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Title: CO₂ RESPONSIVENESS OF THE CEREBRAL CIRCULATION DURING ISOFLURANE ANESTHESIA AND N₂O 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 hypocarbic a valuable adjunct to the management of neurosurgical patients. Accordingly, the impact of anesthetics on CO₂ response (CBF/PAO₂) 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 CO₂ responsiveness during I anesthesia and N₂O sedation.

Methods: Seven mongrel cats were anesthetized with 4% halothane (H), paralyzed (pancuronium), intubated, ventilated and maintained with 4% H and 75% N₂O. Blood pressure (BP), central venous pressure, EEG, EOG, temperature (kept at 37°C), end-tidal (ET) CO₂, 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. CBF was calculated (T½ method) from Xe133 washout recorded over the right parieto-occipital region (extracranial tissue removed). After surgical preparation, wound margins were infiltrated with 0.25% bupivacaine and the H was omitted. N₂O administration continued throughout the experiment. Noise and contact with the animal were avoided. A 90 minute "washout" period resulted in ET H concentrations ≤0.05% for at least 20 minutes prior to study. CO₂ response curves were derived during administration of 1.0 MAC I (in 75% N₂O) or 75% N₂O 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, N₂O:1). Prior to study of I, ET concentration was maintained at 1.0 MAC for 15 minutes. PaCO₂ was then lowered to 18-20 torr by adjusting inspired CO₂ and CBF was measured.

Successive determinations were made at PaCO₂'s of 29-31 (normal for the cat), 39-41 and 47-50 torr. PaCO₂ was held constant at each level for 5 minutes before flow determination.

Results: There were no significant intergroup differences between the mean PaCO₂ levels at which CBF determinations were made. The CBF data are presented in Fig.1. At PaCO₂ 39-41 torr, CBF was greater (p<.05) during I anesthesia than during administration of N₂O. While the mean CBF was also greater during I at PaCO₂ 47-50 torr, the difference was not significant. At PaCO₂ 18-20 torr, CBF was less (p<.01) during I anesthesia than during administration of N₂O. The data indicate that CO₂ response (the slope of the CBF/PaCO₂ relation) was greater during I administration at PaCO₂'s between 18 and 41 torr (Fig.1).

Discussion: Our data indicate that, under conditions of hypocarbia and mild hypocarbic CO₂ responsiveness of the feline cerebral circulation is enhanced during 1.0 MAC I administration as compared with an N₂O-seated control state. Increased CO₂ responsiveness is probably not unique to I. We have preliminary data which suggest that the CBF/PaCO₂ 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 N₂O control) during normocapnic 1.0 MAC anesthesia observed in this experiment is in keeping with previous results in this laboratory. This phenomenon, in conjunction with enhanced CO₂ responsiveness, resulted in remarkably low flows during hypocarbic 1.0 MAC I administration (26.7±2.6(SEM) ml/100g vs 39.6±1.8 during N₂O/hypocarbia.)

These results indicate that I anesthesia augments the CBF-reducing effects of hypocarbic 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 ICG) that will occur as a result of inadvertent hypocarbic may be more marked with I anesthesia than with other techniques.

Fig.1: Cerebral blood flow (CBF) at four PaCO₂ levels during Isoflurane/N₂O anesthesia and N₂O sedation in cats. Statistical significance is indicated (ns=non-significant, p>.05; Students unpaired T-test).