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Increased Spatial Distribution of Airflow in Lungs with Low-Level Pressure Support Ventilation Compared to Maintenance Ventilation

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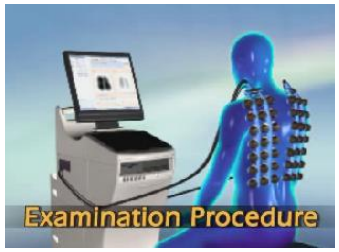
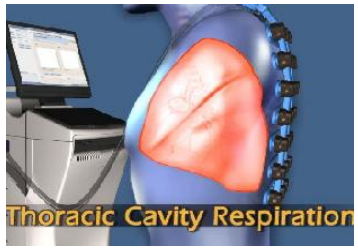
Introduction

Vibration response imaging (VRI) is a novel technology that utilizes surface skin sensors placed on the back and sophisticated software to record, analyze and display vibrations as a non-invasive measure of lung ventilation.

Hypothesis

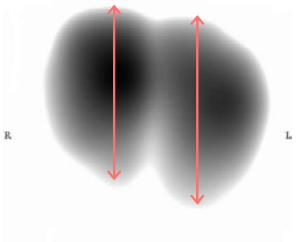
Compared to assist volume control ventilation (AVC), pressure support ventilation (PSV) will result in a greater spatial distribution of lung airflow.



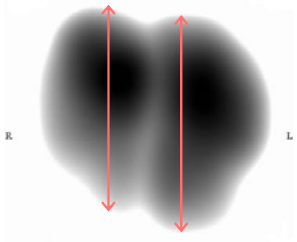


Vibration Response Images at Mid Inspiration

Assist volume control



Pressure Support Ventilation



Results

Tidal volume (V_T) was 574.9 +/- 78.1 for assist volume control ventilation and 432.3 +/- 171.1 for pressure support ventilation . The mean of the summed vertical heights of both lungs were 13.2 +/- 1.5 and 14.4 +/- 0.9 (mean in cm +/- stdev) in assist volume control ventilation and pressure support ventilation images, respectively (p = 0.0018). There was a mean increase of 10.51% +/- 12.21 in the summed vertical heights of both lungs during pressure support ventilation compared to assist volume control ventilation (p= 0.002).

Methods

We performed serial VRI during maintenance AVC and immediately following initiation of spontaneous breathing trial using low-level PSV (pressure support of 5 and PEEP of 5) in 16 mechanically ventilated patients. Images were performed over 12-second periods of respiration. Computer software selected the optimal respiratory cycle for analysis based on pre-programmed breath characteristics. The maximum vertical heights of right and left lung measured at mid-inspiration (maximum vibration signal) were summed, and compared, AVC versus PSV. Statistical analysis was performed using the t-distribution.

Conclusions

Despite lower tidal volumes, pressure support ventilation (compared to assist volume control ventilation) produced a greater spatial distribution of lung airflow during inspiration. Possible mechanisms of this PSV associated increase are (a) a greater magnitude of negative intrapleural pressure (b) more sustained negative intrapleural pressure and (c) better synchronization of negative pressure with positive pressure from the ventilator. Vibration response imaging allows a non-invasive quantitation of airflow distribution during different modes of mechanical ventilation.