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A Mathematical Examination of I:E Ratio and PEEP on Mean Airway Pressure Utilizing a Lung Model

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During mechanical ventilation, mean airway pressure, P_m, is considered a measure of total alveolar recruitment.[1, 2] Increases in inspiratory time have been shown to beneficial, in some studies, in the management of ARDS and other life-threatening pulmonary conditions. This is frequently through the application of inverse ratio (IRV) ventilation.[3] Furthermore, positive end-expiratory pressure, PEEP, is also utilized in these situations.[4] However, excessive inspiratory time can lead to “air trapping” by not allowing adequate expiratory time. In addition, excessive PEEP can lead to pulmonary barotrauma. A mathematical model, incorporating P_m, I:E ratio, and plateau pressure, P_L, has been previously derived:[5]

$P_m/P_L = [(I:E) + R]/[(I:E) + 1]$. (1)

Where $R = PEEP/P_L$.

In order to examine this relationship, a lung model was created using a typical 3 liter collapsible bag, from an anesthesia circuit, with a large rubber band placed circumferentially around the bag. Using a Dräeger Narkomed 6000, a 1 liter tidal volume was then delivered, to this model, at a rate of 10 breaths per minute. PEEP was varied from 0 to 8 cm H_20 and I:E ratio was also varied from 1:5 to 5:1.

An analysis of these data showed an R-squared coefficient of 98.5% when compared to the predicted values from equation (1).

In conclusion, a mathematical model of mean airway pressure has been demonstrated in a bench setting. Further assessment of this physical relationship, in both normal and pathological states, appears indicated.

1. Boros SJ. Variations in inspiratory:expiratory ratio and airway pressure wave form during mechanical ventilation: the significance of mean airway pressure. *Journal of Pediatrics*. 94(1):114-117, 1979.

2. Huang, CC, MJ Shih, YH Tsai, YC Chang, TCY Thomas, KH Hsu. Effects of inverse ratio ventilation versus positive end-expiratory pressure on gas exchange and gastric intramucosal PCO_2 and *p*H under constant mean airway pressure in acute respiratory distress syndrome. *Anesthesiology* 95(5):1182-1188, 2001.

3. Mercat, A, JL Diehl, F Michard, N Anguel, JL Teboul, J Labrousse, C Richard. Extending inspiratory time in acute respiratory distress syndrome *Crit Care Med*. 29(1):40-44, 2001.

4. Naik S, A Greenough, FJ Giffin, A Baker. Manoeuvres to elevate mean airway pressure, effects on blood gases and lung function in children with and without pulmonary pathology. *European Journal of Pediatrics* 157(4):309-312, 1998.

5. Atlas G. A mathematical model of mean airway pressure based upon positive end-expiratory pressure, I:E ratio, and plateau pressure. *Cardiovascular Engineering: An International Journal* 3(4): 131-139, 2003.

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