TITLE: TRANSIENT HYPOTHERMIC REPERFUSION IMPROVES RECOVERY OF CEREBRAL ELECTRICAL ACTIVITY AFTER NORMOTHERMIC CEREBRAL ISCHEMIA

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INTRODUCTION: Hypothermia (HYPO) during cerebral ischemia is well known to provide protection from neurologic injury. Little is known about the therapeutic potential for hypothermia initiated during reperfusion. This study was designed to determine whether transient hypothermic reperfusion affects recovery of cerebral blood flow (CBF), cerebral oxygen uptake ($CMRO_2$), and somatosensory evoked potential (SEP).

METHODS: Following induction of anesthesia (pentobarbital and fentanyl) dogs (10-13 kg) were intubated and mechanically ventilated. Catheters were inserted for measurement of arterial blood pressure (MABP), intracranial pressure (ICP) arterial and cerebral venous blood gases and CBF (microspheres). Epidural (ET) and esophageal temperature (BT) were monitored continuously. SEP was measured in all dogs as an indication of electrical function. Prior to and during ischemia ET was maintained at 38.5±0.5°C in all dogs. Ischemia was produced for 20 min by increasing ICP to 70 mmHg above MABP. During ischemia blood was withdrawn through an externalized cooling/warming circuit to control BT independent of ET. In dogs selected for HYPO (n=8), the blood in the circuit was cooled to achieve a BT of 29°C while ET remained at 38°C. Reperfusion was induced by normalization of ICP. In HYPO dogs ET was allowed to fall with reperfusion and was maintained at 29°C for 60 min. Rewarming occurred from 60-120 min and dogs remained at 38.0±0.5° from 120-240 min. Normothermic (NORM; n=8) dogs had externalization of blood but had ET maintained 38.0±0.05°C at all times.

RESULTS: There were no differences between groups for pre-ischemic CBF (HYPO, 26±1;NORM, 28±1 ml/min/100g) or $CMRO_2$ (HYPO, 3.1±0.2; NORM 3.3±0.2 ml/min/100g). During ischemia SEP became isoelectric within 2 min. At 240 min of reperfusion cerebral perfusion pressure was higher in HYPO (93±6 mmHg) than NORM (76±4 mmHg) because of lower ICP (25±6 vs 45±7 mmHg). There was no difference for CBF between groups at 10 (HYPO, 134±22; NORM, 152±13 ml/min/100g) or 240 min (HYPO, 19±1; NORM, 24±2 ml/min/100g). $CMRO_2$ recovered to 60±5% of control in NORM and 74±5% of control in HYPO (p=0.07). SEP amplitude recovered to 11±2% of control in NORM and 26±6% of control in HYPO (p<0.05).

DISCUSSION: Transient hypothermic reperfusion minimizes post-ischemic increases in ICP and improves recovery of electrical function without alteration in recovery of CBF. The mechanism for improved SEP recovery following HYPO may relate to reduced ICP or alterations in production or washout of toxic metabolites.

TITLE: EFFECTS OF SEVOFLURANE, ISOFLURANE AND HALOTHANE ON HEPATIC BLOOD FLOW AND OXYGENATION IN CHRONICALLY INSTRUMENTED GREYHOUND DOGS

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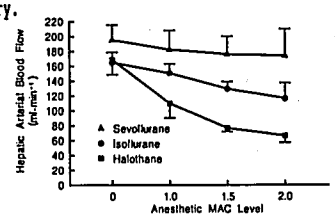
INTRODUCTION: Inhalational anesthetics have variable effects on hepatic arterial blood flow (HABF), portal venous flow (PVF) and total hepatic blood flow (THBF). In this study we compared the effects on hepatic blood flow and hepatic oxygenation of halothane (H), isoflurane (I), and a newer inhalational anesthetic, sevoflurane (S), in a group of chronically instrumented greyhound dogs.

MATERIALS AND METHODS: Seven greyhound dogs (26-30 kg) were anesthetized with thiopental and maintained with isoflurane for electromagnetic flow probe insertion. A midline laparotomy was performed and flow probes placed around the hepatic artery and portal vein. Catheters for blood sampling and pressure monitoring were placed in the portal vein, hepatic vein and aorta. All probes and catheters were tunnelled subcutaneously to the animal's back. The animals recovered for 4-5 days, during which time antibiotics and analgesics were administered. Following recovery, each animal received by inhalation induction either S, I or H on alternate days in a random fashion. Prior to anesthetic administration, baseline measurements of hepatic flow and oxygenation were made. End tidal CO_2 was maintained at 35-40 mmHg during measurements. Data was analyzed by one-way ANOVA with multiple range testing. Significance was defined as $p < .05$. Each anesthetic agent was given at 1.0, 1.5 and 2.0 MAC concentrations equilibrated for 30 min prior to repeating measurements.

RESULTS: HABF was maintained with both I and S compared to control values (Figure 1). Values for HABF with S or I at all MAC levels did not differ. PVBF was maintained better with isoflurane compared to control, however values at individual MAC levels did not differ from those for sevoflurane (Figure 2). Isoflurane did not significantly change O_2 delivery, consumption or the ratio of delivery to consumption. S decreased O_2 delivery compared to control at 1.5 MAC and 2.0 MAC ($p < .05$), while O_2 consumption did not change and the ratio of O_2 delivery to consumption remained unaltered even at 2.0 MAC. At equianesthetic concentrations, S and I did not differ in terms of hepatic delivery or consumption. H, by comparison, reduced HABF and PVBF at 1.0, 1.5 and 2.0 MAC compared to control ($p < .05$) in combination with reductions in hepatic O_2 delivery and consumption.

DISCUSSION: Both S and I produced comparable effects on THBF and hepatic oxygenation. In contrast, halothane causes a loss of autoregulation and semireciprocal flow such that HABF becomes pressure dependent, reducing hepatic blood flow and O_2 delivery.

Figure 1



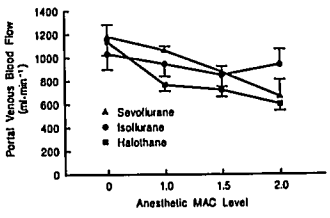


Figure 2