Title: COMPARATIVE CEREBROVASCULAR AND METABOLIC EFFECTS OF HALOTHANE, ENFLURANE, AND ISOFLURANE

Authors: M.M. Todd, M.D., J.C. Drummond, M.D., and H.M. Shapiro, M.D.

Affiliation: Neuroanesthesia Research Laboratory, M-004, Department of Anesthesiology, University of California at San Diego, La Jolla, CA 92093 and the Veteran's Administration Medical Center, La Jolla, CA 92161

Introduction: The volatile anesthetics alter cerebral blood flow (CBF), oxygen consumption ($CMRO_2$) and intracranial pressure (ICP). However, there is insufficient data to allow good comparisons of the effects of the different agents. We therefore evaluated the changes in CBF, $CMRO_2$ and ICP produced by halothane (H), isoflurane (I) and enflurane (E).

Methods: 18 cats were anesthetized with 1% H in 75% N_2O for surgery that included placement of catheters into the femoral artery, rt. atrium, rt. lingual artery (for 133-Xe injection), left parietal subarachnoid space (ICP) and posterior sagittal sinus (SS-for venous sampling). Temperature and P_aCO_2 were kept at 37°C and 30 torr respectively. CBF was measured by recording the washout of intraarterially injected 133-Xe over the rt. parietal skull (after removal of extracranial tissue). $CMRO_2$ was calculated as the arterio-SS O_2 content difference x CBF. When surgery was complete, wound margins were infiltrated with 0.25% bupivicaine, pancuronium given, H discontinued, and ventilation continued with 75% N2O. Study of the selected agent began when end-tidal (ET) H had been <.05% for 20 min. Each agent was studied 15 min. after reaching an ET concentration equal to 0.5, 1.0 and 1.5 MAC, with a return to N_2O control between each level (all possible sequences were studied and N_2O inhalation continued at all times). To correct for different changes in BP, cats were also studied at the 1.0 MAC level after the i.v. infusion of angiotensin sufficient to raise BP to 120 torr.

Results: There were no intergroup differences in any control values. At all levels tested, CBF during H was higher than with I or with E (Figure 1) with the difference maximal at 1.0 MAC with BP control: H=75±12ml/min/100gm (145±9.5% of control: $p<0.05$ vs control and vs E and I), I=44±7ml/min/100gm (83±11% of control: ns vs control), E=53±7ml/min/100gm (101±8% of control: ns vs control) (all data mean±SEM). Nevertheless, there were no differences in ICP, with comparable, dose-related, increases occurring with all agents (maximum observed ICP change =4.4 torr at 1.5 MAC) $CMRO_2$ fell with all agents, but was consistently lower with I and E than with H (Figure 2).

Discussion: Our data confirms the belief that CBF during H anesthesia is higher than with I or E, and suggests that H is a more potent cerebral vasodilator. Conversely, H appears to cause less reduction in cerebral metabolic activity than equi-MAC concentrations of the other two agents. In fact, the minimal changes in CBF seen with I and E may have been due to the greater fall in $CMRO_2$, via intact coupling between flow and metabolism, and the well known effects of changing CMR on flow. The fact that the three agents produced comparable changes in ICP may be explained by the fact that significant differences in brain volume (e.g. blood volume) may not be detectable in these normally compliant animals. The data would seem to support the view that I and E are preferable to H for use in neurosurgical patients if a volatile agent is needed.

Fig.1: CBF (mean±SE-relative to N_2O control) with H,I and E. CBF with H>I, E and control ($p<0.05$) at all levels. CBF with I and E not significantly lower than control.

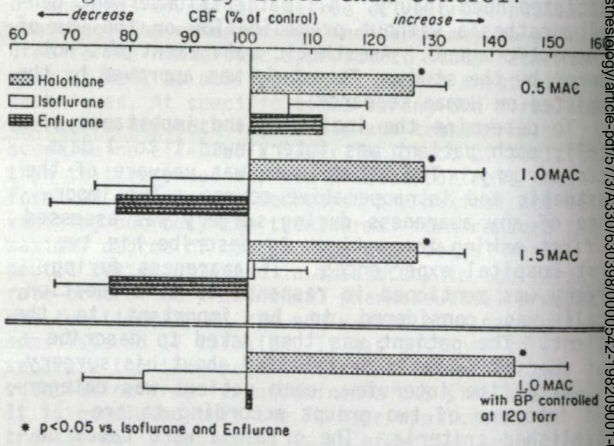

Fig.2: $CMRO_2$ (mean±SE-relative to N_2O control) with H,I and E. $CMRO_2$ with all agents <control, but $CMRO_2$ with H>I and E at all levels ($p<0.05$).