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Introduction

PaO₂/FiO₂ ratio is the marker of hypoxemia according to the American-European Consensus Conference on lung injury. A high FiO₂ level has been reported to variably alter PaO₂/FiO₂ (Allardet-Servent et al. 2009). Adequate blood oxygenation may be difficult to be achieved, even when lungs are ventilated with high O₂ mixtures. In human beings, inspiration of 100% oxygen during anesthesia promotes intra-pulmonary shunt and atelectasis, in contrast to the inspiration of 30% oxygen in nitrogen (Magnusson & Spahn 2003; Marntell et al. 2005). Little attention has been paid to the effect of different fractional inspired oxygen concentration (FiO₂) on arterial oxygenation in dogs. Oxygen causes tissue injury through formation of reactive oxygen intermediates that cause lipid peroxidation, direct DNA damage and protein sulfhydryl oxidation. Until now, it is not known how an exposure to unnecessary high oxygen mixtures can trigger this complex metabolic cascade, especially in those individuals with decreased antioxidant defenses, who are highly susceptible to oxidative stress. The main issue is not related to the use of 100% oxygen, but also to any amount of oxygen that is not necessary. For example, resuscitation of piglets for only 15 min with just 40 or 60% oxygen causes increased oxidative stress and dose-dependent oxidation of DNA and phenylalanine (Sola 2008). The aim of the present study was to compare the effects of different FiO₂ (40, 60, 80 and 100%) on the PaO₂/FiO₂ ratio during mechanical ventilation in anesthetized dogs.

Material and Methods

After approval of the Ethics Committee of the Veterinary Hospital of The Faculty of Veterinary Medicine of the University of Sao Paulo, 24 dogs of different breeds and ages, weighing from 10 to 20kg undergoing elective surgery lasting from 2 to 3 hours were evaluated. All animals included in this experiment were ASA I and II based in clinical examinations and laboratory tests. Pre-anesthetic medication was acepromazine (0.05 mg.kg⁻¹) associated with meperidine (2 mg.kg⁻¹) administered intramuscularly. Anesthesia was induced with 5 mg.kg⁻¹ of intravenous propofol and orotracheal intubation was then performed using a cuffed endotracheal tube. General anesthesia was maintained with 1.4% end-tidal concentration of isoflurane and dogs were mechanically ventilated with intermittent positive-pressure ventilation (IPPV) with a tidal volume of 10 ml/kg, no positive end-expiratory pressure (ZEEP); respiratory frequency was adjusted in order to maintain end-tidal carbon dioxide tension (PETCO₂) between 35-45 mmHg. Intravenous fluid administration used consisted in 10 ml. kg⁻¹ hour⁻¹ lactated Ringer solution. Dogs were randomized into four groups of 6 animals each (n = 6). Group I (G40) was maintained with an expired oxygen fraction (FiO₂)
of 40%; group II (G60) with a FiO₂ of 60%; group III (G80) with a FiO₂ of 80% and group IV (G100) 100% of FiO₂. Arterial blood samples were collected from a catheter inserted in the femoral artery in three different moments in order to obtain the arterial partial pressure of oxygen (PaO₂). The first sample was collected 10 minutes after pre-anesthetic medication; the second sample 10 minutes after stabilization of general anesthesia and the third sample was collected 10 minutes after extubation. The PaO₂/FiO₂ ratio was then evaluated and compared among different moments and groups. Parametric values were analyzed by using one-way analysis of variance (ANOVA). Tukey test was used to analyze differences among groups. P values < 0.05 were considered significant.

**Results**

There were no statistical differences among groups receiving different inspired oxygen concentrations (FiO₂) nor among moments. PaO₂/FiO₂ ratios were similar despite of the FiO₂. Data shown on table 1 demonstrates the behavior of this variable. The ratio was lower in G40 after stabilization of anesthesia (372±96), but statistically there was no difference from the basal value (M1) and also no difference among groups receiving higher O₂ mixtures. G100 animals had slightly higher ratio values in all moments of the experiment.

**Discussion and Conclusions**

According to our study the use of different inspired fractions of oxygen resulted in similar values of PaO₂/FiO₂, which means that maintaining lower FiO₂ levels (40%, for instance) during mechanical ventilation in dogs didn’t cause hypoxemia. It is known that high O₂ mixtures can be harmful for the patient, since it may cause intra-pulmonary shunt and atelectasis as well as tissue injury through formation of reactive oxygen intermediates that cause lipid peroxidation, direct DNA damage and protein sulfhydryl oxidation. For these reasons the use of lower FiO₂ in order to prevent the “side effects” of oxygen would be interesting, as long as it didn’t compromise oxygenation. Although G40 had lower PaO₂/FiO₂, it was statistically and physiologically similar to all other groups. In conclusion, the use of lower FiO₂ during mechanical ventilation in anesthetized dogs didn’t cause hypoxemia and had similar values of oxygenation when compared with groups with higher O₂ mixtures.

**References**


**Keywords:** PaO₂/FiO₂ ratio, oxygenation, hypoxemia, oxygen toxicity

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**Table 1 - PaO₂/FiO₂ ratios**

<table>
<thead>
<tr>
<th>Group</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>G40</td>
<td>441±103</td>
<td>372±96</td>
<td>403±105</td>
</tr>
<tr>
<td>G60</td>
<td>415±65</td>
<td>447±39</td>
<td>465±46</td>
</tr>
<tr>
<td>G80</td>
<td>426±22</td>
<td>436±57</td>
<td>468±61</td>
</tr>
<tr>
<td>G100</td>
<td>441±18</td>
<td>465±95</td>
<td>475±37</td>
</tr>
</tbody>
</table>

Data presented as mean ±SD. M1 = 10 minutes after pre-anesthetic medication. M2 = 10 minutes after stabilization of anesthesia. M3 = 10 minutes after extubation. Numbers shown in the group column represent the inspired fraction of oxygen (ie. G40 = 40% of FiO₂).