PULMONARY EFFECTS RELATED TO AIRWAY OBSTRUCTION DURING HIGH FREQUENCY JET VENTILATION FOR LARYNGOSCOPY.

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INTRODUCTION : High Frequency Jet Ventilation (HFJV) has been proposed as a method of ventilation during direct laryngoscopy (1). The patients scheduled for laryngoscopy are likely to suffer from chronic obstructive pulmonary disease (COPD) and/or upper airway obstruction (UAO). These two clinical conditions may expose the patients to the risks of barotrauma and hypoventilation. The aim of the study was to investigate lung volumes, end expiratory airway pressure (EEP) and gas exchange during steady state HFJV for laryngoscopy.

METHODS : Prior to laryngoscopy for oropharyngolaryngeal cancer, 52 patients who had given informed consent were divided into three groups according to their clinical data and pulmonary function tests : group "control subjects" (no clinical history of airway obstruction), group "COPD" (clinical history of chronic bronchitis), group "UAO" (clinical history of compromised upper airway). Before induction, fentanyl (3 mcg/kg) and atropine 0.5 mg were injected. Anesthesia was induced by methohexital (3 mg/kg) or propofol (2 mg/kg) and maintained by continuous infusion according to clinical criteria. Vecuronium was administred under guidance of train of four stimulation. After induction of anesthesia a 14-G catheter (length 9 cm) was introduced into the trachea through the cricothyroid membrane and HFJV was started using a jet ventilator (GR300 LSA France) with settings : 2 Hz, FiO2:1, I:E ratio : 0.54, driving pressure 3.7 Bar. Optimal upper airway patency was maintained by lifting the jaw. All measurements were performed after 15 min in the steady state. At the end of insufflation, the pneumatic system of the ventilator was automatically opened to the atmosphere allowing rapid evacuation of the compressed gas. Then, using a second solenoid valve, the trachea was connected to a transducer via the injector. This tranducer permitted the measurement of expiratory pressure between each insufflation. This measurement was accurate for respiratory rates up to 7 Hz. Two 50 cm mercury strain gauges were strapped on the thorax and abdomen to measure changes in rib cage and abdominal circumferences, allowing the measurement of tidal volume (Vt) and pulmonary volume above apneic FRC (△FRC). These gauges were calibrated by insufflating the lungs by the jet ventilator at the given setting with the upper airway firmly occluded. The volume delivered by the ventilator at this setting was determined for each patient using a dry spirometer and plotted against the corresponding abdominal and thoracic displacements. The slope gave the coefficient of calibration (2). All the signals were recorded on a Gould ES1000 recorder. Blood gases were sampled from the radial artery in 46 patients. Statistical analysis used two way analysis of variance and least square regression.

RESULTS : △FRC inferred from abdominal and thoracic displacements were highly correlated (r=0.95 slope=0.93). In contrast the correlation between Vt inferred from abdominal and thoracic displacements was poor (r=0.68 slope=0.52). As a consequence only changes in △FRC could be interpreted. In group control △FRC and EEP were relatively small and blood gases were in the normal range (Table). In group COPD △FRC and EEP were not statistically different but PaO2 was lower and PaCO2 higher when compared to control subjects. In group UAO △FRC, EEP and PaCO2 were higher than in control group, while PaO2 was similar. For all the patients there was a positive correlation between EEP and △FRC (r=0.89) (Figure).

DISCUSSION : When administered through a percutaneous intercricothyroid catheter without intubation, HFJV allowed good gas exchange in control subjects with a minimal PEEP effect. In contrast the risk of alveolar hypoventilation was present in COPD patients, raising the problem of CO2 monitoring. The risk of hypercapnia and pulmonary overdistension was important in patients with a compromised upper airway ; end expiratory pressure is a good indicator of overdistension and its monitoring may bring security in this indication.

TABLE : mean ± SD ; * p<0,05 : group control versus either group COPD or group UAO. FEV1 represents the preoperative FEV1 (expressed in % of theoretical value).

	CONTROL	COPD	UAO
n	25	13	8
FEV1 %	88 ± 15	46 ± 18 *	65 ± 15 *
△FRC (ml)	143 ± 93	133 ± 108	449 ± 231 *
EEP (cm H2O)	1.5 ± 1.5	1.0 ± 1.4	5.5 ± 2.3 *
PaCO2 (mm Hg)	42.6 ± 6.6	52.0 ± 14.6 *	55.8 ± 10.6 *
PaO2 (mm Hg)	393 ± 90	278 ± 146 *	413 ± 64

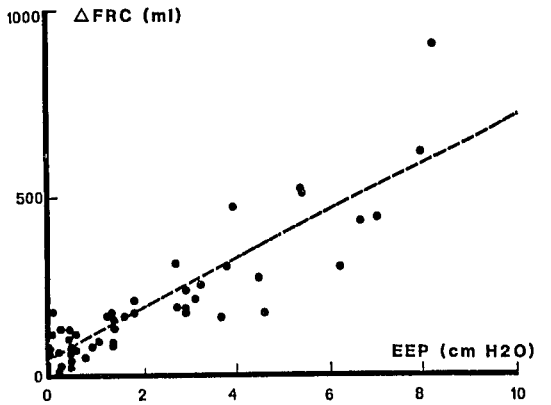

FIGURE : Correlation between EEP and △FRC.

1) BABINSKI M. Anesthesiology 52 ; 178-180 (1980).
2) ROUBY J.J. Anesthesiology 63 ; 473-482 (1985).