Bench Comparison of Non-Invasive Open Ventilation to Home and Bilevel Ventilation in Non-Invasive Conditions

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Introduction

COPD patients who are capable of ambulation are often limited in their mobility due to symptoms of respiratory insufficiency. Pulmonary rehabilitation has been shown to improve exercise endurance and quality of life for these patients. A new Non-Invasive Open Ventilation (NIOV) system designed to provides volume and pressure support to augment patients' own breathing has been developed to address and relieve COPD symptoms such as oxygen desaturation and dyspnea on exertion. Bench testing was completed to compare selected performance characteristics of NIOV to that of an invasive home care ventilator and a bi-level ventilator in non-invasive ventilation (NIV) scenarios. Performance characteristics such as tidal volume, pressure support, airway pressure, and patient flows were measured.

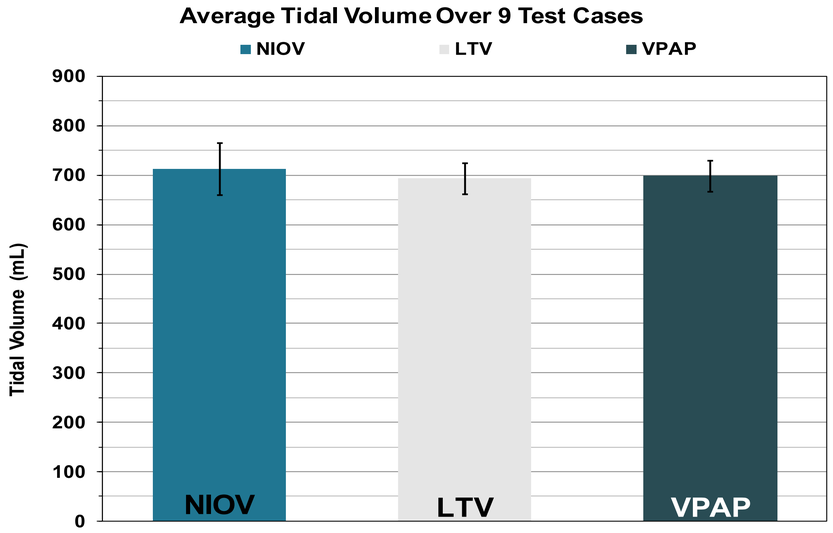
Methods and Material

A Hans Rudolph Breathing Simulator was set to run a range of active conditions: Resistance 5/10/20 cmH2O/L/s; Compliance 70/100/120 mL/ cmH2O; RR 12 BPM; with effort settings adjusted to achieve 1:2 I:E and Vt 500 mL for each R/C combination. Data acquisition parameters were set to include airway pressure, patient flow, volume, and effort. The Breathe Technologies NIOV system was set to 250mL and 21% delivery time. NIOV performance data in each condition was recorded, and IPAP/EPAP pressure support and tidal volume (Vt) was noted. Similarly, we recorded Vt and pressure support delivered by a CareFusion LTV 1100 and a ResMed VPAP Tx operating in pressure support modes and set to mimic the IPAP/EPAP pressure differential found in the NIOV performance data.

Results

Although NIOV and LTV demonstrated EPAP pressure of 0 cmH_2O and the VPAP Tx was set on minimum EPAP of 3.0 cmH_2O, tidal volume and pressure support were similar among the three units in all test scenarios. The LTV ventilator displayed auto-triggering characteristics in one test scenario (r20/c70); therefore, data was not compared to the other tested units in that test scenario. Average tidal volumes over the nine test scenarios were: NIOV 709.0 mL ± 51, LTV 698.2 ± 31.4, VPAP Tx 693.7 ± 48. Average pressure support over the nine test scenarios was: NIOV 9.0 cmH_2O ±2.0, LTV 8.7 cmH_2O ±1.8, VPAP Tx 8.5 cmH_2O ±1.9.

	Tidal Volume (ml)				Pressure Support (cmH_2O)			
	Baseline	NIOV	VPAP	LTV	Baseline	NIOV	VPAP	LTV
Average	511.6	709.0	693.7	698.2	0.3	9.0	8.5	8.7
SD	3.2	51.0	48.0	31.4	0.1	2.0	1.9	1.8



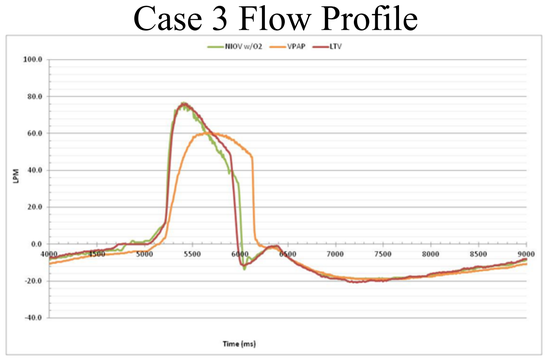
Averaged Vt:

NIOV:
709.0 ± 51.0 mL

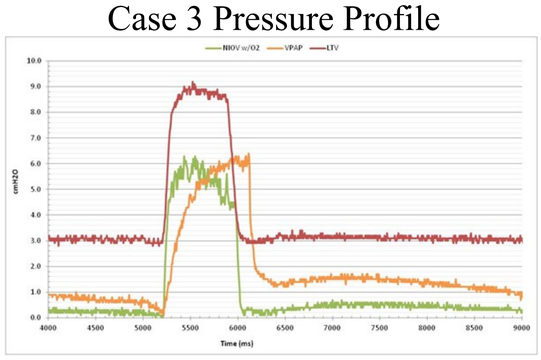
LTV:
698.2 ± 31.4 mL

VPAP Tx:
693.7 ± 48.0 mL

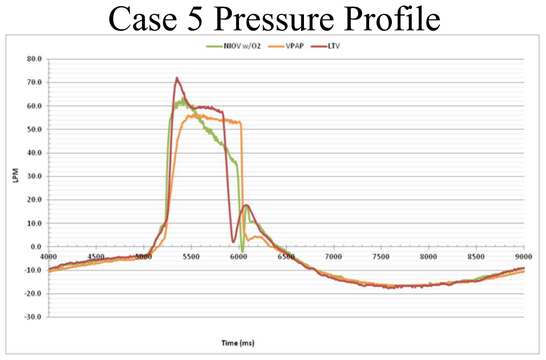
Case 3 Flow Profile



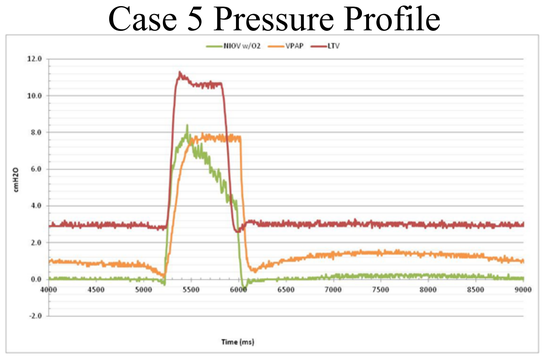
Case 3 Pressure Profile



Case 5 Pressure Profile



Case 5 Pressure Profile

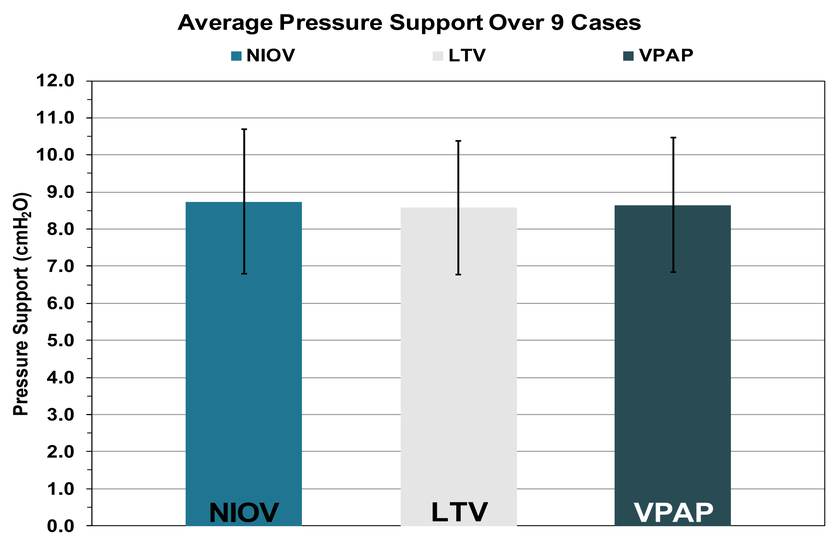


Averaged PS:

NIOV:
9.0 ± 2.0 cmH_2O

LTV:
8.7 ± 1.8 cmH_2O

VPAP Tx:
8.5 ± 1.9 cmH_2O



Conclusions

NIOV was able to generate similar pressure support and tidal volumes as compared to the other ventilators in a variety of lung conditions. NIOV may be able to offer COPD patients relief for symptoms such as oxygen desaturation and dyspnea to facilitate pulmonary rehabilitation and participation in activities of daily living. Further clinical evaluations of the NIOV system to assess its long-term effect on symptoms and mobility may be warranted.

Valleyaire Respiratory Services, Inc.

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