TITLE: EVOLUTION OF CEREBRAL BLOOD FLOW WITH TIME DURING 1.4 AND 2.8% ISOFLURANE IN DOG

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INTRODUCTION: Previous studies have shown a decrease in cerebral blood flow (CBF) with time during anesthesia with volatile anesthetics (1,2). Those studies have not vigorously controlled factors such as cerebral perfusion pressure and carbon dioxide tension ($PaCO_2$) which may effect CBF. In the present study, we studied two clinically useful concentrations of isoflurane (1.4 and 2.8%) administered for a prolonged period.

METHODS: Eight mixed sex dogs (20-25 kg) were initially anesthetized with thiopental (12 mg/kg, IV bolus), intubated and mechanically ventilated. All animals received 1.4% isoflurane (end tidal) during instrumentation. In group 1 (n=4) isoflurane was continued at 1.4% and in group 2 (n=4), isoflurane was increased to 2.8%. Mean arterial blood pressure (MAP), sagittal sinus pressure (Pss), and cerebrospinal fluid pressure (Pcsf) were recorded and CBF was measured using 15 u radiolabeled microspheres (6 isotopes). Arterial and cerebrovenous PO_2, PCO_2, and O_2 content were measured and cerebral O_2 uptake ($CMRO_2$) was computed as arterial cerebrovenous O_2 content x hemispheric CBF. Cerebral perfusion pressure (CPP) was computed as MAP - Pcsf or Pss, whichever was greater. In both groups, CPP was maintained constant during the study period (6 hours). All animals were allowed a 15 minute period to stabilize following instrumentation and data were determined on an hourly basis for 6 hours.

RESULTS: In both groups, initial data were determined about 1 hour after anesthesia induction. In group 1, total CBF was initially 113 ± 25 ml/100gm/min and fell to 40% of control over the 6 hours of the study. All regions studied (cerebellum, medulla, caudate, white matter and cerebral hemispheres) demonstrated a similar proportional fall in flow. Flow decreased markedly during the first 2 hours and was stable thereafter (Fig 1). CPP was unchanged from control (95 ± 4 mmHg) during the course of the study. Cerebral vascular resistance (CVR) increased from 1.0 ± 0.1 mmHg/ml/min/ 100gm to 2.6 ± 0.5 mmHg/ml/min/100gm at 6 hours. The ratio of $CBF/CMRO_2$ declined from 25 to 16. In group 2, total CBF decreased from 175 ± 24 ml/100gm/min at 1 hour after induction to 52% of control at 6 hours. There was a more prolonged decay in flow than in group 1 and the maximum flow decrease did not occur until 5 hours after anesthesia induction. There was a similar decline in flow in all areas studied except for white matter which showed no change. $CMRO_2$ was unchanged over the course of the experiment but the ratio of $CBF/CMRO_2$ fell from 63 ± 8 to 25 ± 6 (Fig 2). Cerebral vascular resistance increased from 0.5 ± 0.1 to 1.2 ± 0.4 mmHg/ml/min/100gm.

CONCLUSION: CBF declines over time despite constant CPP, $PaCO_2$ and arterial O_2 content with both 1.4 and 2.8% isoflurane. These data suggest that such changes are related to intrinsic anesthetic properties. We found a similar percentage decrease in CBF with 1.4 and 2.8% isoflurane but the decline in CBF was slower in the animals receiving 2.8% isoflurane. Thus, the effect of isoflurane on CBF is both dose and time dependent and the decrease in $CBF/CMRO_2$ ratio with time suggests the decrease in CBF is not metabolically controlled.

Fig 1

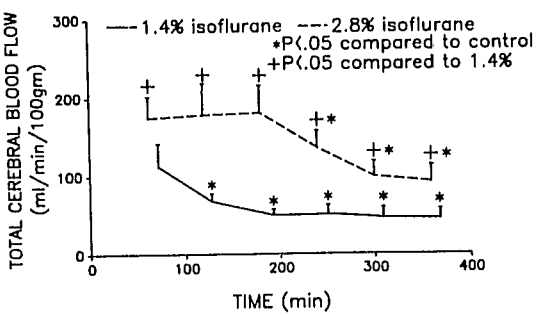
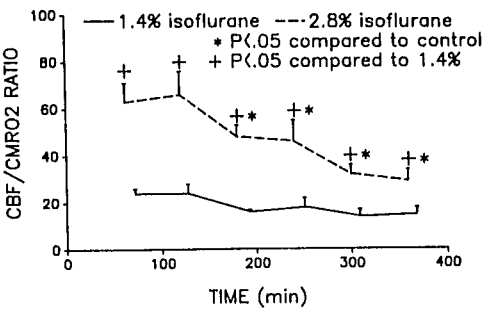


Fig 2



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Supported by NS 20020.