The (Mechanical) Power of (Automated) Ventilation

To the Editor,

Recently, in the Journal, Baedorf Kassis et al[1] compared adaptive support ventilation (ASV) with conventional invasive ventilation with respect to important ventilator settings in subjects with ARDS. The results of their randomized crossover clinical trial, confirm the results of another study that compared ASV with invasive ventilation.[2] Indeed, ASV keeps tidal volume (V_T) within the broadly accepted safety limit. With automated ventilation modes like ASV, V_T decreases especially in patients with a higher driving pressure (ΔP).

Mechanical power (MP) of ventilation is the amount of energy transferred from the ventilator to the respiratory system, a summary value that includes relevant components of lung-protective ventilation[3] that have been shown to have associations with patient-centered outcomes as well as mortality.[4-6] In the study of Baedorf Kassis et al,[1] the amount of MP was 28.2 [22.2–36.4] J/min and 26.9 [23.8–37.9] J/min, with ASV and with invasive ventilation, respectively, surprisingly higher than in other studies in subjects with ARDS.[4,5] This difference may be driven by disease severity: the sicker the lungs, the higher the MP. However, differences may also be caused by differences in the way MP was calculated. Baedorf Kassis et al determined the inspiratory work of breathing from the area under the inspiratory limb of the airway pressure/volume curve and multiplied it by the breathing frequency to calculate the MP.[7,8] This is somewhat different from the frequently used simple equation for MP, wherein V_T is multiplied by frequency and the difference between peak pressure and ΔP:[3]

$$\text{MP (J/min)} = 0.098 \times V_T \times \text{frequency} \times (\text{Ppeak} - \tfrac{1}{2} \times \Delta P)$$

We are aware that it is not certain yet what the correct method is to calculate MP, but to allow comparison with other studies, it would be helpful if Baedorf Kassis et al also provide MP calculated by using the simple equation. Besides, given that all of the subjects in this study received an esophageal balloon catheter as standard of care, it would be very interesting to also see the MP of the lung (ie, using the transpulmonary pressures with the equation mentioned above).

We also noticed in their study that permissive hypercapnia may not have been used in all subjects, since the reported median arterial pH was normal. This suggests that clinicians may have targeted a more "normal" arterial P_{aCO_2} that corrects the arterial pH, than accepting a "high" arterial P_{aCO_2} as part of permissive hypercapnia. Could this also explain the high MP in their study? In fact, permissive hypercapnia is an attractive way to reduce MP. Since each breath contains energy, decreasing the number of breaths, as part of permissive hypercapnia, lowers the total energy. It is uncertain how ASV will compare to traditional ventilation with regard to MP when permissive hypercapnia is used.

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