

**TITLE:** SYNCHRONIZED HIGH FREQUENCY JET VENTILATION DURING EXTRACORPEAL SHOCK WAVE LITHOTRIPSY

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### Introduction

High frequency jet ventilation (HFJV) has been shown to minimize renal stone movement during extracorporeal shock wave lithotripsy (ESWL).<sup>1</sup> The purpose of this study was to determine if using HFJV synchronized to the human cardiac cycle further minimizes renal stone movement, and if this reduction in stone movement improves the results of ESWL.

### Materials and Methods

The study population consisted of 34 patients (23 men and 11 women) undergoing ESWL. Age ranged from 20 to 73 years, and weight 45 to 116 kg. The ASA status was I - III. These patients were randomized into four groups: Ten patients in Group I received epidural anesthesia, eight patients in Group 2 received low-volume conventional ventilation (LVCMV (5-8 ml/kg tidal volume), eight patients in Group 3 received anesthesia with HFJV synchronized to their heart rate, and eight patients in Group 4 received HFJV at a standard rate of 150 breaths/min. No significant differences in patient demographic data between the groups. No difference existed among groups in stone burden, as evaluated by the PICA system.<sup>2</sup> The study was approved by the Arizona Health Sciences Human Subjects Committee, and written informed consent was obtained in all cases. General anesthesia was induced with thiopental 1-2 mg IV, sufentanil 0.5 µg/kg IV and vecuronium 0.1 mg/kg IV. Maintenance was with a sufentanil drip beginning at 0.5 µg/kg/min and titrated downward as tolerated, and 60% N<sub>2</sub>O/40% O<sub>2</sub>. Patients receiving HFJV were first ventilated with conventional mechanical ventilation (CMV) at rates of 15-20 breaths/min, tidal volumes of 9-13 ml/kg, and placed on HFJV when they were positioned in the tub. Both HFJV groups had an inspiratory time of 30%. Driving pressure was adjusted to maintain the pulse oximeter > 95% and EtCO<sub>2</sub> < 40 mmHg. The synchronization unit allowed the patient one breath (per Healthdyne HFJV Model 300) every QRS segment. The breath was delivered 50 ms after the peak of the R wave. Hemodynamic variables were collected during the procedure and during cystoscopy. Vertical renal stone movement, length of ESWL treatment, recovery room time, anesthesia time and transfer time, as well as follow-up KUB results and complications were also recorded. Results were analyzed with one-way analysis of variance for, Student's t-tests for grouped and paired data, and chi-square analysis. Significance was defined as p < 0.05.

### Results

Mean renal stone excursion was significantly less for both HFJV groups (p < 0.05) (Fig. 1). Mean stone excursion was significantly higher in subjects receiving epidurals (p < 0.05). There were no significant differences noted between the two HFJV groups. Figure 2 summarizes results of follow-up

KUB exams obtained 4-7 weeks post ESWL. No significant differences between the groups were obtained in any category. The two reported complications were kidney infections.

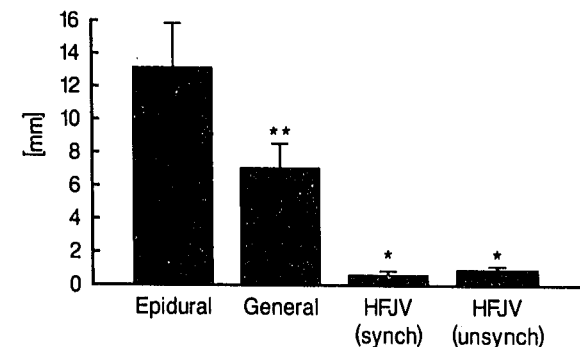
### Discussion

HFJV, is an effective method of ventilation which decreases renal stone excursion during ESWL. Synchronizing HFJV to the human cardiac cycle does not appear to have any more beneficial effects than unsynchronized HFJV in terms of minimizing stone movement and success of ESWL treatment. No results indicated that general anesthesia is a better method than epidural anesthesia. The only failures (renal stone still present) occurred in the non-HFJV groups, as did the complications.

### References

- Shulte M, Esch J, Kochs E, Meyer WH: High frequency positive pressure ventilation during general anesthesia for extracorporeal shock wave lithotripsy. *Anesth & Analg* 65(11):1231-1234, 1986.
- Griffith DP, Voliquette L: PICA/Burden: A staging system for upper tract urinary stones. *J Urology* 138:253-257, 1987.

### Stone Displacement



\* HFJV groups significantly different from non-HFJV groups at p<0.05

\*\* General group significantly different from Epi group at p<0.05

### Follow-Up KUB Results

KUB Results	EPI # of Subjects	General # of Subjects	HFJV (Syn) # of Subjects	HFJV (Unsyn) # of Subjects
Success	4	5	6	4
Failure	2	2	0	0

### Complications Post ESWL

Complications	EPI # of Subjects	General # of Subjects	HFJV (Syn) # of Subjects	HFJV (Unsyn) # of Subjects
Yes	0	2	0	0
No	6	5	6	6