiratory failure.<sup>3</sup> In the acute setting, BPAP with AVAPS may be most useful in treating COPD exacerbation and hypercapnic encephalopathy. This mode may be ideal for this patient population as it would not require the same level of monitoring in order to ensure a given tidal volume is administered, and would not need to be adjusted by the practitioner if the patient had a change in the ability to participate in the respiratory effort. Furthermore, if ventilation remains adequate for this disease process, it will resolve the encephalopathy, and the patient will recover the ability to participate actively in the respiratory process. One small study of 22 patients with COPD and hypercapnic encephalopathy demonstrated more rapid improvement in Glasgow Coma Scale (GCS), carbon dioxide (CO<sub>2</sub>), and respiratory rate when using BPAP with AVAPS compared to traditional BPAP started in the emergency department or intensive care unit.<sup>4</sup> Further, several abstracts have shown a reduction in days on NIPPV, days of hospitalization, and treatment compliance using BPAP with AVAPS compared with traditional BPAP settings.<sup>5,6</sup> Whether the use of BPAP with AVAPS reduces the progression to mechanical intubation when compared to patients on traditional BPAP settings has yet to be investigated.

## CONCLUSION

The advent of NIPPV has had a dramatic impact on the management and outcomes of patients presenting to the hospital with acute COPD and congestive heart failure exacerbations. While the use of traditional BPAP settings should be applied to the broadest

swathe of such patients, BPAP with AVAPS may more rapidly reverse pure hypercapnic encephalopathy.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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