The complicated relationship between PEEP and mechanical power in ventilator-induced lung injury

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Mechanical ventilation is a tricky balancing act. Ventilators involve many different settings, and a change to one nearly always causes shifts in others. This interdependence makes it difficult to pinpoint what parameters might contribute to lung injury. And this ambiguity extends to positive end-expiratory pressure, or PEEP. Although many believe that PEEP protects against ventilation-induced lung injury, a new report in the journal Anesthesiology argues that PEEP is also a source of risk. According to the report, this dual nature is the result PEEP’s key role in mechanical power. The concept of mechanical power serves to provide a unified overview of how different ventilator settings relate to the risk for ventilator-induced lung injury. In essence, mechanical power describes the intensity of energy delivered to the respiratory system during ventilation. The sum of this energy depends on everything from tidal volume to respiratory rate. And it also depends on PEEP, which makes PEEP a potential risk factor for injury. To determine what circumstances might cause PEEP to become dangerous, researchers looked at the effects of different PEEP levels in pigs. Thirty-six animals were randomly allocated to six PEEP groups and then ventilated for 50 hours at the assigned PEEP level. Respiratory mechanics, gas exchange, and hemodynamic variables were assessed every 6 hours. The team found that over a certain threshold, there’s a change in how PEEP contributes to mechanical power. Total mechanical power didn’t shift much at lower levels of PEEP, presumably from due to offsets in other factors, like driving pressure. But at higher levels of PEEP, this compensatory effect disappeared, and mechanical power increased proportionally to the applied PEEP.
In line with these results, increasing PEEP was also associated with proportionally greater damage to the lung. For example, higher levels of PEEP resulted in increased vascular congestion, inflammation, lung collapse, and septal dilatation. Notably, however, the complete absence of PEEP caused nearly as much damage. Overall, it seems that PEEP is indeed an important determinant of damage under certain scenarios. And while these findings can’t directly translate to humans, they do lay an important foundation for understanding the purely mechanical role of PEEP in ventilator-induced lung injury.

Positive End-expiratory Pressure and Mechanical Power by Francesca Collino, Francesca Rapetti, Francesco Vasques, +16 Anesthesiology (2 October, 2018)