

TITLE: Effects of Hypoglycemia and Hypocarbica on Brain pH, ATP Phosphocreatine, and Blood Flow by NMR Spectroscopy.
AUTHORS: S.A. Derrer, F.E. Sieber, R.C. Koehler, R.J. Traystman and C.D. Saudek
AFFILIATION: Johns Hopkins Medical Institution, Department of Anesthesiology, Baltimore, Maryland 21205

Introduction: Hypoglycemia has been shown to alter cerebrovascular responsivity to hypocarbica. The response to hypocarbica during hypoglycemia is characterized by absence of vasoconstriction and flat EEG, despite normal cerebral oxygen and glucose uptake (CMRO₂ and CMR glu, respectively). The mechanism of this altered response to hypocarbica is unclear. We sought to elucidate the mechanism of this response by using ³¹P-NMR spectroscopy.
Methods: Mongrel dogs (9-11 kg) were anesthetized with fentanyl 50 mcg/kg and pentobarbital 10 mg/kg IV, paralyzed with pancuronium 0.2 mg/kg, intubated and mechanically ventilated. Measurements, including arterial and sagittal sinus blood gases and glucose, NMR spectra, EEG, and microsphere injection, were made sequentially at baseline (condition 1), 60 and 90 minutes after 10,000 U insulin (conditions 2 and 3, respectively) and 10 and 22 minutes after hyperventilation to PCO₂ 15 ± 1 torr (conditions 4 and 5). Normoglycemia was then restored by administration of 8cc of 50% glucose (condition 6), followed by resumption of normal ventilation (condition 7). Four dogs were

not subjected to either hyperventilation or hypoglycemia (group 1). Seven dogs were subjected to hyperventilation only (group 2). Seven dogs were subjected to hypoglycemia only (group 3). Ten dogs received all interventions (group 4). Data were analyzed by ANOVA and Dunnett's Test.

Results: Insulin lowered blood glucose from 2.8 ± 0.2 mmol/l (mean ± SEM) to 1.1 ± 0.1 mmol/l. CMRO₂ and CMR glu did not vary significantly. Cerebral blood flow (CBF) was decreased by hypocarbica in group 2 (36 ± 2 ml/100gm/min) to 23 ± 2 (P < 0.01), while CBF did not vary significantly from baseline in any other group. Arterial pH increased from 7.39 ± 0.01 to 7.64 ± 0.02 during hypocarbica but was unaffected by hypoglycemia. Group 4 had significant changes in ATP to 39% of control (P < 0.01) and phosphocreatine to 43% of control (P < 0.01), as well as an increase in brain pH from 7.13 ± 0.05 to 7.43 ± .09 (P < 0.01). There were no significant changes in these parameters in any other group. Isoelectric EEG was seen in five of ten animals during hypoglycemia and hypercarbia; similar changes were not seen during either hypocarbica or hypoglycemia alone.

Discussion: These data suggest that the loss of cerebrovascular hypocarbica responsivity during hypoglycemia and the associated EEG changes are accompanied by decreases in brain phosphocreatine and ATP, and an increase in brain pH. These alterations occur despite maintenance of normal CMRO₂ and CMR glu.

Title: DOSE-RELATED CHANGES IN CBF AND CMRO₂ DURING PROPOFOL INFUSIONS IN RABBITS
Authors: R Ramani M.D., MM Todd M.D., DS Warner M.D.
Affiliation: Department of Anesthesia, University of Iowa College of Medicine, Iowa City, Iowa

Propofol is known to reduce both CBF and CMRO₂ (1), but no dose-response information is available. This study was thus undertaken to examine the relationship between blood propofol concentrations and changes in CBF and CMRO₂ under conditions where arterial pressures are held constant.

Nine NZW normocarbica, normothermic rabbits anesthetized with morphine (10mg/kg load, 2mg/kg/hr infusion) and 70% N₂O were surgically prepared to allow measurement of forebrain CBF and CMRO₂, using a platinum needle electrode and sampling catheter in the confluence of cerebral venous sinuses. CBF was determined using the H₂ clearance technique, and CMRO₂ was calculated as AVO₂ × CBF. EEG was also recorded. Baseline data was collected, and an infusion of propofol started at a rate of 0.28mg/kg/min. This was increased in increments to a maximum of 1.67mg/kg/min, over a total study period of 3hrs. During this study period, CBF and CMRO₂ were determined every 22.5min. At each data point, arterial blood was also obtained for determination of whole blood propofol concentration, using HPLC. Mean arterial pressure was supported using angiotensin.

In spite of angiotensin, MAP decreased slightly, but did not fall below ~80mmHg. There was a progressive dose-related decrease in CBF, with a minimum CBF ~ to 65% of baseline at a blood concentration of ~40µg/ml (at which point the EEG was isoelectric). At higher concentrations, CBF increased reaching

baseline values at very high concentrations of propofol (i.e. values 2-3x those required for EEG suppression). CMRO₂ fell in parallel with CBF until the EEG was flat, with no further change thereafter. Note that the observed levels of propofol are much higher than seen in humans, but compatible with the levels needed for anesthesia in rabbits (2).

These results indicate a dose-related decrease in CBF and CMRO₂ with propofol under conditions where blood pressure is maintained. However, direct drug-related cerebral vasodilation may occur at excessive propofol concentrations.

- 1) Vandesteene A et al. Anesthesia (Suppl) 43:42-43, 1988
- 2) Adam HK et al. Br J Anaesth 52: 743-746, 1980

