camera system provides a complete view from the perspective of the laryngoscopist, including essential oropharyngeal elements.

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The authors have no financial affiliation with Airway Cam Technologies, Inc., relating to sales or use of their direct laryngoscopy video system.

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(Accepted for publication January 9, 1996.)

Anesthesiology
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Alveolar Oxygen Partial Pressure, Alveolar Carbon Dioxide Partial Pressure, and the Alveolar Gas Equation

To the Editor:—I wish to comment on a frequent misconception found in many textbooks of anesthesia and critical care concerning the alveolar gas equation. The usual form of the equation has led to the incorrect conclusion that a change in alveolar oxygen partial pressure (PA_{O_2}) following a change in alveolar ventilation ($\dot{V}A$) is secondary to a change in the alveolar carbon dioxide partial pressure (PA_{CO_2}). PA_{O_2} does not change secondary to changes in PA_{CO_2} but depends on three factors: inspired oxygen partial pressure (PI_{O_2}), oxygen consumption ($\dot{V}_{O_2}$), and alveolar ventilation. These three factors can be altered clinically to affect PA_{O_2}.

The alveolar gas equation, in its simplest form, derives PA_{O_2} from the expression $PI_{O_2} - PA_{CO_2}/R$, where R is the respiratory exchange ratio.[1] Riley *et al.*[2] derived the original form of the equation from the statement $R = \dot{V}_{CO_2}/\dot{V}_{O_2}$, where $\dot{V}_{CO_2}$ is the production of carbon dioxide, to overcome practical problems in the measurement of PA_{O_2}. Further, a Fick equation states; $\dot{V}_{O_2} = \dot{V}A(FI_{O_2} - FA_{O_2})$, where FI_{O_2} is the fraction of oxygen in inspired air and FA_{O_2} is the fraction of oxygen in alveolar air. This can be modified to:

$$PA_{O_2} = PI_{O_2} - PB - 47)\ \dot{V}_{O_2}/\dot{V}A, \qquad (1)$$

where PB is barometric pressure, partial pressures are in mmHg, and all measurements are at BTPS, which Nunn describes as a universal alveolar air equation.[3] This equation demonstrates the features that determine PA_{O_2}.

Moreover, a second Fick equation for carbon dioxide states, where

$$FI_{CO_2} = 0,\ \dot{V}_{CO_2} = \dot{V}A \cdot PA_{CO_2}/(PB - 47). \qquad (2)$$

From the definition of R, it follows that

$$\dot{V}_{CO_2} = R \cdot \dot{V}_{O_2}. \qquad (3)$$

Substituting equation 3 into equation 2, one finds that

$$R \cdot \dot{V}_{O_2} = \dot{V}A \cdot PA_{CO_2}/(PB - 47)$$

or $\qquad (4)$

$$\dot{V}_{O_2}/\dot{V}A = PA_{CO_2}/R \cdot (PB - 47).$$

Equation 4 demonstrates how the ratio $\dot{V}_{O_2}/\dot{V}A$ from equation 1 is directly related to PA_{CO_2}. Substituting equation 4 into equation 1, $PA_{O_2} = PI_{O_2} - PA_{CO_2}/R$. Some authors assume that the alveolar gas equation also illustrates the underlying physiology and conclude that changes in PA_{CO_2} result in changes in PA_{O_2}.[4]

Therefore, the term PA_{CO_2}/R in the alveolar gas equation is used as an indirect measure of $\dot{V}_{O_2}/\dot{V}A$. Further, the alveolar gas equation is only valid under steady-state conditions with no inspired carbon dioxide, and as FI_{O_2} approaches 1.0, a correction factor must be applied to allow for differences in inspired and expired volumes. This is explained more completely by Hlastala.[5]

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(Accepted for publication January 12, 1996.)