

Title: EFFECT OF HIGH-FREQUENCY VENTILATION ON LEFT-VENTRICULAR FUNCTION AS MEASURED BY ESOPHAGEAL ECHOCARDIOGRAPHY

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Introduction. Moynihan, et al, have shown that analysis of left ventricular function by 2-D echocardiography is best done using change in area.¹ The Dasonics esophageal 3.5 MHZ phased-array probe now provides us with a monitor of left ventricular cross-sectional areas during anesthesia. The purpose of this study was to analyze the effect of conventional mechanical ventilation (CMV) and high-frequency jet ventilation (HFJV) on left ventricular function, as measured by esophageal echocardiography.

Methods. After approval by the Human Subjects Committee and informed consent, 64 studies were performed on 5 women undergoing elective abdominal surgery. After induction of anesthesia, a Dasonics 3.5 MHZ esophageal 2-D ultrasound probe was passed until cross-sectional imaging of the short axis at the level of the chordae was obtained. The Dasonics CV-3400R phased-array ultrasonograph was used to freeze images of the heart in systole and diastole, and the built in 2-D calculation programs were used to calculate diastolic area (DA) and systolic area (SA). Thirty-four studies were performed during conventional ventilation (R = 6-8, TV = 15 ml/kg, I:E = 1.3); 30 studies were performed during high-frequency ventilation (F = 150, I:E = 30%, \overline{AWP} = 7.10). Percent area reduction (PAR) was calculated as $PAR = (DA - SA) \times 100/DA$.¹ Results were analyzed using Student's t-test for grouped data. Significance was defined as $p < 0.05$.

Results. The patients' ages ranged from 22 to 67 years with mean \pm SEM of 42 ± 8 . Average height was 161 ± 2 cm, average weight 60.0 ± 6.7 kg. In comparing HFJV to CMV over 28 periods in the 5 patients, there were no significant changes of heart rate, CVP or PaO_2 . An increase in $PaCO_2$ was observed for HFV (39.1 ± 2.6 Torr) vs CMV (29.8 ± 1.3 Torr, $p < 0.05$). Further, systolic (139.4 ± 7.2 vs. 118.3 ± 3.5), diastolic (79.6 ± 2.5 vs. 66.0 ± 2.6), and mean (98.7 ± 5.3 vs. 85.3 ± 2.3) blood pressures (mm Hg) were all higher ($p < 0.05$) after 5 minutes HFV, probably due to decreased isofluorane absorption. Despite increased afterload, there were no significant differences in SA LV areas in diastole, systole, or SA %

area reduction for HFJV vs CMV respectively (Table 1). The study showed no significant changes of cardiac pump function in HFJV vs CMV.

TABLE 1.

	Conventional Ventilation (n = 34)	HFJV (n = 30)
Diastolic Area (cm ²)	12.1 \pm 0.06	12.0 \pm 0.7
Systolic Area (cm ²)	5.5 \pm 0.4	4.9 \pm 0.4
Percent Area Reduction	55.3 \pm 1.7	58.0 \pm 1.9

Discussion/Conclusion. These data are in general agreement with previous studies. Although no similar two-dimensional echocardiographic studies have been done, thermodilution and angiographic techniques have shown no differences in cardiac function with HFJV versus conventional ventilation.² The technique of 2-D imaging and calculation of percent area reduction as an index of cardiac function has been employed by Goldberg, et al, in the evaluation of viral cardiomyopathy.³ These data support the conclusion that HFJV is not significantly different from conventional ventilation with respect to effect on cardiac function.

References.

1. Moynihan PF, Parisi AF, Feldman CL: Quantitative detection of regional left ventricular contraction abnormalities by two-dimensional echocardiography. *Circulation* 1981; 63: 752-760.
2. Otto CW, Quan SF, Conahan TJ, Calkins JM, Water-son CK, Hameroff SR: Hemodynamic effects of high-frequency jet ventilation. *Anesth Analg* 1983; 62:298-304
3. Goldberg SJ, Valdes-Cruz LM, Sahn DJ, Allen HD: A two-dimensional echocardiographic evaluation of viral cardiomyopathy. Submitted for publication to *Circulation*.