

**TITLE:** COMPARISON OF TWO FORMULAS FOR CALCULATING ALVEOLAR OXYGEN TENSION IN CANINE OLEIC ACID-INDUCED PULMONARY EDEMA

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**Introduction** Alveolar oxygen tension (PAO<sub>2</sub>) is a major variable in the calculation of venous admixture or intrapulmonary shunt. PAO<sub>2</sub> can be derived from either of two formulas: one assumes a respiratory quotient of 0.8 (1,2); the other requires analysis of inspired, expired, and end-tidal gases using the mixing equation (3).

In an experimental model of oleic acid-induced pulmonary edema, we examined the differences in PAO<sub>2</sub> and venous admixture resulting from these two different methods of calculating PAO<sub>2</sub>.

**Methods** Thirty-six mongrel dogs were anesthetized with pentobarbital and succinylcholine, intubated, and ventilated with an inspired oxygen tension (FiO<sub>2</sub>) of 0.4. The tidal volume was 18-20 ml/kg, and the respiratory rate was adjusted to achieve normocarbida. Arterial blood was sampled from the femoral artery; mixed venous blood was sampled from the pulmonary artery. Percent oxygen saturation in blood samples was measured directly using cooximetry.

PAO<sub>2</sub> was calculated using the following formulas:

$$\text{PAO}_2\text{-1} = \text{PiO}_2 - [\text{PaCO}_2] [\text{FiO}_2 + \{(1 - \text{FiO}_2) \div R\}]$$

$$\text{PAO}_2\text{-2} = \text{PiO}_2 - \{(\text{PetCO}_2 - \text{PiCO}_2) \div (\text{P}\bar{\text{E}}\text{CO}_2 - \text{PiCO}_2)\} [\text{PiO}_2 - \text{P}\bar{\text{E}}\text{O}_2]$$

where R = respiratory quotient (assumed to be 0.8); PiO<sub>2</sub> and PiCO<sub>2</sub> = inspired O<sub>2</sub> and CO<sub>2</sub> tensions, respectively; PaCO<sub>2</sub> = arterial CO<sub>2</sub> tension; PetCO<sub>2</sub> = end-tidal CO<sub>2</sub> tension; P<sub>̄</sub>E<sub>2</sub>O and P<sub>̄</sub>E<sub>2</sub>CO<sub>2</sub> = mixed expired O<sub>2</sub> and CO<sub>2</sub> tensions, respectively.

Mixed expired gas samples were obtained from a 3-liter reservoir, which filled over 6 to 7 breaths. Alveolar O<sub>2</sub> saturation was calculated using PAO<sub>2</sub>-1 and PAO<sub>2</sub>-2 values by the method of Ruiz et al (1). Oxygen content and venous admixture were calculated using standard formulas with PAO<sub>2</sub> obtained by the PAO<sub>2</sub>-1 or the PAO<sub>2</sub>-2 formula.

Following baseline measurements, oleic acid, 0.06-0.08 ml/kg, was administered into the right atrium while the left pulmonary artery was temporarily occluded to produce a model of asymmetric pulmonary edema. Two hours later, repeat measurements were obtained.

Data, expressed as mean ± standard deviation, were analyzed by paired t-tests. This study was approved by the Institutional Research Practice and Animal Care Committees.

Table 1. PAO<sub>2</sub> and Venous Admixture using PAO<sub>2</sub>-1 and PAO<sub>2</sub>-2 Formulas (mean ± SD)

	PAO <sub>2</sub> -1	Baseline	Oleic Acid
PAO <sub>2</sub> (mmHg)		213±22	211±25
Venous admixture (%)	8.7±2.9		29.9±12.2
	PAO <sub>2</sub> -2		
PAO <sub>2</sub> (mmHg)		211±22	223±28 *
Venous admixture (%)	8.5±2.9		30.2±12.3 *

\* p < 0.01 compared to corresponding PAO<sub>2</sub>-1 value

**Results** As seen in Table 1, there were no differences in the calculated PAO<sub>2</sub> or venous admixture values at baseline. Following the administration of oleic acid, PAO<sub>2</sub> and venous admixture were significantly higher when the PAO<sub>2</sub>-2 formula was used. However, the correlation of venous admixture values calculated from PAO<sub>2</sub>-1 and PAO<sub>2</sub>-2 was 0.998 after oleic acid (Figure 1).

**Discussion** Both methods of calculating PAO<sub>2</sub> yielded similar results at baseline. Although the differences in PAO<sub>2</sub> after oleic acid were statistically significant, we believe that a 1% difference in venous admixture would have minimal clinical importance. As can be seen in Figure 1, the calculated values of venous admixture following oleic acid were quite similar and highly correlated. Thus, in our model, the PAO<sub>2</sub>-1 and PAO<sub>2</sub>-2 formulas yield essentially similar values, and the simpler PAO<sub>2</sub>-1 formula can be used.

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#### References

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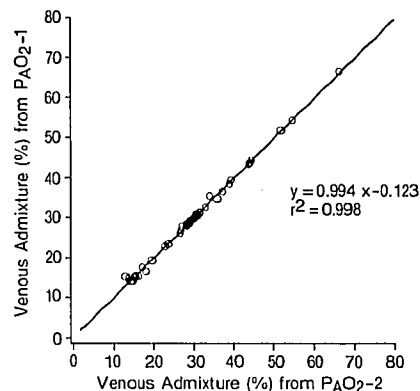


Figure 1. Correlation of venous admixture calculated by the two PAO<sub>2</sub> formulas after oleic acid.