TITLE: CSF OUTFLOW RESISTANCE AND ICP DURING PENTOBARBITAL AND HALOTHANE ANESTHESIA IN THE CAT

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Introduction. Halothane is known to cause marked increases in intracranial pressure (ICP) in patients with compromised intracranial compliance. The mechanism by which halothane increases ICP has generally been attributed to increased cerebral blood flow, although the effects of halothane on CSF formation and outflow resistance have not been assessed.

The primary objectives of this investigation were to compare: 1) the relative effects of halothane and pentobarbital anesthesia on ICP, both in the resting state and during constant flow infusions of CSF, and 2) to describe the impact of these agents on calculated CSF formation rate and resistance to CSF absorption.

Methods. Thirteen (13) mongrel cats (2.25 to 2.75 kg) were initially anesthetized with pentobarbital (30 mg/kg, IP) and atropine (0.08 mg/kg, IP). Femoral artery and vein catheters were inserted for arterial pressure monitoring and fluid replacement (5 ml/hr), respectively. The animals were intubated and placed in a stereotaxic instrument in the sphinx position. Core body temperature was regulated at 37.5±0.5°C (servo controlled) and end-tidal CO_2 (Beckman LB-2) was maintained at a normal 30 mmHg (controlled volume ventilation). Anesthesia was then maintained with either halothane (0.7%; N=7) or pentobarbital anesthesia (10 mg/kg/hr, IV; N=6). A 16-gauge needle was placed into the cisterna magna through the atlanto-occipital membrane, resting ICP was recorded, and constant flow infusions were performed using artificial CSF at flows of 40, 75, 150, and 400 µL/min until steady-state intracranial pressures (ICP-SS) were obtained. The resulting pressure-flow profile was used for the estimation of both CSF production and CSF resistance to absorption as described previously.[1,2] Data from halothane and pentobarbital were compared for statistical significance using analysis of variance.

Results. Mean resting ICP and mean steady-state ICP (ICP-SS) observed during constant flow infusions are shown in Table 1. There was no significant difference between halothane and pentobarbital with regard to mean arterial pressure or ICP. The ICP-flow profiles were fit to both linear and logarithmic curves, and had correlation coefficients of 0.95 and 0.99, respectively, for halothane, and 0.96 and 0.99, respectively, for pentobarbital. Model estimates of CSF formation were 20.1±0.9 µL/min (halothane) and 25.8±1.0 µL/min (pentobarbital) ($P < .005$). All values were within the normal range.[3] Mean resistance to CSF absorption was greater with halothane than with pentobarbital at all infusion rates, and was statistically significant at infusion rates of 0, 40 and 75 µL/min (Figure 1 and Table 1).

Discussion/Conclusions. Heretofore, the differential effects of halothane and pentobarbital on ICP have been related only to their opposing effects on cerebral vascular resistance. The present study in normal animals suggests an additional difference between these 2 anesthetics with regard to CSF outflow resistance.

We conclude that pathological changes in ICP observed during halothane anesthesia may not be solely related to cerebral vasodilation, but also may be mediated by an increase in CSF outflow resistance acting to further compromise intracranial compliance in cerebral pathological states.

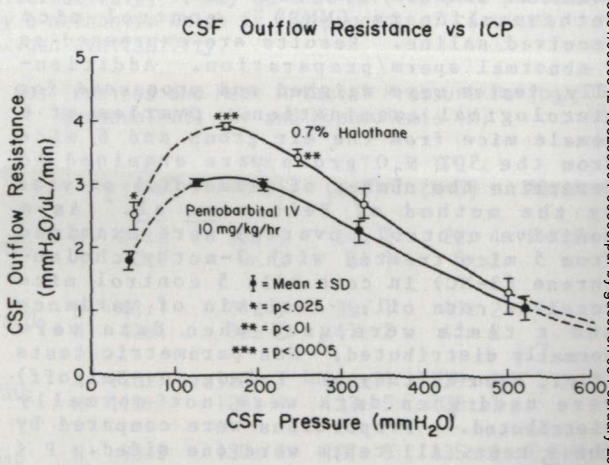
TABLE I

Infusion Rate (µl/min)

		Resting	40	75	150	400
ICP ss	H	51±7	160±12	244±16	325±26	498±[illegible]
(mmH_2O)	P	47±6	127±13	207±17	320±24	522±[illegible]
Resistance	H	2.50±.22*	3.86±.02***	3.41±.12**	2.74±.24	1.42±[illegible]
(mmH_2O/µl/min)	P	1.82±.17	2.99±.05	2.96±.07	2.30±.17	1.09±[illegible]

H = Halothane, P = Pentobarbital,
* = $P < .025$, ** = $P < .01$, *** = $P < .0005$ versus Pentobarbital
ss = steady state

Figure 1



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