Title: CEREBRAL BLOOD FLOW RESPONSES DURING VARYING RATES OF ISOFLURANE INDUCED HYPOTENSION

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Introduction: Isoflurane has recently been used in neuroanesthesia to induce hypotension during clipping of intracranial aneurysms.[1] Induced hypotension to 50mmHg with Isoflurane has been shown by Newberg et al[2] to cause a significant reduction in cerebral blood flow (CBF) and cerebral metabolic rate for oxygen ($CMRO_2$) at 60 minutes following induced hypotension. The purpose of this study was to determine the effect of the rate of Isoflurane induced hypotension on CBF and $CMRO_2$ immediately following blood pressure reduction as well as after a stabilization period.

Method: 12 mongrel dogs were anesthetized with intravenous thiopental (25mg/kg) intubated and ventilated to maintain arterial blood gases within normal ranges. The animals were paralyzed with pancuronium bromide (.15mg/kg) and anesthesia was maintained with 1.25% inspired Isoflurane. Arterial and venous pressures as well as the ECG were monitored throughout the procedure. A left ventricular catheter, inserted retrograde from the femoral artery, was used for microsphere injections (57Co 113Sn, 103Ru, 46Sc) in order to measure CBF. A catheter was also inserted into the sagittal sinus to determine blood oxygen content for calculation of $CMRO_2$ ($CMRO_2$ =CBF x arterial-sagittal sinus blood oxygen content difference). Following completion of the surgical procedure, the inspired Isoflurane concentration was decreased to 0.75% for 20 minutes prior to control measurements. Mean arterial blood pressure (MAP) was then reduced to 45mmHg (referenced to base of skull) by adjusting the concentration of Isoflurane. In 6 of the dogs, the MAP was reduced rapidly over a 1 to 5 minute period, while in another 6 dogs, the MAP was reduced more gradually over a period of 6 to 10 minutes. Measurements of CBF and $CMRO_2$ were obtained immediately, 15 and 30 minutes following attainment of hypotension. Data was compared by analysis of variance followed by specific post tests where indicated and $p<.05$ considered significant.

Results: Induction of hypotension with Isoflurane resulted in no significant change in $CMRO_2$ (Fig. 1). Rapid reduction of the MAP within 1 to 5 minutes ($2.38 \pm .22$ min) resulted in a significant reduction in CBF (Fig. 2). This reduction remained significant at 15 minutes with recovery to control levels by 30 minutes. A slower induction of hypotension over 6 to 10 minutes ($7.8 \pm .28$ min.) resulted in no significant change in CBF at 0, 15, or 30 minutes following attainment of hypotension.

Discussion: Our results indicate that a transient reduction in CBF that is not accompanied by a similar reduction in $CMRO_2$ is seen when hypotension is induced rapidly with Isoflurane. A slower reduction in blood pressure leaves CBF unaffected. This contrasting effect on CBF of rapid versus slow induction of hypotension may be critical, particularly in patients with regional areas of marginal perfusion due to intrinsic cerebrovascular disease or application of brain retraction pressure. It appears therefore, that when Isoflurane is used to induce hypotension blood pressure reduction should be done gradually to permit enactment of homeostatic mechanism that result in the least alteration in cerebral blood flow.

References:

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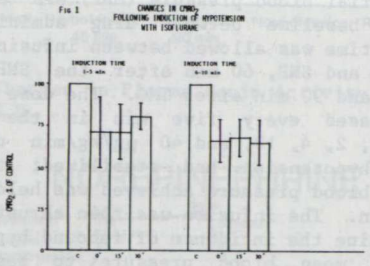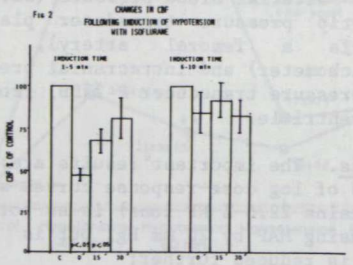
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