Title: COMPARASON OF REGIONAL CEREBRAL BLOOD FLOW DURING ISFLURANE AND HALOTHANE INDUCED HYPOTENSION

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Introduction. The effects of isoflurane (forane) on cerebral blood flow (CBF) have been studied only in terms of the whole brain or regions of the cerebral cortex. There is evidence, however, indicating that CBF is not homogeneously distributed in the brain. In the present study we studied the effects of isoflurane on regional CBF (rCBF) including the subcortical tissues. The concentration of isoflurane was progresively increased to induce arterial hypotension. The results of rCBF distribution at various arterial pressures were compared with those obtained under halothane anesthesia.

Methods. Studies were performed on 17 dogs weighing 13-25 kg. Anesthesia was induced and maintained with isoflurane- or halothane- N_2O (66 percent) + O_2 mixture. Pancuronium (0.3 mg/kg, I.V.) was given for muscle relaxation. P_aCO_2 was maintained at 35-45 torr with a respirator. The end-tidal concentration of isoflurane and halothane was monitored with an Engstrom Multigas Monitor. Following surgical preparation, the dog was ventilated with N_2O (66 percent) and O_2 mixture for at least one hour before making the first set of blood flow measurement (control). Thereafter, 4 concentrations of isoflurane (0.8, 1.5, 2.3 and 3.0 percent; n = 7) or halothane (0.5, 1.0, 1.5 and 2.0 percent; n = 10) were studied. The dogs were ventilated with a given anesthetic concentration until the end-tidal concentration stabilized for at least 15 min before the flow measurement. The rCBF were determined by using radioactive 15 um microspheres (MS). The rCBF and cardiac output (CO) were then calculated from the radioactivities in tissue samples and the arterial reference flow. The mean CBF (mCBF) was obtained from the weighted mean of rCBF. The results were analyzed by using analysis of variance, Student-Newman-Kneul multiple comparison and unpaired Student t test.

Results and Discussion. The hemodynamic and rCBF data are summarized in Table 1. As the concentration of isoflurane or halothane increased, MAP decreased progressively and the changes were comparable in the two groups of dogs. CO and mCBF were comparable in the two groups at low anesthetic concentration. When MAP decreased below 60 mmHg, CO and mCBF were significantly lower during isoflurane anesthesia than halothane. At this arterial pressure, rCBF to cortical and subcortical areas, including diencephalon and brain stem, were all lower during isoflurane than halothane. These findings suggest that halothane is a more potent cerebral vasodilator as compared to isoflurane. The results further indicate that rCBF is better maintained under halothane induced hypotension and that the effects of anesthetic agents on rCBF should be considered in induced hypotension.

Table 1 Anesthetic concentrations, hemodynamic variables, and rCBF during isoflurane (F) and halothane (H) anesthesia

Anesthetic conc		N_2O(66%)	0.8%	1.5%	2.3%	3.0%
			0.5%	1.0%	1.5%	2.0%
MAP (mmHg)	F	157.1 ± 11.7	128.6 ± 5.9	107.9 ± 8.0	87.0 ± 10.5	54.2 ± 5.7
	H	150.5 ± 5.3	128.4 ± 6.3	112.0 ± 6.2	90.3 ± 7.4	57.2 ± 7.9
HR (min^{-1})	F	164.3 ± 17.3	157.1 ± 15.1	147.6 ± 12.6	135.0 ± 10.3	124.3 ± 6.7
	H	156.8 ± 11.0	142.0 ± 9.1	138.1 ± 4.4	132.5 ± 4.4	132.9 ± 4.6
CO(ml/min/kg)	F	108.9 ± 16.1	82.1 ± 12.9	65.9 ± 14.5	55.2 ± 6.3	30.9 ± 4.6*
	H	109.8 ± 12.5	80.9 ± 7.0	69.1 ± 9.8	61.9 ± 7.7	47.7 ± 7.6
mCBF	F	99.7 ± 14.8	63.6 ± 9.0	57.0 ± 6.5	46.9 ± 8.0	21.8 ± 6.3*
(ml/min/100g)	H	85.2 ± 10.4	65.9 ± 8.3	67.2 ± 7.4	73.1 ± 11.2	55.0 ± 11.5
Regional Blood Flow (ml/min/100g)						
Cerebral Cortex	F	109.7 ± 20.5	64.0 ± 9.6	54.2 ± 7.2	39.2 ± 6.6	17.9 ± 5.6*
	H	89.1 ± 11.9	64.4 ± 8.0	67.1 ± 7.2	70.3 ± 10.8	50.9 ± 10.4
Gray matter	F	134.8 ± 29.7	73.3 ± 16.2	57.2 ± 6.9	40.6 ± 5.1	35.2 ± 6.8*
	H	97.4 ± 14.7	75.1 ± 8.9	76.7 ± 8.6	81.6 ± 13.2	55.0 ± 14.3
White matter	F	42.3 ± 5.2	28.0 ± 3.5	27.3 ± 2.6	23.7 ± 5.8	10.2 ± 3.2*
	H	39.8 ± 4.7	23.9 ± 5.5	31.6 ± 4.2	37.0 ± 9.3	19.9 ± 5.6
Upper Medulla	F	59.0 ± 5.4	47.0 ± 6.5	56.7 ± 5.6	61.6 ± 12.4	36.3 ± 10.3*
	H	57.9 ± 6.8	48.1 ± 7.2	54.1 ± 6.4	71.8 ± 10.3	58.3 ± 16.7
Lower Medulla	F	51.8 ± 11.9	38.7 ± 8.4	46.0 ± 6.0	50.5 ± 9.4	30.8 ± 7.9*
	H	42.8 ± 5.3	38.9 ± 4.8	41.9 ± 4.6	63.8 ± 11.6	53.9 ± 18.5
Pons	F	46.4 ± 2.6	37.2 ± 3.9	44.4 ± 6.9	49.9 ± 12.4	24.7 ± 6.4*
	H	48.2 ± 6.3	41.7 ± 6.5	45.6 ± 7.1	59.8 ± 11.4	44.1 ± 13.8
Cerebellum	F	93.2 ± 22.1	59.9 ± 12.9	56.4 ± 6.7	52.4 ± 12.0	28.7 ± 8.4*
	H	63.5 ± 6.0	55.3 ± 6.0	59.7 ± 6.1	61.3 ± 6.6	43.3 ± 11.5
Caudate Nucleus	F	117.2 ± 17.4	73.4 ± 12.4*	80.8 ± 7.8*	85.4 ± 20.0*	33.7 ± 9.5*
	H	117.7 ± 16.7	102.8 ± 18.1	105.9 ± 15.8	120.6 ± 26.0	67.9 ± 23.5
Thalamus	F	90.3 ± 13.72	61.9 ± 11.2	60.5 ± 9.0	68.3 ± 17.2	30.9 ± 8.7*
	H	90.9 ± 14.8	69.0 ± 10.3	73.4 ± 12.1	93.0 ± 19.0	64.1 ± 21.0
Dura mater	F	22.5 ± 4.1	24.6 ± 3.8	21.0 ± 2.6	13.9 ± 4.3	7.5 ± 1.8
	H	30.1 ± 6.7	23.6 ± 4.3	20.0 ± 3.9	13.0 ± 3.5	8.4 ± 2.4

* Significant difference between isoflurane and halothane ($p < 0.05$, student t test)