



Intrapulmonary Percussive Ventilation superimposed to conventional mechanical ventilation: comparison between volume controlled and pressure controlled mode. A bench study.

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BACKGROUND: Previous bench studies suggest that dynamic hyperinflation may occur if Intrapulmonary Percussive Ventilation (IPV) is superimposed to mechanical ventilation in volume controlled continuous mandatory ventilation mode (VC-CMV). We tested the hypothesis that pressure controlled continuous mandatory ventilation mode (PC-CMV) can protect against this risk.

METHODS: ICU ventilator was connected to an IPV device cone adaptor attached to a lung model (compliance $30 \text{ ml} \cdot \text{cmH}_2\text{O}^{-1}$, resistance $20 \text{ cmH}_2\text{O} \cdot \text{s} \cdot \text{L}^{-1}$). We measured inspired tidal volume (VTI) and lung pressure. Measurements were first taken with IPV off and ICU ventilator set to VC-CMV or PC-CMV with a target of VTI 500 ml. For each mode, 0.8 or 1.5 sec inspiratory time (Ti) and 7 or 15 cmH_2O PEEP were selected. The experiments were repeated with IPV set to 20 or 30 PSI. The dependent variables were differences in VTI (ΔVTI) and lung pressure with IPV off or on. The effect of VC-CMV or PC-CMV mode was tested between the ICU ventilators for Ti, PEEP and IPV working pressure using analysis of variance on repeated measurements.

RESULTS: With 0.8 sec Ti and 20PSI, ΔVTI was significantly higher in VC-CMV than in PC-CMV. PEEP had no effect on ΔVTI . With 1.5 sec Ti and 20PSI and for both Ti at each PSI, mode and PEEP both had a significant effect on ΔVTI . Across the ICU ventilators with 1.5 sec Ti, PEEP 7 cmH_2O , and 30 PSI, ΔVTI (average \pm SD) ranged from -27 ± 25 to -176 ± 6 ml in PC-CMV and from 258 ± 369 to 369 ± 16 ml in VC-CMV. The corresponding ranges were -15 ± 17 to -62 ± 68 ml in PC-CMV and 26 ± 21 to 102 ± 95 ml in VC-CMV for 0.8 sec Tli, PEEP 7 cmH_2O , and 20PSI working pressure. Similar findings pertained to lung pressure.

CONCLUSIONS: When IPV is added to mechanical ventilation the risk of hyperinflation is greater with VC-CMV than with PC-CMV. We recommend using PC-CMV to deliver IPV, and adjusting the trigger variable to avoid auto-triggering.

KEYWORDS: bench study; hyperinflation; intrapulmonary percussive ventilation; lung model; mechanical ventilation; pressure controlled continuous mandatory ventilation; volume controlled continuous mandatory ventilation.

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