

**TITLE:** EFFECTS OF CHANGE IN ARTERIAL CO<sub>2</sub> TENSION ON BRAIN ENERGY LEVEL DURING INDUCED HYPOTENSION

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Changes in arterial carbon dioxide tension (PaCO<sub>2</sub>) may occur during anesthesia caused by hyper or hypoventilation. It has been shown that hypocarbia can produce changes in the brain energy state similar to those of hypoxia<sup>1</sup> probably by reducing cerebral blood flow (CBF). The absence of CBF autoregulation during profound hypotension<sup>2</sup> in hypocarbic state may cause further decrease in CBF, thus producing severe brain tissue injury due to ischemic tissue hypoxia. On the other hand hypercarbia causes a major derangement of the brain energy state during profound hypotension.<sup>3</sup> We have shown deep anesthesia with halothane reduced cerebral metabolic rate for oxygen (CMRO<sub>2</sub>) and in fact protected the brain against hypotensive stress in normocarbic Wistar rats with unilateral carotid ligation.<sup>4</sup> Can halothane anesthesia also provide some cerebral protection against hypotensive stress during hypocarbia and hypercarbia in the same animal model? This study was designed to answer this question.

**Methods:** Twenty-four hours after left carotid ligation, male Wistar rats (275-300 gms) were anesthetized with halothane-oxygen. Following tracheostomy and cannulation of femoral vessels, they were paralyzed with d-tubocurarine and ventilated with halothane one percent in oxygen at least for 30 minutes, and then throughout the experiment. Four groups were studied. Group 1 with mean arterial pressure (MAP) over 100 torr and PaCO<sub>2</sub> 40 torr was control group. In the remaining groups MAP was maintained at 40 torr by intravenous infusion of Trimetaphan during the experiment. Ventilation was adjusted to maintain PaCO<sub>2</sub> at 40, 20, and over 50 torr in groups 2, 3, and 4 respectively. Temperature was kept at 37C in all groups by means of heat lamp servo-mechanism.

After 20 minutes of hypotension and a corresponding period in the control group the animal's brain was prepared by funnel freezing for subsequent microfluorometric analysis of cortical tissue Adenosine triphosphate (ATP), Phosphocreatine (PCr), and lactate. Student t test was employed for analysis of unpaired data. A value for P of less than 5 percent was considered significant.

**Results:** Arterial pressure and temperature were all maintained at predetermined levels (Table 1). PaO<sub>2</sub> was over 200 torr in all groups. PaCO<sub>2</sub> was not different from control in group 2, but was significantly (P<0.05) lower in group 3 and higher in group 4 than the control group. As the result of changes in PaCO<sub>2</sub> significant respiratory alkalosis and acidosis occurred in groups 3 and 4 respectively.

The levels of ATP and PCr were all preserved in the hypotensive groups when compared with the control group regardless of the level of PaCO<sub>2</sub>. Lactate increased significantly from control only in the hypocarbic group probably representing the metabolic compensation for Alkalosis (Table 2).

**Discussion:** Changes in PaCO<sub>2</sub> of the magnitudes in this study, caused derangements in brain energy stores in lightly anesthetized animals.<sup>1,3</sup> Halo-

thane one percent in oxygen protected the brain tissue regardless of the PaCO<sub>2</sub> levels during Trimetaphan-induced hypotension. It is quite possible that halothane one percent decreases CMRO<sub>2</sub> to a desirable level, hence protecting cerebral tissue against ischemic hypoxia in the rat.

**Table 1** Physiologic Parameters

GROUPS	MAP (torr)	PaO <sub>2</sub> (torr)	PaCO <sub>2</sub> (torr)	pHa
1	105± 3.4	231± 22.9	41.5± 0.3	7.39± 0.01
2	40.1±* 0.2	296.6± 8.0	39.6± 1.0	7.39± 0.01
3	40.8±* 0.2	285.0± 11.0	21.2±* 2.1	7.54±* 0.02
4	40.2±* 0.2	307.5± 11.0	57.2±* 2.1	7.21±* 0.02

Temperature 37C in all groups.

All values are Mean ± S.E.M.

\*Significantly different from Control (P<0.05 unpaired Student t test)

**Table 2** Cerebral Cortical Tissue Metabolite Levels (µmol/gm wet weight) in Control (Group 1) and Hypotensive Groups

GROUPS	ATP	PCr	LACTATE
1	2.33± 0.09	3.63± 0.23	2.30± 0.25
2	2.46± 0.06	3.36± 0.28	1.90± 0.20
3	2.34± 0.06	3.73± 0.40	4.20±* 0.20
4	2.38± 0.05	3.40± 0.20	1.90± 0.20

All values are from Cortex hemolateral to ligated carotid artery.

All values are Mean ± S.E.M.

\*Significantly different from Control (P<0.05 unpaired Student t test)

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