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Inspiratory flow: The lost variable?

Flujo inspiratorio: ¿la variable perdida?

Dear Editor,

Mechanical power (MP) has been defined as the energy applied per cycle multiplied by respiratory rate (RR). Also, it has been associated with the development of ventilator-induced lung injury (VILI) and mortality in patients with acute respiratory distress syndrome (ARDS).[1,2]

Controlling some of the variables that condition MP has become the paradigm of ventilatory strategy in ARDS: *a)* using appropriate levels of positive end-expiratory pressure (PEEP) to improve alveolar recruitment and functional residual capacity (FRC); *b)* limiting tidal volume (TV) above the FRC (strain); *c)* controlling transpulmonary pressure (stress) or its surrogate, driving pressure (DP). We may, however, have paid less attention to other determinants of MP like inspiratory flow.

ARDS is a heterogeneous condition with open alveolar units coexisting with units occupied by edema and collapsed units. How can inspiratory flow impact such a heterogeneous lung parenchyma? In a randomized study, Santini et al. compared the effects of low (400 mL/s), medium (800 mL/s), and high (1200 mL/s) inspiratory flows demonstrating a worsening of the Pendelluft phenomenon and an uneven distribution of TV with higher inspiratory flow rates.[3] The time constant of the units varies, and those with longer time constants could be being ventilated inadequately with shorter inspiratory times and higher flow rates, thus leading to overdistension of the units ventilated earlier, increased DP, and more damage to the lung/s. On the other hand, rapid and repeated deformations with high flow rates could also lead to a heterogeneous distribution of MP, thus triggering intracycle rupture of the interstitial matrix separating the alveolar units and, ultimately, causing alveolar structural damage, especially in units with more deteriorated viscoelastic properties.[4] We could hypothesize that the existence of an MP threshold for each alveolar unit, dependent upon inspiratory peak flow, is a contributing factor to VILI.

From our own point of view, the use of low inspiratory flows would be part of the measures aimed at homogenizing lung ventilation along with the search for optimal PEEP to improve FRC and prone positioning. However, using low flows is associated with the risk of making expiratory time insufficient to achieve complete lung emptying, thus favoring the appearance of auto-PEEP. Also, asynchronies may occur in the context of low flows if the patient has preserved respiratory drive and high flow demand. Finally, we cannot overlook the importance of flow morphology (constant/decelerating) without being able to clarify the impact of each on lung injury.

Proper monitoring followed by the addition of these concepts into the search for an individualized ventilatory strategy poses an interesting and necessary challenge.[5] Therefore, advocating for a comprehensive strategy aimed at minimizing ventilatory parameters in ARDS to avoid VILI, including all the variables that impact MP (TV, DP, PEEP, respiratory frequency, and flow) seems like the right thing to do

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