Ventilo

What is alveolar ventilation?

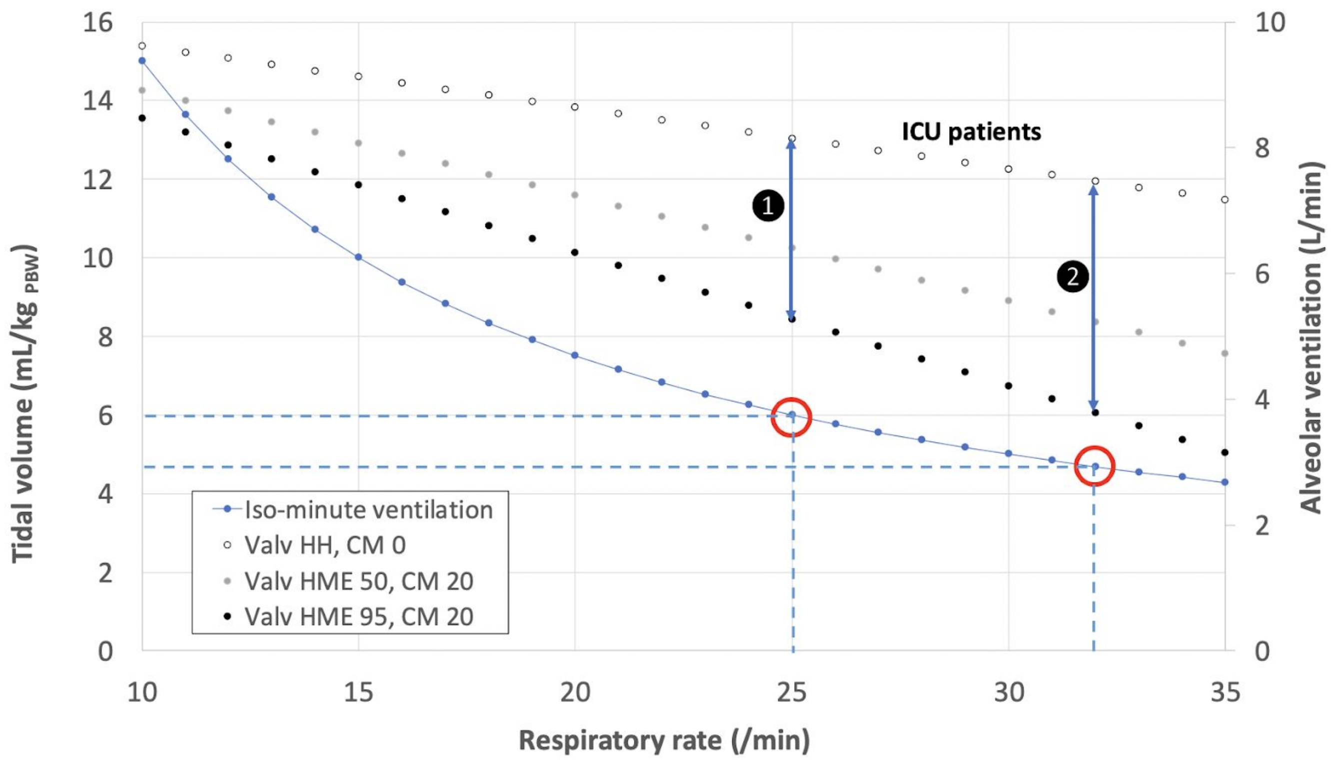
○ Alveolar ventilation (V_{alv}) is the part of the ventilation that is effective for gas exchanges, i.e. minutes ventilation minus dead space ventilation.

The calculation of the alveolar ventilation corresponds to the following formula:

$$V_{alv} = (V_T - V_{Dtotal}) \times RR$$

During protective ventilation, with reduced V_T and elevated respiratory rates (RR), the V_D/V_T is increased and alveolar ventilation can be substantially reduced if the instrumental dead space is important (use of catheter mounts or other connectors and HMEs).

This is illustrated in the following figure.



The figure represents the impact of dead space on alveolar ventilation for different settings that provide the same minute ventilation (iso-minute ventilation blue line, corresponding to 150 mL/kg $_{PBW}$ in a 175 cm man). In intensive care patients (ICU) with protective ventilation, the impact of V_D can be substantial. For a V_T of 6 mL/kg $_{PBW}$ with a RR of 25/minute (case ❶), the alveolar ventilation increases from 5.3 to 8.1 L/min by reducing the V_D to a minimum. For a V_T of 4.7 mL/kg $_{PBW}$ with a RR of 32/minute (case ❷), alveolar ventilation increases by two fold from 3.8 to 7.5 L/min, reducing V_D to a minimum. In these situations, it is crucial to minimize the instrumental dead space as much as possible in order to prevent the accumulation of CO_2 [1].

Abbreviations : V_{Alv}: alveolar ventilation; HH: heated humidifier; HME: heat and moisture exchanger; CM: catheter mount.

In this application, we estimate alveolar ventilation from well-known equations as a function of dead space and minute ventilation. We estimate the gain in alveolar ventilation after reduction of the instrumental dead space for stable V_T and RR settings [2-6]. We also propose an estimation of the impact of the reduction in V_T for constant alveolar ventilation on plateau and driving pressure as described in Moran's study [4].

All these estimations underline the importance of the different parameters (ventilator settings and V_D) on the efficiency of mechanical ventilation, the impact on alveolar ventilation, and on gas exchanges. This is all the more relevant as tidal volumes have been gradually reduced over the past 20 years[7], as a consequence of trials that have demonstrated the negative effects of high V_T delivered to patients undergoing mechanical ventilation.

References

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