TITLE: EFFECT OF HIGH FREQUENCY JET VENTILATION ON CARDIOPULMONARY VARIABLES AFTER HEART-LUNG BYPASS

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Introduction

Mechanical ventilation during cardiopulmonary bypass (CPB) has been shown to result in increased shunt and decreased compliance, compared to no ventilation at all.[1] However, since the post-CPB changes in the lung have been likened to those changes following shock and trauma, we decided to look at the cardiopulmonary effects of high frequency jet ventilation (HFJV) during CPB and HFJV plus conventional ventilation (CV) pre- and post-CPB.

Methods

After approval by the Human Subjects Committee and informed consent, 22 patients scheduled for coronary artery bypass grafts were randomized to a Control Group (CV) and a High-Frequency Group (HF). The CV patients were given conventional ventilation (TV = 8.6 ± 0.1 ml/kg, R = 8.6 ± 0.9) pre-CPB, no ventilation during CPB, and conventional ventilation (TV = 9.6 ± 1.6 ml/kg, R = 7.7 ± 0.6) after cardiopulmonary bypass. The HF patients were treated exactly the same way except that HFJV (R = 150, Inspiratory Time = 20%, Drive pressure = 20 PSIG) was administered in addition to the conventional ventilation pre- and post-CPB and as the sole ventilatory technique during bypass, where drive pressure was adjusted to obtain a peak airway pressure of $\leq 10\,cmH_2O$ (9.0 ± 0.7) to minimize shaking the surgical field. Baseline patient variables were examined to look for differences between groups. Pulmonary function tests were administered pre-operatively and 3-4 days post-operatively. Intraoperative arterial and venous blood gases, as well as a complete set of systemic and pulmonary artery hemodynamic measurements were collected pre-bypass (prior to cannulation) and post-bypass (after chest closure). Data were analyzed using Student's grouped t-test for comparisons of the CV Group with the HF Group and Student's paired t-test for comparison of pre- to post-CPB variables within each group. Significance was defined as $p < 0.05$.

Results

Of the 22 patients enrolled, 12 were randomized to the CV Group, 10 were randomized to the HF Group. There were no significant differences between groups in baseline demographic or hemodynamic variables. Cardiac status, as indicated by NYHA classification, ejection fraction, dyskinesis, and LVEDP, was not significantly different between groups. Pre-operative pulmonary function tests were not significantly different between groups.

Post-CPB hemodynamic and pulmonary variables were not significantly different between groups, with the interesting exceptions of PVR and shunt. Post-CPB PVR was signfiicantly higher for the CV Group (171 ± 18 dynes-sec-cm^{-5}) compared to the HF Group (119 ± 13 dynes-sec-cm^{-5}) ($p < 0.05$) (Figure 1). Post-CPB calculated shunt (Qs/Qt) was 0.26 ± 0.02 for the CV Group and 0.30 ± 0.03 for the HF Group ($p < 0.05$).

Conclusions

The results of this study may in part be explained by the effect that different modes of ventilation have on the large pulmonary arteries and/or arterioles versus their effects on airways and the alveoli. The net effect appears to be a a lower PVR and a slight increase in Qs/Qt in the HFJV group. The lower PVR seen with HFJV can be considered an advantage for the stunned right venticle after cardiopulmonary bypass. Less outflow resistance means less work for the weakened ventricle. However, the trade-off appears to be a small increase in calculated Qs/Qt. The clinical importance of this finding may be realized in the patient with known preoperative right ventricular function and/or elevated PVR.

Reference

1. Stanley TH, Liu WS, Gentry S: Effects of ventilatory techniques during cardiopulmonary bypass on post-bypass and post-operative compliance and shunt. Anesthesiology 46:391-195, 1977.

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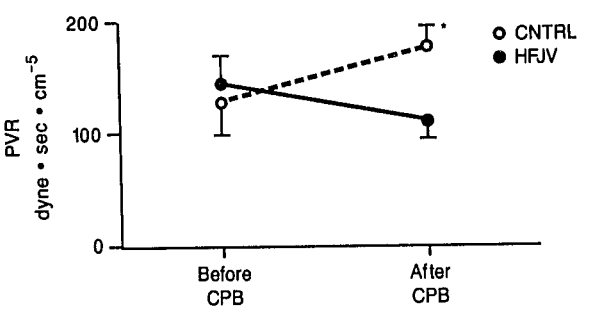
FIGURE 1



*Significant between groups, $p < 0.05$

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