Title: DIFFERENTIAL EFFECTS OF ANESTHETICS ON CHEMICAL REGULATION OF BLOOD FLOW

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Introduction. Our laboratory recently reported an apparent absence of chemical regulation of cerebral blood flow in pentobarbital-anesthetized dogs (3). Therefore, the purpose of the present study was to compare the changes in vital organ blood flow following Pco_2 alterations in conscious dogs with those seen in animals under halothane or pentobarbital anesthesia.

Methods. After induction with thiopental, anesthesia was maintained with halothane 1.5% (HAL, n=9) or pentobarbital 45 mg/kg followed by 6 mg/kg/hr infusion (PB, n=24). Radioactive microspheres were injected into the left ventricle via a catheter passed retrograde through a brachial artery. Cannulation of both femoral arteries permitted dual sampling of microspheres and monitoring of pH, blood gases and systemic blood pressure. Dogs were immobilized with pancuronium bromide (0.1 mg/kg/hr) after completion of surgical preparation 1 hr prior to organ blood flow (OBF) determinations. Alteration of respiratory rate and tidal volume served to vary Pco_2 over a range of 22 to 55 torr. In HAL dogs, anesthesia was then discontinued and a second OBF measurement was made during consciousness (CON) 2 hr later. Animals were terminated with an overdose of KCl, organs removed, dissected, weighed, desiccated, reweighed and counted by gamma spectroscopy to determine absolute OBF (ml/min/g wet tissue). Following log normal transformation of the resulting OBF values (4), an intercorrelation matrix of group OBF vs. Pco_2, hematocrit, mean arterial pressure and cardiac output was constructed. Regression analysis indicated that consistent significant ($P<.01$) correlations occurred only between OBF_{HAL} and Pco_2. The strong dependency of OBF on Pco_2 in the HAL group necessitated its separation into 2 subgroups prior to further analysis (lo CO_2=Pco_2<30 torr, n=4; hi CO_2=Pco_2>40 torr, n=5). Group differences in OBF were then determined by one-way analysis of variance and subsequent multiple comparison by Dunnett's test (2).

Results. As indicated in the accompanying table, no signficant changes from the CON group in OBF occurred in PB dogs. In contrast, Pco_2-related increases in brain, duodenal and lung OBF were observed in animals receiving HAL. Similar results were obtained when OBF data were expressed as percent of cardiac output. Normally, first-pass entrappment of the microspheres results in spuriously low lung OBF (e.g., 0.3 for CON dogs). During anesthesia, regional decreases in vascular tone lead to non-entrappment or "shunting" of spheres and an apparent increase in lung OBF. Such shunting was most obvious in the hi CO_2 HAL subgroup. Interestingly, shunting was well-correlated with Pco_2 in HAL ($r=.835$, $P<.01$), but not in PB dogs ($r=.274$).

Discussion. These results support the earlier observation that HAL augments the vasodilator response to hypercapnia (1). Further, the data substantiate the clinical observation that halothane anesthesia may elevate intracranial pressure to potentially dangerous levels during hypercapnia. Conversely, the well-documented depression of myocardial OBF occurred only during hypocapnia. These findings emphasize the importance of the 1) choice of anesthetic for patients with an ischemic myocardium and 2) continuous monitoring of Pco_2 during halothane anesthesia.

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ORGAN BLOOD FLOWS (ml/min/g wet tissue)

Organ	CON	PB	lo CO_2	hi CO_2
brain[1]	0.8 ± 0.2	0.5 ± 0.2	0.6 ± .3	2.1 ± 0.1*
heart[2]	1.5 ± 0.7	1.6 ± 0.9	0.7 ± .2	1.8 ± 1.0[3]
kidney	4.4 ± 1.2	4.5 ± 1.7	3.2 ± .9	5.4 ± 0.7
lung	0.3 ± 0.3	1.8 ± 1.8	3.5 ± .7*	1.2 ± 0.7
spleen	1.8 ± 1.3	2.0 ± 2.0	1.8 ± .7	2.5 ± 2.0
pancreas	1.2 ± 1.6	0.3 ± 0.2	0.3 ± .3	1.4 ± 1.7
duodenum	0.8 ± 0.4	0.6 ± 0.2	0.7 ± .3	1.6 ± 0.6*

* $P<0.01$

1. entire organs measured
2. left ventricular free wall
3. $\bar{x} \pm$ s.d.