Comparison of two differing modes of non-invasive ventilation (NIV) in patients with an acute exacerbation of chronic obstructive pulmonary disease

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Background

Non-invasive ventilation (NIV) has been shown to improve gas exchange in patient with acute type II respiratory failure (TIIRF) secondary to COPD. Although spontaneous/timed (S/T) non-invasive ventilation is commonly used to manage hypercapnic respiratory failure in patients with COPD, this mode of ventilation requires multiple manual adjustments to optimise pressure settings. Average volume assured pressure support (AVAPS) mode allows clinicians to set a fixed tidal volume (based on patient's ideal body weight), and the device makes automatic adjustments to inspiratory pressure to ensure that the predefined target tidal volume is met.

Figure 1: A patient receiving AVAPS. Image available at http://www.philips.com/cdam/corporate/newscenter/global/standard/resources/healthcare/2017/trilogy/Trilogy.jpg)

Aim

To determine the effects of spontaneous/timed (S/T) and average volume assured pressure support (AVAPS) non-invasive ventilation modes on pH, $PaCO_2$ and hospital length of stay (LoS) in patients with Type II respiratory failure secondary to acute exacerbation of COPD.

Methods

The project was registered as an audit at the Royal Free Hospital London NHS Foundation Trust and, therefore, patient consent was not required. Approval to perform the data collection for this project was granted by the hospital's research and development department. Data protection procedures were followed (Data Protection Actz., 1998). Patient data were anonymised at source. Data were collected from all patients admitted to a London foundation trust, with type II respiratory failure (TIIRF) secondary to acute exacerbation of COPD (AECOPD) between September 2015 to December 2016. Between September 2015 and March 2016, patients received S/T ventilation, while patients from March 2016 onwards received AVAPS. Incomplete datasets were excluded, as were patients admitted to intensive care requiring mechanical ventilation.

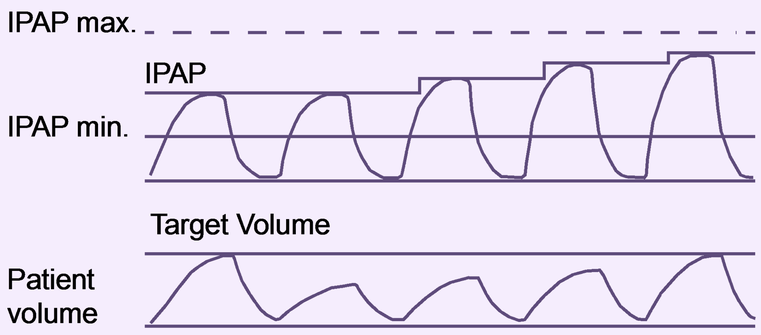

Figure 2. AVAPS algorithm (Philips Respironics 2015)

Results

Thirty-four patients were included (S/T n=19, AVAPS n=15). Both NIV groups were moderately acidotic on admission (Table 1). pH normalisation occurred within 12h-post NIV in 79% of patients on S/T and 73% on AVAPS (p=0.33), with significant reductions in $PaCO_2$ in both groups. There was a trend towards reduced LoS in patients on AVAPS (Median(IQR) S/T 10(6,15) vs 8(5,12) days, median (95%CI) between-group difference 3(-1 to 6) days, p=0.32)

Table 1: Changes in pH and $PaCO_2$ following S/T or AVAPS.

	Baseline mean(SD)	12h post-NIV mean(SD)	Mean within-group differences(95%CI)	Pre-discharge mean(SD)	Mean within-group differences(95%CI)	Mean between-group differences pre-discharge(95%CI)
pH S/T	7.29(0.06)	7.36(0.06)	0.07(0.04 to 0.09)*	7.41(0.01)	0.12(0.08 to 0.15)*	0.03 (-0.03 to 0.08)
pH AVAPS	7.29(0.07)	7.38(0.07)	0.09(0.04 to 0.15)*	7.38(0.04)	0. 09(0.05 to 0.13)*	
$PaCO_2$ S/T	9.61(1.95)	7.96(2.27)	-1.65(-2.66 to -0.65)*	6.93(1.93)	-2.68(-3.98 to -1.39)*	- 0.13 (-1.87 to 1.6)
$PaCO_2$ AVAPS	9.70(3.04)	7.13(1.80)	-2.57(-4.24 to -0.88)*	7.15(1.47)	-2.55(-3.70 to -1.37)*	

***P<0.001**

Discussion and implications

Results demonstrated that patients receiving either S/T or AVAPS NIV modes had improved pH values within the first 12 hours after NIV initiation. The results of the present study support the findings of Battisti et al. (2007) in that similar physiological benefits were obtained using the AVAPS mode, which automatically adapts pressure support according to changes in tidal volume, as compared with S/T that requires manual adjustment.

There was a tendency for $PaCO_2$ levels to reduce in both groups, although patients were often still hypercapnic at discharge (and were likely to be chronically hypercapnic, owing to the progress of their condition). Our current findings concur with other literature which suggests that $PaCO_2$ values do not reduce to normal range values even after 24 hours of NIV in this population (Battisti et al, 2007)

In the present study, although there were no significant differences in LoS between groups, the trend towards a reduced LoS in patients receiving AVAPS warrants further investigation. One previous study has compared LoS in AVAPS and S/T groups for patients with TIIRF secondary to AECOPD (Briones et al, 2003). They reported a mean difference in LOS between groups that was not statistically significant (mean (SD) S/T 7.27(2.49) vs. AVAPS 7.09 (1.45) p>0.05 days). Our findings are comparable with the results published of a 2013 annual NIV audit (n=2693), in which the median of length of stay was 9.0 days (British Thoracic Society, 2013).

Conclusion

Ventilation using AVAPS is as effective as S/T mode in treating TIIRF secondary to COPD. Furthermore, AVAPS may be beneficial in reducing hospital LoS. Continued research is required to investigate this potential benefit.

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