Title: DISTRIBUTION OF CEREBRAL BLOOD FLOW (CBF) DURING HALOTHANE ANESTHESIA

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Introduction. The effects of halothane on CBF have been studied. In most instances, however, these reports were either on the mean CBF (mCBF) or on the regional CBF (rCBF) of only the cerebral cortex. There is evidence indicating that CBF is not homogeneously distributed in the brain. In the present study the effects of various concentrations of halothane on rCBF including the subcortical tissues, were determined by using the radiolabeled microsphere (MS) technique.

Methods. Studies were performed on 10 dogs weighing 13-25 kg. Anesthesia was induced and maintained with halothane-nitrous oxide (66%)-O_2 mixture. Pancuronium (0.3 mg/kg I.V.) was given for muscle relaxation and P_aCO_2 was maintained at 35-45 torr with a respirator. The end-tidal concentration of halothane (H%) was monitored with an Engstrom Multigas Monitor. Four concentrations (0.5%, 1.0%, 1.5% and 2.0%) of halothane were studied. The dogs were ventilated with a given H% until the end-tidal H% stabilized for at least 15 min before the measurement. The rCBF were determined by radioactive 15 um MS. The rCBF and cardiac output (CO) were then calculated from the radioactivities in tissue samples and the arterial reference flow. The mean arterial pressure (MAP), mean pulmonary arterial pressure (MPAP), pulmonary wedge pressure (PWP), central venous pressure (CVP) and sagittal sinus pressure (SSP, via a midline trephenation) were determined. The systemic and cerebral flow resistances (SFR and CFR) were calculated from the ratio of pressure gradients to flow (CO and mCBF). mCBF was obtained from the weighted mean of rCBF. The stroke volume (SV) was calculated from CO and heart rate (HR). The results were analyzed with the use of analysis of variance and Student-Newman-Kneuls multiple comparison.

Results and Discussion. The hemodynamic data are summarized in Table 1. As H% increased, both MAP and CO decreased progressively while the SFR remained relatively constant. The significant elevations of CVP and PWP associated with a decrease in SV indicate myocardial depression caused by halothane. The relatively constant mCBF associated with a significant decrease in CFR at 1.5 and 2.0% H suggests the presence of autoregulation.

The distribution of rCBF as a fraction of CO (rCBF/CO ratio) was calculated for each H%. The values were compared with those obtained at 0.5% H, and the % change in CBF/CO ratio from that at 0.5% H is shown in Fig. 1. The rCBF/CO ratio in most regions of brain increased at higher H%, but its variation with increasing H% showed remarkable regional variations resulting in a significant redistribution of rCBF when H% increased from 0.5 to 2.0%. As MAP and CO decreased, proportionately more flow was distributed to those regions of brain, e.g., hypothalamus, brain stem and cervical cord, where neurons related to pressure regulations are located. These findings may have significant implications on cardiovascular control during halothane-induced hypotension.

Table 1 Hemodynamic data obtained during halothane-N_2O(66%)-O_2 anesthesia with various concentrations of halothane

	0.5%	1.0%	1.5%	2.0%
MAP	128.4 ±6.3	112.0 ±6.2*+	90.3 ±7.4*+	57.2 ±7.9*
CVP	5.5 ±1.1	6.0 ±1.4+	6.4 ±1.7+	7.6 ±2.9*
MPAP	15.9 ±1.2	15.9 ±0.9	17.6 ±1.5	18.2 ±1.6
PWP	7.9 ±0.9	9.2 ±1.0	10.8 ±1.0*+	12.6 ±1.1*
SSP	8.5 ±0.6	9.9 ±1.1	11.5 ±1.0	9.8 ±1.0
HR	142.0 ±9.1	138.1 ±4.4	132.5 ±4.4	132.9 ±4.6
SV	9.6 ±1.0	8.5 ±1.0+	7.6 ±0.9	5.3 ±0.8*
CO	80.9 ±7.0	69.1 ±9.8+	61.9 ±7.7*	47.7 ±7.6*
mCBF	65.9 ±8.3	67.2 ±7.4	73.1 ±11.2	47.4 ±12.9
SFR	1.74±0.19	1.91±0.27	1.57±0.17	1.29±0.20
CFR	2.24±0.35	1.71±0.23	1.29±0.21*	1.41±0.25*

Units: Pressures in mmHg; HR in min^{-1}; SV in ml^{-1}; CO in $ml\text{-}min^{-1}\text{-}kg^{-1}$; mCBF in $ml\text{-}min^{-1}\text{-}100g^{-1}$; SFR in $mmHg\text{-}ml^{-1}\text{-}min\text{-}kg$; CFR in $mmHg\text{-}ml^{-1}\text{-}min\text{-}100g$

All values are Mean ± S.E.M.
*Compared to 0.5% H : $P < 0.05$.
+Compared to 2.0% H : $P < 0.05$.

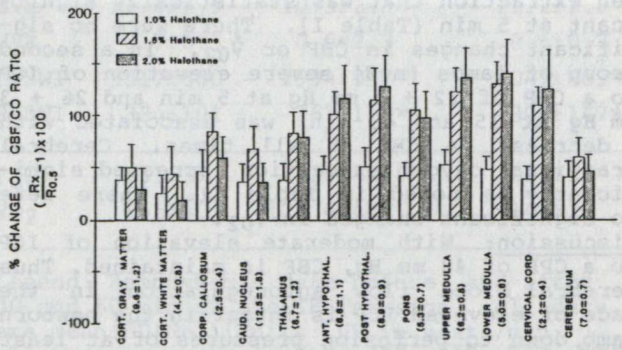

Fig. 1 % change of rCBF/CO ratio (Rx) at 1.0%, 1.5% and 2.0% halothane for various regions of brain as compared to this ratio ($R_{0.5}$) at 0.5% halothane.

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