

Oxygen Consumption in Two Portable Ventilators Using a High Pressure Gas Source

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Background

The VOCSN (Ventec Life Systems, Bothell, WA) and Trilogy (Philips Respironics, Murrysville, PA) ventilators can deliver oxygen via low or high pressure sources utilizing different circuits. We evaluated and compared oxygen consumption from a high pressure gas source using the two ventilators with a null hypothesis that there would be no difference.

Methods

The VOCSN and Trilogy ventilators were evaluated using a high pressure gas source (e-cylinders regulated to 50 psi) with both passive (constant leak) and active (exhalation valve) circuits connected to a TTL test lung (Michigan Instruments, Grand Rapids, MI).

The three simulated TTL lung models were: normal - Cst 60 mL/cm H₂O and Raw 5 cm H₂O/L/s, restrictive - Cst 30 mL/cm H₂O and Raw 5 cm H₂O/L/s, and obstructive - Cst 60 mL/cm H₂O, Raw 20 cm H₂O/L/s.

Using pressure ventilation modes, the peak pressure and rise time were titrated to achieve a tidal volume of 500 mL, as measured by a Certifier FA Plus (TSI Inc, Shoreview MN). Other settings include: frequency 12 breaths/min, PEEP 5 cm H₂O and IT 1.0 second, set FIO₂ of 0.40. Delivered FIO₂ was measured by the Handi + oxygen analyzer (Maxtec, Salt Lake City, UT) at the lung inlet. In addition, the VOCSN pulse dose function was evaluated by titrating its oxygen flow to achieve an FIO₂ of approximately 0.40.

We measured the length of time to reduce e-cylinder pressure by 100 PSI for each lung model and test configuration, then calculated the liters of oxygen utilized per minute during each test run. A series of three tests were performed for all lung models and circuit configurations. Data for the three lung models were averaged for each test configuration and reported as the mean ± SD for both circuits.

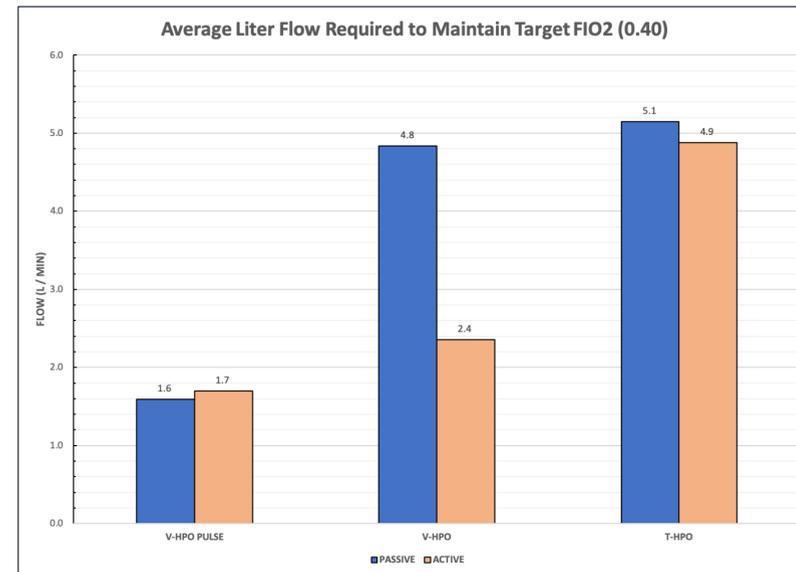


Figure 1

Average liter flow (L/min) consumption required to maintain a target fraction of inspired oxygen (FIO₂) equal to forty-percent (0.40).

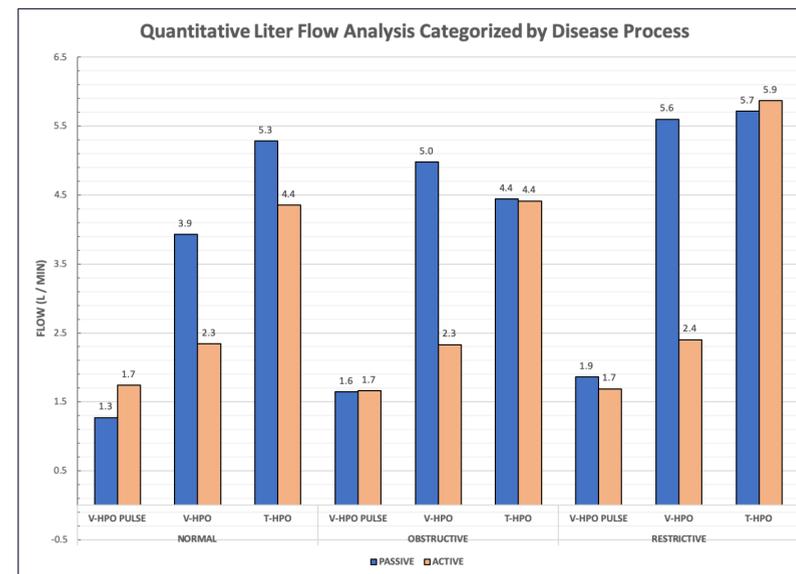


Figure 2

Average liter flow (L/min) consumption required to maintain a target fraction of inspired oxygen (FIO₂) equal to forty-percent (0.40), categorized by: ventilator, circuit type, and lung physiology



Figure 3

VOCSN multifunctional critical-care ventilator (Courtesy of Ventec Life Systems)

Results

Tidal volume delivery and measured FIO₂ remained relatively constant during all lung models, test configurations and circuit types (501 ± 7 mL and 0.397 ± 0.01 respectively). Oxygen consumption using VOCSN with pulse dose oxygen delivery was 1.7 ± 0.7 and 1.7 ± 0.1 L/min, using VOCSN with set FIO₂ was 4.8 ± 0.8 and 2.4 ± 0.1 L/min, and using Trilogy with set FIO₂ was 5.2 ± 1.0 and 4.8 ± 0.9 L/min with passive and active circuits respectively.

Conclusions

Oxygen utilization was lowest using the VOCSN ventilator with pulse dose oxygen delivery with both the passive and active circuits, and with VOCSN using a set FIO₂ with the active circuit compared to the Trilogy 202 ventilator.

Disclosures

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Mr. Siobal serves as a consultant and discloses commercial relationships with Aerogen³ and Origin Medical⁴.

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