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 PCO₂ 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 bronchial artery. Cannulation of both femoral arteries permitted dual microsphere sampling for simultaneous monitoring of Pb, blood gases and systemic blood pressure. Dogs were immobilized with pancuronium bromide (0.1 mg/kg/hr) after completion of surgery on preparation 1 hr prior to organ blood flow (OBF) determinations. Alteration of respiratory rate and tidal volume served to vary PCO₂ 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. PCO₂, hematocrit, mean arterial pressure and cardiac output was constructed. Regression analysis indicated that consistent significant (P<0.01) correlations occurred only between OBF,HAL and PCO₂. The strong dependency of OBF on PCO₂ in the HAL group necessitated its separation into 2 subgroups prior to further analysis (4°CPCO₂<40 torr, n=4; hi CO₂=Pco₂>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 significant changes from the CON group in OBF occurred in PB dogs. In contrast, PCO₂-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 entrainment of the microspheres results in spuriously low lung OBF (e.g., 8.3 for CON dogs).

During anesthesia, regional decreases in vascular tone lead to non-entrainment or "shunting" of spheres and an apparent increase in lung OBF. Such shunting was most obvious in the hi CO₂ HAL subgroup. Interestingly, shunting was well-correlated with PCO₂ in HAL (r=235, P<0.01), 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 myocardiun and 2) continuous monitoring of PCO₂ during halothane anesthesia.

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References.

<table>
<thead>
<tr>
<th>ORGAN</th>
<th>OBF (ml/min/g wet tissue)</th>
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<tr>
<td>brain</td>
<td>0.8±0.2</td>
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<tr>
<td>heart</td>
<td>1.5±0.7</td>
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<tr>
<td>kidney</td>
<td>4.4±1.2</td>
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<td>0.3±0.3</td>
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<td>1.8±1.3</td>
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<tr>
<td>duodenum</td>
<td>0.8±0.4</td>
</tr>
</tbody>
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* P<0.01

1. entire organs measured
2. left ventricular free wall
3. 3±2 ml