Title: ASPIRATION PNEUMONIA: TREATMENT WITH HIGH FREQUENCY OSCILLATORY VENTILATION

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Introduction. High frequency oscillatory ventilation (HFO) has been shown to provide significantly better oxygenation at a lower airway pressure than conventional ventilation. It also causes less hemodynamic changes that could further affect pulmonary gas exchange. In order to evaluate its possible role in the management of aspiration pneumonia, the pulmonary responses following the intrabronchial instillation of hydrochloric acid (HCl) were compared during conventional ventilation (CV) and HFO using an isolated canine pulmonary lobe model.

Method. A total of 26 canine isolated left pulmonary lobes were studied. Fourteen lobes were ventilated with CV with positive end expiratory pressure (PEEP) (Group A), and 12 lobes with HFO (Group B). After 45 minutes of stabilization with a constant blood perfusion and ventilation, paired studies were carried out for each mode of ventilation. In Group A, following instillation of 1/10 N HCl, lobes were ventilated with an animal ventilator (Harvard pump) with either 5 cm (6 lobes) or 10 cm H_2O PEEP (8 lobes). In Group B, lobes were ventilated with HFO (10 HZ) with mean airway pressure (MAP) of 5 cm (6 lobes) or 10 cm H_2O (6 lobes). Ventilation was kept similar (P_aCO_2) with the 2 modes of ventilation during a 4 hour experimental period. Lobe weight, pulmonary artery pressure, and airway pressure were monitored and recorded continuously. Arterial and venous blood gas determinations were performed at 30 min. intervals for calculation of pulmonary shunt.

Results. Group A lobes treated with CV and PEEP: The lobes with PEEP maintained at 5 cm H_2O increased an average of 216% in weight (Fig. 1) and developed a pulmonary shunting of 34% at the end of 4 hours. The perfusion pressure increased from 10.8 to 16 mm Hg and peak airway pressure increased from 6 to 12 cm H_2O. When PEEP was maintained at 10 cm H_2O, pulmonary shunting did not increase (7%), and average weight gain was 176% (Fig. 2). The perfusion pressure increased markedly from 11 to 20 mm Hg and peak airway pressure increased from 5 to 12 cm H_2O. Group B lobes treated with HFO: When MAP was maintained at 5 cm H_2O, lobes weight increased an average of 130% (Fig. 1) and the pulmonary shunting increased 28%. There was no significant change in pulmonary artery pressure. The lobes maintained at 10 cm H_2O MAP increased an average of 215% in weight (Fig. 2) and pulmonary shunting increased to 20%. Pulmonary artery pressure increased from 13 to 19 mm Hg.

Discussion. This study demonstrated that with conventional ventilation, there is a close relationship between PEEP level and oxygenation; however, this relationship was not seen in HFO (between MAP and oxygenation) in acid aspiration lung model. These findings are somewhat in contrast to those seen in other forms of lung injury. In a model in which surfactant is depleted by repeated lung washings, it has been shown that oxygenation is significantly better with HFO than conventional ventilation at a given mean airway pressure. The presumed explanation is that in HFO, the lung is operating constantly above the alveolar opening pressure throughout the entire respiratory cycle, whereas with CV it is not. In an acid injury, epithelial and endothelial linings are injured resulting in a leaking capillary membrane. This type of injury not only produces alveolar instability, but also increases the permeability of the membrane. Consequently, diffusion of gas is decreased. In the lung injury produced by repeated washing, though surfactants are depleted, capillary membranes are probably still intact. This form of injury results only in instability of the alveoli. Therefore, by maximizing the recruitment of aveoli, oxygenation can be improved. The mean airway pressures were not matched in the 2 modes of ventilation in the present study; this, however, did not appear to be important. Despite the lower MAP in HFO, the weight gains were similar to that of CV with PEEP (Fig. 1 and 2). It is concluded that this study did not demonstrate the benefit of HFO in aspiration pneumonia.

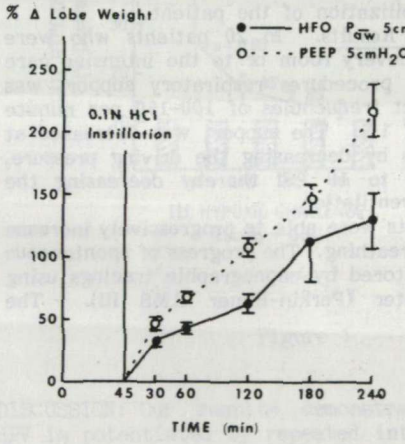

Fig. 1
% increase in lobe weight in Group A. Values are in mean ± SEM.

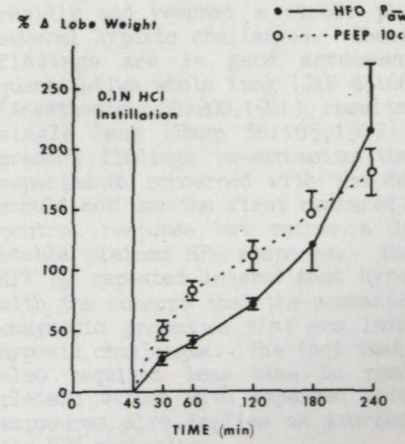

Fig. 2
% increase in lobe weight in Group B. Values are in mean ± SEM.