Commentary

Ventilatory management of ARDS: high frequency oscillation and lung recruitment!

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See related research by David *et al*., http://ccforum.com/content/10/4/R100

Abstract

Many aspects of ventilatory management in patients with ARDS are still controversial and one of the major controversies is should HFO or CMV ideally be used to manage this patients. As shown by David *et al*. when the two approaches to ventilatory support are applied using similar principles the physiologic outcomes appear to be similar. With both approaches the use of lung recruitment maneuvers early in ARDS (1 to 3 day) after hemodynamic stabilization in patients without baratrauma is promising. The key to managing ARDS regardless of mode is to use an open lung protective ventilatory strategy. It is not the mode that makes the difference, it is the approach used to apply the mode!

It is now clearly established that the approach to ventilatory support in acute respiratory distress syndrome (ARDS) can have a negative impact on outcome [1]. Most would agree that overdistension and opening and closing of unstable lung units should be avoided [2]. However, the precise methodology to accomplish these two primary goals of ventilatory support is still hotly debated. Should we use conventional mechanical ventilation or high frequency oscillation (HFO)? Should we use low positive end-expiratory pressure (PEEP) or high PEEP? Should we recruit the lung or allow it to gradually open over time? In spite of the scores of laboratory and clinical studies addressing these questions published over the years, these questions are still left unanswered.

In the current issue of *Critical Care*, David and colleagues [3] provide another piece to this puzzle. They compared the impact of lung recruitment on organ blood flow and hemodynamics using HFO and pressure-controlled ventilation (PCV) in a swine combined lung lavage and ventilator induced lung injury model. They demonstrated that regardless of approach, at comparable mean airway pressures blood flow to the brain, heart, kidneys and jejunum was maintained during lung recruitment. This occurred in spite of significant decreases in mean arterial blood pressure, cardiac output and stroke volume along with significant increases in left ventricular end-diastolic pressure, pulmonary artery occlusion pressure, and intracranial pressure during recruitment with both HFO and PCV. The maximum mean airway pressure evaluated was 30 cmH_2O. In pressure control, this was accomplished with a PEEP of 20 cmH_2O, peak inspiratory pressure of 40 cmH_2O and an inspiratory:expiratory ratio of 1:1. With both HFO and PCV, oxygenation markedly improved during the recruitment procedure, with shunt fractions decreased to $<5\%$ at the highest mean airway pressures.

These data from David and colleagues [3] again demonstrate comparable physiological responses from HFO and conventional mechanical ventilation (CMV) when similar strategies are used to ventilate patients. Comparable physiological outcomes have been previously demonstrated by Sedeek and colleagues [4], and others [5,6] in laboratory studies when HFO and CMV have been applied with the same principles. This is also true in clinical studies; Bollen and colleagues [7] preformed a meta-analysis of neonatal randomized controlled trials comparing high frequency ventilation to CMV and demonstrated that, when both approaches were applied with a similar open lung protective strategy, no difference whatsoever existed in measured outcomes. Only in those trials where high frequency ventilation or CMV were applied with a non-lung protective approach were outcomes different. The only adult randomized controlled trial [8] of HFO versus CMV also provides no answer to the question of which of these techniques is preferred. No significant differences in mortality

ARDS = acute respiratory distress syndrome; CMV = conventional mechanical ventilation; HFO = high frequency oscillation; PCV = pressure-controlled ventilation; PEEP = positive end-expiratory pressure.

were observed, although a strong trend in mortality favored HFO. However, CMV was hardly provided in a lung protective format. Tidal volumes were 10 ml/kg predicted body weight and plateau pressures were on average 38 cmH_2O. An additional better-designed randomized controlled trial is needed to determine if outcome differs between the use of HFO and CMV in adult ARDS. My guess, as shown by David and colleagues [3], is that no difference will be observed if both approaches are applied with a similar open lung protective strategy. It is not the mode of ventilation that is important, it is the approach used to apply the mode that is critical!

The second issue raised by the Davis and colleagues study [3] is should the lung in ARDS be recruited? Unfortunately, there are no outcome data available to definitively answer this question. Nor are there definitive data available to clearly define how to recruit the lung. In my opinion, the lung should be recruited as soon as the patient is hemodynamically stabilized during the initial application of mechanical ventilation regardless of the mode used. The recruited lung requires less fraction of inspired oxygen, less ventilating pressure, is less likely to develop pneumonia, has better surfactant function, and is less likely to develop ventilator associated lung injury compared to the unrecruited lung. These benefits should translate into better outcome. A recent study by Borges and colleagues [9] clearly demonstrated that, in early ARDS, lung recruitment maneuvers can open and maintain open ≥ 95% of the lung. This required the use of high peak airway pressure (40 to 60 cmH_2O) with high PEEP levels (25 to 45 cmH_2O) and the careful selection of the optimal PEEP level post-lung recruitment using a decremental PEEP/MAP trial.

How high a pressure to use during recruitment is also debatable; I am now comfortable based on available data recommending the use of PCV with a peak pressure up to 50 cmH_2O and a PEEP up to 30 cmH_2O for 1 to 3 minutes as a recruiting strategy provided patients are recruited early in ARDS (1 to 3 days), are hemodynamically stable and have no indication of existent barotrauma or an increased likelihood of developing barotrauma. Post-recruitment, the key to sustaining the lung open is the identification of the optimal PEEP level required by the specific patient using a decremental PEEP trial.

Management of ARDS is complex and still generates more questions than answers. Additional laboratory and clinical studies are clearly needed to complete the puzzle and definitively define the best ventilatory approach in ARDS.

Competing interests

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