



Risks and benefits of Ventilatory Ratio

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Background

Increased dead space is associated with adverse outcome in ARDS patients. Ventilatory Ratio (VR) has been proposed as its bedside surrogate. We investigated to which extent VR may surrogate the physiological deadspace in an experimental setting.

Methods

Seventy-eight pigs (23.8±2.2 kg) were ventilated with different setups for 48 hours. The VR was computed as:

$$VR = \frac{VE \ (ml/min) * PaCO_2(mmHg)}{178 \ ml \cdot kg^{-1} \cdot min^{-1} * 40 \ mmHg}$$

where VE is the minute ventilation, and 178 $ml \cdot kg^{-1} \cdot min^{-1}$ is the predicted "ideal" minute ventilation to keep PaCO₂ at 40 mmHg. In men, this constant is 100 $ml \cdot kg^{-1} \cdot min^{-1}$ accounting for lower metabolic CO₂ production. Gas exchange variables were collected every 6 hours.

Results

Tidal volume ranged from 7.03 to 43.2 ml/kg, respiratory rate from 5 to 44 bpm, and PEEP from 0 to 25 cmH₂O. At baseline, VR was 1.34 ± 0.2 , due to instrumental deadspace, and decreased with time(p<0.001). In Figure (A) we report the regression between the physiological deadspace and VR(p<0.001). Of note, the association between the two variables was primarily due to the anatomic component of the deadspace directly related to VR, while the alveolar dead space was slightly but significantly inversely related to the VR, as shown in Figure (B) (p<0.001). The inverse relationship between alveolar deadspace and VR is possible when the alveolar ventilation decreases more than the VCO₂ production, as occurred in our experimental setup. In addition, the VR may stay unmodified even in presence of a large increase of physiological deadspace if the PaCO₂ remains constant, due to the associated decrease of metabolic CO₂ production.



Conclusions

Although VR is increasingly used as a surrogate of deadspace fraction due to its simplicity and availability at bedside, it is worth recognizing that in several situations, primarily when the VCO₂ excretion suddenly changes together with the alveolar deadspace, VR may stay unmodified despite large modification of underlying physiology.