Title: HIGH FREQUENCY VENTILATION, SUPERIMPOSED TO A CONVENTIONAL VOLUME-CYCLED VENTILATION, DECREASES ELEVATED INTRACRANIAL PRESSURE

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Introduction.
Although the treatment of elevated intracranial pressure (ICP) is tailored to the cause, if possible, particularly cerebral edema cannot be treated immediately as the repair of the blood-brain barrier begins hours after injury and the clearance of edema fluid takes several days. Consequently, a variety of symptomatic interventions has been proposed including high frequency ventilation (HFV) (1,2). However, the employment of HFV alone insufficient to hyperventilate patients with elevated ICP. The goal of the present study was to determine whether HFV, superimposed to the conventional volume-cycled ventilation, can be useful in the treatment of elevated ICP.

Methods.
12 patients, 14-64 years of age, with localized or generalized cerebral edema and elevated ICP after evacuation of an intracerebral hematoma, exstirpation of a brain tumor or head trauma are included in the present investigation. Epidural ICP was measured by means of a Gaeltec probe. All patients were ventilated in a volume-cycled fashion (IPPV), (Dräger UV2-respirator, PEEP = 5-8 cm H2O, pCO2 = 29-32 mmHg). When ICP reached a level of 20-25 mmHg and, therefore, a decision was made to treat, HFV (8-12 Hz, Clinijet, Logic Air) was superimposed to the conventional volume-cycled ventilation. The tidal volume of the conventional respirator was set back to give the same peak inspiratory pressures measured prior to HFV. The data obtained with IPPV and HFV were compared to the data prior to and after superimposed HFV. Arterial and pulmonary artery pressures were measured direct and continuously, cardiac output was determined using the thermodilution technique.

Results.
Superimposed HFV caused a marked decrease in ICP in about two thirds of the patients under study (Fig. 1), (Table, n=8) while the elimination of carbon dioxide was not changed significantly. There was an increase in pO2 after cessation of HFV which can be attributed to a better distribution of gas flow due to resolution of microatelectases. No significant changes in overall hemodynamics were detected. However, four patients with a malignant increase in ICP and a strikingly reduced cerebral perfusion pressure did not show any improvement.

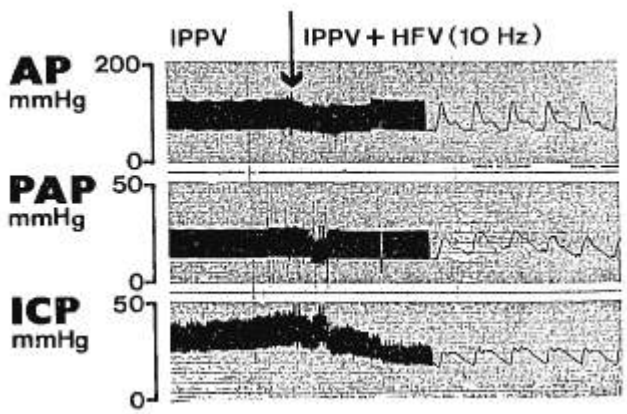
Discussion.
A variety of drugs with many different modes of action is used to control ICP and to protect the brain from the injury caused by ischemia or hypoxia. The present study indicates that HFV on top of conventional ventilation by attenuating the respiration-related alterations in intravascular pressures can be beneficial in patients with elevated ICP.

Table.

	IPPV	IPPV+HFV	IPPV
ICP	30±10	16±9*	15±7*
pCO2	30±1	28±3	31±2
PO2	135±27	136±30	150±26+
HR	96±3	97±3	93±3
MAP	89±3	89±3	87±4
CI	3.6±0.2	3.4±0.2	3.2±0.3
PAP	21±1	22±1	20±1

Means ± SD; +: $p < 0.05$, *: $p < 0.01$

References.
(1) Merritt J, Thompson DR, Layton TR: The effect of high-frequency jet ventilation on intracranial pressure in patients with closed head injuries. J Trauma 24:73-75, 1984
(2) Todd MM, Toutant SM, Shapiro HM: The effects of high-frequency positive pressure ventilation on intracranial pressure and brain surface movement in cats. Anesthesiology 54:496-504, 1981



Recordings of arterial pressure, pulmonary artery pressure and ICP in a patient after head trauma. HFV, superimposed to the conventional volume-cycled respiration decreases ICP markedly.