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Vivo 40 - Clinical validation of the Target Volume function

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Introduction

Following the expansion of NPPV therapy over the past 15 years, the technique for the application of NPPV has been greatly refined. There has been a shift away from volumelimited ventilators to more comfortable and smaller pressure-limited ventilators. Recent randomized controlled trials1,2 have indicated that therapy with volume-limited and pressurelimited NPPV are comparably effective. However, while pressure-limited NPPV has been shown to be very well tolerated by the patient, volume-limited NPPV provides greater stability of tidal volume (Vt) in the face of varying patient effort, chest wall compliance, or airway resistance1. To ensure a more consistent Vt while delivering the comfort and advantages of pressure support ventilation, combining the advantages of pressure-limited and volume-limited modes of ventilation into one ventilation mode such as Target Volume seems a valuable alternative3.

Method

Patients with stable chronic hypercapnic respiratory failure treated with NIV, who were referred between January and March 2008 to the Department of Pneumology, University Hospital Freiburg, have been enrolled.
In a randomized cross over design patients were ventilated one hour with and one hour without Target Volume. Settings without Target Volume function were identical as used at home or in hospital. With Target Volume IPAPmax was set at 40 mbar whereas IPAPmin was set 5 mbar below the at home or in hospital used IPAP. Target Volume was set to 10 ml/kg calculated to an ideal bodyweight of 24 kg/m2. End points for the validation are comfort and tolerance of the patient, consistency of ventilation patterns and stable gas exchange.

Measurements

Ventilation patterns (Ventrak-Respiratory-Monitoring-System 1550, Novametrix Medical System Inc., Wallingford, USA), PtcCO2 and oxygen saturation (TCM40 Monitoring System
TINA, Radiometer, Copenhagen, Denmark) during NIV have been analyzed with and without Target Volume.
After the two periods of ventilation a non-standardized questionnaire has been used to detect patients' compliance of the treatment with and without the Target Volume function.
The questionnaire includes 10 items with values of +2 indicating maximal comfort or no side effects and values of -2 indicating maximal discomfort or severe side effects.

Results

In total 10 measurements have been performed on 7 patients suffering from COPD, OHS or interstitial lung disease using NPPV with full-face or nasal mask.
Measurements of $PtcCO_2$ and oxygen saturation during NPPV are presented in table 1 showing a good oxygenation in both modes and a trend of lower transcutaneous $PtcCO_2$ when using Target Volume (p=0.08).

Analysis of the questionnaire shows that adding Target Volume results in a comfortable ventilation mode that is well tolerated. No discomfort, decreased quality of ventilation or side effects were reported by the patients when using the Target Volume.

	PCV	PCV + Target Volume
Mean $PtcCO_2$ (mmHg)	70.9±26.6	67.6±22.6
Mean SaO_2 (%)	97.1±3.6	98.2±0.4

Table 1: Transcutaneous PCO2 and Oxygen saturation during NPPV

Ventilation patterns have been analyzed with a pneumotachograph (table 2) showing a constant delivery of volumes, pressures and breathing frequency in both modes of ventilation. During NIV with Target Volume mode standard deviation of the maximal inspiratory pressure (PIP max-SD) tended to be higher comparing to the mode without Target Volume (1.6±0.9 vs. 0.9±0.3). This indicates the expected variance of the inspiratory pressure during ventilation with the Target Volume function, since a range of inspiratory pressures is preset.

	PCV	PCV + Target Volume
Vol Insp (ml)	705±184	739±134
Vol Exp (ml)	490±210	495±150
PIP (mbar)	25.7±5.1	27.5±4.8
PIP max-SD	0.9±0.3	1.6±0.9

Table 2: Pneumotachographic measurements during NPPV

Conclusion

Ventilation with the new VIVO40 including the option of a Target Volume was successfully performed. The Target Volume function is a promising new option for pressure limited ventilation.

References

1. Windisch W, et al., Respir Med 2005; 99:52–59
2. Tuggey JM, et al, Thorax 2005; 60:859–864
3. Storre JH, et al., Chest, 2006; 130; 815-821

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