Title: THE CEREBRAL HEMODYNAMIC AND METABOLIC EFFECTS OF SUFENTANIL IN DOGS

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Introduction. Sufentanil, a synthetic opioid analgesic developed as a total intravenous anesthetic, has a rapid onset of action; provides rapid awakening; produces minimal systemic hemodynamic changes; and blunts the endocrine and metabolic responses to surgical stress. Because of these characteristics, sufentanil has been advocated for use during neurosurgical procedures.[1,2] Clinical studies have reported hemodynamic stability, rapid awakening (± naloxone), and adequate brain relaxation. However, the cerebral hemodynamic and metabolic effects of sufentanil are largely unknown, except when added to $N_2O$ analgesia in the rat.[3] The purpose of the present study was to determine the effects of a large range of sufentanil doses on cerebral function, cerebral blood flow (CBF), intracranial pressure (ICP), cerebral oxygen consumption ($CMRO_2$), and the resultant cerebral energy state in dogs.

Methods. Following approval by the Animal Care Committee, 15 dogs were anesthetized with 0.9% halothane, 70% $N_2O$ in $O_2$. Ventilation was controlled to maintain normocarbia. Cannulae were placed in a femoral artery for blood sampling and pressure measurement and into the posterior sagittal sinus for continuous measurement of CBF and calculation of $CMRO_2$. Mean arterial pressure (MAP), ICP, temperature, electrocardiogram, and 4 lead electroencephalogram (EEG) were monitored continuously. CBF, $CMRO_2$, arterial blood gases, hemoglobin, lactate, pyruvate, glucose, catecholamines, and blood sufentanil levels were measured during the control period and at 5 min intervals for 1 h following the administration of sufentanil. All skin and muscle edges of incisions were infiltrated with 1% procaine. Following discontinuation of halothane and $N_2O$, steady state control measurements were obtained during $N_2/O_2$ ventilation. Each dog then received an IV bolus dose of sufentanil ranging from 2-200 µg/kg and all measurements were continued for 1 h. At the end of the study, cerebral cortical biopsies were taken for determination of the cerebral energy state by measuring levels of ATP, phosphocreatine, glucose, lactate, and by calculating the energy charge.

Results. At all doses, sufentanil produced a significant increase in CBF accompanied by a decrease in cerebral vascular resistance. The maximal increase in CBF (31%; range 2-94%) occurred at 5 min following the bolus injection but the CBF remained significantly increased for 30 min following injection. Because the increase in CBF was not dose-related, figure 1 shows the mean percent change in CBF with time produced by the entire range of sufentanil doses. A significant increase in ICP mirrored the increase in CBF. There was no significant change in $CMRO_2$ with any dose of sufentanil despite EEG changes indicative of deep anesthesia. Cerebral metabolites measured at the end of the study were within normal limits.

Discussion. This study demonstrates that in the dog sufentanil alone, at any of the doses used, is a potent cerebral vasodilator producing a significant increase in CBF and ICP which lasts approximately 30 min following a single injection. This increase in CBF and ICP can be maintained if a constant infusion of sufentanil is used. If these results can be extrapolated to man, the use of sufentanil may be detrimental to neurosurgical patients with space occupying masses and decreased intracranial compliance. In addition, the inability of sufentanil to decrease cerebral metabolism offers no advantage over other neuroanesthetics in situations of possible cerebral ischemia.

References.

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Fig. 1 SUFENTANIL EFFECT ON CEREBRAL BLOOD FLOW