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How Do Tidal Volume and Peep Settings Affect Expiratory Resistance? A Bench Study of the LTV® 1200 Homecare Ventilator

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Abstract

Background: Home care ventilators hold a prominent place in the world of mechanical ventilation, and careful selection of ventilator modes and settings profoundly impact patient outcomes. In addition to patient factors, exhalation valves can generate expiratory resistance (ER) and can increase work-of-breathing and contribute to auto-PEEP. Analyzing ER on new homecare ventilators is crucial to patient care. The purpose of this study is to analyze the affects of tidal volume (Vt) and PEEP on ER on the Pulmonetic LTV® 1200 homecare ventilator.

Method: ER was measured on the Pulmonetic LTV® 1200 (LTV) homecare ventilator. The LTV was attached to the Hans Rudolph Electronic Breathing Simulator (HR 1101) using Pulmonetic's non-heated circuit. Pressure and flow transducers (Hans Rudolph 4700 series) were calibrated using DT Foundry software and a Downs CPAP generator. Both transducers were placed before the exhalation valve, and ER was calculated using the equation (P1-P2/V). P1 = pressure before the exhalation valve, P2 = ambient pressure after the exhalation valve, and V = flow in liters per second. The ventilator was placed in volume A/C mode, frequency 12 breaths/minute, using tidal volumes (Vt) of 300, 500, 700, and 900 mL, ER was measured and recorded at each change. This process was repeated with set PEEP levels of 8, 11, and 14 cmH2O.

Results: See Table 1.

Conclusion: As expected, this study found that ER changed when Vt and PEEP were manipulated. The values for ER in this study are consistent with previous studies which reported ER values of 2.1 – 159.0 cmH2O/L/sec for modern intensive care ventilators. The apparent inconsistency of expiratory resistance values at Vt 500 ml and 900 ml was possibly due to a defect in sampling methods--insufficient time devoted to letting the LTV stabilize after adjusting Vt. Future studies should utilize a longer sampling period. Overall, additional studies are necessary to thoroughly evaluate expiratory resistance in the clinical setting since patient variables may also impact expiratory resistance.

HOW DO TIDAL VOLUME AND PEEP SETTINGS AFFECT EXPIRATORY RESISTANCE? A BENCH STUDY OF THE LTV® 1200 HOMECARE VENTILATOR

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Results: See Table 1.Table 1:

	Vt 300 ml	Vt 500 ml	Vt 700 ml	Vt 900 ml	PEEP 8 cmH2O	PEEP 11 cmH2O	PEEP 14 cmH2O
Mode	Vol. A/C	Vol. A/C	Vol. A/C	Vol. A/C	Vol. A/C	Vol. A/C	Vol. A/C
Set Rate	12	12	12	12	12	12	12
Cst (ml cmH2O)	40	40	40	40	40	40	40
PIP (cmH2O)	14	19	25	31	25	28	31
PEEP (cmH2O)	5	5	5	5	8	11	14
VE (L/min)	3.6	6.0	8.4	10.8	7.2	7.2	7.2
Vte (ml)	255	427	592	770	490	480	500
Vt (ml)	300	500	700	900	600	600	600
Exp. Flow (L/sec)	0.76	1.25	1.06	1.50	1.37	1.41	1.13
P1-P2 (cmH2O)	11.47	17.90	23.52	29.73	23.55	26.28	29.35
Exp. Resistance (cmH2O/L/sec)	15.09	14.32	22.19	19.82	17.19	18.64	25.97

Conclusion: As expected, this study found that ER changed when Vt and PEEP were manipulated. The values for ER in this study are consistent with previous studies which reported ER values of 2.1 – 159.0 cmH2O/L/sec for modern intensive care ventilators. The apparent inconsistency of expiratory resistance values at Vt 500 ml and 900 ml was possibly due to a defect in sampling methods--insufficient time devoted to letting the LTV stabilize after adjusting Vt. Future studies should utilize a longer sampling period. Overall, additional studies are necessary to thoroughly evaluate expiratory resistance in the clinical setting since patient variables may also impact expiratory resistance.