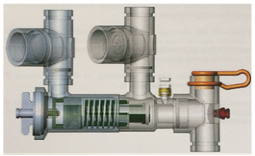

High frequency percussive ventilation increases alveolar recruitment in early acute respiratory distress syndrome: an experimental, physiological and CT scan study.

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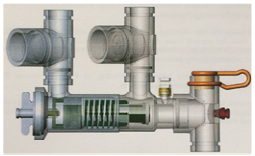
BACKGROUND:

High frequency percussive ventilation (HFPV) combines diffusive (high frequency mini-bursts) and convective ventilation patterns. Benefits include enhanced oxygenation and hemodynamics, and alveolar recruitment, while providing hypothetic lung-protective ventilation. No study has investigated HFPV-induced changes in lung aeration in patients with early acute respiratory distress syndrome (ARDS).

METHODS:

Eight patients with early non-focal ARDS were enrolled and five swine with early non-focal ARDS were studied in prospective computed tomography (CT) scan and animal studies, in a university-hospital tertiary ICU and an animal laboratory. Patients were optimized under conventional "open-lung" ventilation. Lung CT was performed using an end-expiratory hold (Conv) to assess lung morphology. HFPV was applied for 1 hour to all patients before new CT scans were performed with end-expiratory (HFPV EE) and end-inspiratory (HFPV EI) holds. Lung volumes were determined after software analysis. At specified time points, blood gases and hemodynamic data were collected. Recruitment was defined as a change in non-aerated lung volumes between Conv, HFPV EE and HFPV EI. The main objective was to verify whether HFPV increases alveolar recruitment without lung hyperinflation. Correlation between pleural, upper airways and HFPV-derived pressures was assessed in an ARDS swine-based model.



RESULTS:
One-hour HFPV significantly improved oxygenation and hemodynamics. Lung recruitment significantly rose by 12.0% (8.5-18.0%), P = 0.05 (Conv-HFPV EE) and 12.5% (9.3-16.8%), P = 0.003 (Conv-HFPV EI). Hyperinflation tended to increase by 2.0% (0.5-2.5%), P = 0.89 (Conv-HFPV EE) and 3.0% (2.5-4.0%), P = 0.27 (Conv-HFPV EI). HFPV hyperinflation correlated with hyperinflated and normally-aerated lung volumes at baseline: r = 0.79, P = 0.05 and r = 0.79, P = 0.05, respectively (Conv-HFPV EE); and only hyperinflated lung volumes at baseline: r = 0.88, P = 0.01 (Conv-HFPV EI). HFPV CT-determined tidal volumes reached 5.7 (1.1-8.1) mL.kg-1 of ideal body weight (IBW). Correlations between pleural and HFPV-monitored pressures were acceptable and end-inspiratory pleural pressures remained below 25 CmH_20.

CONCLUSIONS:
HFPV improves alveolar recruitment, gas exchanges and hemodynamics of patients with early non-focal ARDS without relevant hyperinflation. HFPV-derived pressures correlate with corresponding pleural or upper airways pressures.

TRIAL REGISTRATION:
ClinicalTrials.gov, NCT02510105. Registered on 1 June 2015. The trial was retrospectively registered.

KEYWORDS:
Acute respiratory distress syndrome; Alveolar hyperinflation; Alveolar recruitment; High frequency percussive ventilation; Lung morphology; Mechanical ventilation

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