Title: CO_2 RESPONSIVENESS OF THE CEREBRAL CIRCULATION DURING ISOFLURANE ANESTHESIA AND N_2O SEDATION IN CATS

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Introduction: The reduction in cerebral blood flow (CBF), cerebral blood volume (CBV) and intracranial pressure (ICP) that occurs in response to hypocarbia is a valuable adjunct to the management of neurosurgical patients. Accordingly, the impact of anesthetics on CO_2 response ($\Delta CBF/\Delta CO_2$) should be known. It has been suggested that isoflurane (I) may be a useful agent in anesthesia for neurosurgery. To further evaluate this possibility, we compared CO_2 responsiveness during I anesthesia and N_2O sedation.

Methods: Seven mongrel cats were anesthetized with 4% halothane (H), paralyzed (pancuronium), intubated, ventilated and maintained with 1% H and 75% N_2O. Blood pressure (BP), central venous pressure, EKG, EEG, temperature (kept at 37°C), end-tidal (ET) CO_2, ET inhalation agent and ICP (subdural catheter) were monitored continuously. A catheter was placed in the right lingual artery to permit intermittent intracarotid injection of $Xenon^{133}$. CBF was calculated ($T_{\frac{1}{2}}$ method) from Xe^{133} washout recorded over the right parieto-occipital region (extracranial tissue removed). After surgical preparation, wound margins were infiltrated with 0.25% bupivicaine and the H was omitted. N_2O administration continued throughout the experiment. Noise and contact with the animal were avoided. A 90 minute "washout" period resulted in ET H concentrations $\leq$.05% for at least 20 minutes prior to study. CO_2 response curves were derived during administration of 1.0 MAC I (in 75% N_2O) or 75% N_2O alone. In 4 animals both studies were performed (random sequence) with an additional 90 minute "washout" between studies. Single studies were performed in 3 animals (I:2, N_2O:1). Prior to study of I, ET concentration was maintained at 1.0 MAC for 15 minutes. $PaCO_2$ was then lowered to 18-20 torr by adjusting inspired CO_2 and CBF was measured. Successive determinations were made at $PaCO_2$'s of 29-31 (normal for the cat), 39-41 and 47-50 torr. $PaCO_2$ was held constant at each level for 5 minutes before flow determination.

Results: There were no significant intergroup differences between the mean $PaCO_2$ levels at which CBF determinations were made. The CBF data are presented in Fig.1. At $PaCO_2$ 39-41 torr, CBF was greater ($p<.05$) during I anesthesia than during administration of N_2O. While the mean CBF was also greater during I at $PaCO_2$ 47-50 torr, the difference was not significant. At $PaCO_2$ 18-20 torr, CBF was less ($p<.01$) during I anesthesia than during administration of N_2O. The data indicate that CO_2 response (the slope of the CBF/$PaCO_2$ relation) was greater during I administration at $PaCO_2$'s between 18 and 41 torr (Fig.1).

Discussion: Our data indicate that, under conditions of hypocarbia and mild hypercarbia, CO_2 responsiveness of the feline cerebral circulation is enhanced during 1.0 MAC I administration as compared with an N_2O-sedated control state. Increased CO_2 responsiveness is probably not unique to I. We have preliminary data which suggest that the CBF/CO_2 relation for 1.0 MAC H is parallel to that of I (but shifted to higher CBF values). The absence of an increase in CBF (relative to N_2O control) during normocapnic 1.0 MAC I anesthesia observed in this experiment is in keeping with previous results in this laboratory. This phenomenon, in conjunction with enhanced CO_2 responsiveness, resulted in remarkably low flows during hypocapnic 1.0 MAC I administration (26.7±2.6(SEM) ml/100gm/min vs 39.6±1.8 during N_2O/hypocapnia.)

These results indicate that I anesthesia augments the CBF-reducing effects of hypocarbia in cats. If this observation proves applicable to humans, I may provide a useful adjunct to the control of CBF and ICP in the neurosurgical patient. However, the metabolic consequences of this flow reduction require further evaluation. Conversely, these results suggest that the increases in CBF (hence ICP) that will occur as a result of inadvertent hypercarbia may be more marked with I anesthesia than with other techniques.

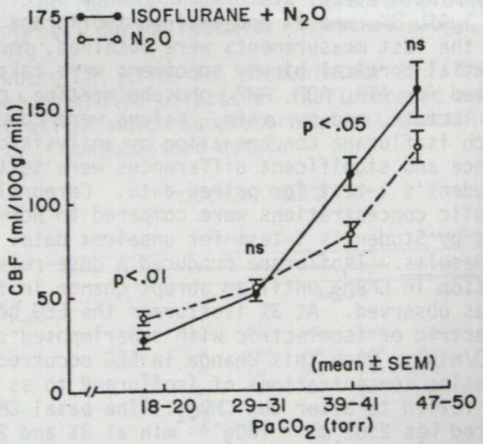

Fig.1: Cerebral blood flow (CBF) at four $PaCO_2$ levels during Isoflurane/N_2O anesthesia and N_2O sedation in cats. Statistical significance is indicated (ns=non-significant, $p>.05$; Students unpaired T-test).