

Critical Care: Mechanical Ventilation

Wednesday, October 25, 2006

12:30 PM - 2:00 PM

DISTRIBUTION OF VIBRATION ENERGY AMONG DIFFERENT MODES OF MECHANICAL VENTILATION

Jean Smith, PhD*, Susmita Rajanala, MD, Ismail Cinel, MD, PhD, Zhen Whang, MD, Lynn Ferchau, RN, Kathie Lofland, RRT, Richard Dellinger, MD, FCCP and Joseph Parrillo, MD, FCCP

Robert Wood Johnson Medical School/Cooper University Hospital, Philadelphia, PA

PURPOSE: Vibration response imaging (VRI) is a novel imaging device that visualizes vibration energy emitted during the respiration process. It captures and records the energy created by airflow in the lungs during the respiration process. The object of this study was to observe how lung vibration energy, a surrogate of lung airflow, shifts with changes of modes of mechanical ventilation.

METHODS: VRI was performed on 25 mechanically ventilated, hemodynamically stable patients requiring minimal ventilatory support (PEEP \leq 8 cmH₂O, FiO₂ \leq 0.5). They were studied on volume control (VC), pressure control (PC), and pressure support (PS) modes of mechanical ventilation. In all three modes, the tidal volume was held constant. In PC and PS, this was achieved by adjusting applied pressure of the ventilator to achieve target tidal volume. The cycles were selected based on predefined criteria for absence of artifact. The average of the maximal inspiratory vibration energy from multiple cycles is expressed as vibration units (VU). VU during inspiration were obtained and regional distribution was calculated. The relative percent change in VU between the lower lung region and the other two regions was calculated then compared with results at different modes of mechanical ventilation.

RESULTS: The percent increase in VU in the lower lung regions was greater compared to the upper and middle regions. Change from VC to PC, PC to PS, and VC to PS was 2.3 ± 37.7 , 9.8 ± 67.4 and 19.6 ± 66.7 per cent respectively (Figure 1).

CONCLUSION: Results show that pressure support mode causes a shift of vibration energy toward lower lung regions although it did not reach statistical significance. Synchronization with the ventilator and greater downward movement of diaphragm may be the physiologic explanation for the re-distribution of vibration energy as a surrogate of airflow to lower lung regions.

CLINICAL IMPLICATIONS: VRI offers physiologic principle for why PS may be preferred mode because it results in maximal distribution of vibration as a surrogate of airflow, particularly in the lower lung regions.

DISCLOSURE: Jean Smith, University grant monies NA; Grant monies (from sources other than industry) NA; Grant monies (from industry related sources) Deepbreeze Ltd.; Shareholder NA; Employee NA; Fiduciary position (of any organization, association, society, etc, other than ACCP NA; Consultant fee, speaker bureau, advisory committee, etc. Joseph Parrillo, MD, FCCP; R. P. Dellinger, MD, FCCP; Other NA; Product/procedure/technique that is considered research and is NOT yet approved for any purpose, Vibration response imaging.