

Critical Care: Mechanical Ventilation

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THE EFFECT OF MECHANICAL VENTILATION MODES ON LUNG VIBRATION ENERGY

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PURPOSE: Vibration response imaging (VRI) is a novel imaging technology that measures vibration during the ventilation process. The vibrations are detected and displayed by 34 sensors, which are attached to a patient's back. As air moves in and out of the lungs, the vibration energy is transmitted to and recorded by the VRI device and a dynamic image is created. The purpose of the study is to observe the effects of different ventilator modes on lung vibration during ventilation.

METHODS: Stable, mechanically ventilated patients requiring minimal ventilatory support (PEEP \leq 8cmH₂O, FiO₂ \leq 0.5) were identified. Serial VR imaging was performed on 25 patients during volume control(VC) with square inspiratory waveform, pressure control (PC) and pressure support (PS) modes of mechanical ventilation. In VC and PC modes the tidal volume and inspiratory time were held constant. In PC and PS, this was achieved by adjusting applied pressure of the ventilator to achieve target tidal volume. Maximal vibration energy during inspiration was measured and statistical analysis was done using t-test.

RESULTS: Compared to VC, maximal vibration energy during inspiration increased by 3.16% \pm 4.68 on PC(p=0.0016) and increased by 2.47% \pm 4.98 on PS(p=0.01). There was no statistical difference in the tidal volume at the different modes.

CONCLUSION: Maximal vibration energy in the lungs during inspiration increased significantly from VC to PC and from VC to PS. Decelerating flow patterns in both PC and PS modes provide increased vibration energy. This is likely related to high flow at the beginning of inspiration having greater effect on maximal vibration energy than flow during middle and later parts of inspiration.

CLINICAL IMPLICATIONS: VR imaging provides a real time comparison of distribution of vibration energy in different modes of mechanical ventilation. If VRI energy distribution can be linked to changes in oxygenation and ventilation, it may offer the potential to adjust ventilator settings in real time at the bedside for optimization of mechanical ventilation.

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