Commentary

Prone position in mechanically ventilated patients – the hard or the soft way?

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See related research by Michelet *et al*. in this issue [http://ccforum.com/content/9/3/R251]

Abstract

Prone positioning may even in patients without abdominal hypertension result in an increased intra-abdominal pressure (IAP). Previous research could not demonstrate a marked increase in IAP associated with cardiovascular, renal, or hepato-splanchnic dysfunction when patients were proned in air-cushioned beds. Michelet and colleagues in this issue of *Critical Care* report that the increase in IAP in the prone position depends on the used mattress type. Compared with air-cushion beds, conventional foam mattresses resulted in a greater increase in IAP which was associated with a decrease in the plasma diappearance rate of indocyanin green (PDRICG) indicating inadequate hepto-splanchnic function.

Lung protective mechanical ventilation with high positive end-expiratory pressure and low tidal volumes has been demonstrated to decrease mortality [1] but it may not always ensure adequate gas exchange in severe acute respiratory distress syndrome (ARDS).

Although prone positioning has been suggested to be lung protective, randomized multicentre trials were unable to demonstrate improved survival in patients with ARDS with prone positioning [2,3]. Prone positioning is increasingly being used to treat patients with ARDS because in 60–70% of these patients prone position improves oxygenation, sometimes dramatically [2]. Several mechanisms have been proposed to account for this effect, including an increase in end-expiratory lung volume, better matching of ventilation and perfusion, and regional changes in ventilation associated with alterations in chest wall mechanics [2,4]. Pelosi and coworkers [3] observed that improvement in arterial oxygenation during prone positioning correlates with a decrease in the compliance of the thoraco-abdominal cage. In anaesthetized, mechanically ventilated pigs, increased intra-abdominal pressure (IAP) has been shown to result in further improvement in arterial oxygenation with prone positioning [5]. These data support the contention that simply turning the patient prone without minimizing restriction of the abdomen should be sufficient to improve arterial blood oxygenation in ARDS [6-9]. However, patients with ARDS rarely die from hypoxia and/or hypercapnia but commonly develop systemic inflammatory response with cardiocirculatory instability and impaired organ perfusion that culminates in multiple organ system dysfunction syndrome and death [10]. Most recently, Malbrain and coworkers [11] demonstrated that IAP above 12 mmHg is associated with severe organ dysfunction in critically ill patients. Increased IAP, even at unchanged arterial pressures, will result in decreased abdominal perfusion pressure, which is strongly associated with development of organ dysfunction and reduced survival in critically ill patients [12].

In this issue of *Critical Care*, Michelet and coworkers [13] report the effects of mattress type on IAP and liver function estimated by plasma disappearance rate of indocyanine green (PDRICG) during prone positioning. They investigated mechanically ventilated patients with ARDS who were placed prone for 6 hours on a conventional foam mattress or an air-cushioned mattress. Compared with the conventional foam mattress, the use of the air-cushioned mattress limited the increase in IAP and prevented the decrease in PDRICG (a marker of inadequate hepatosplanchnic function) with prone positioning in patients with ARDS. In agreement with the findings reported by Michelet and coworkers [13], previous clinical investigations [6-9] found moderate but significant rises in IAP without impairment in cardiovascular function, renal function, or hepatosplanchnic function during short periods of prone positioning with air-cushioned mattresses. In contrast, increased IAP has been observed with foam mattresses, which could not be reversed by placing pillows under the thorax and the pelvis during prone positioning [14].

ARDS = acute respiratory distress syndrome; IAP = intra-abdominal pressure; PDRICG = plasma disappearance rate of indocyanine green.

Based on the findings presented by Michelet and coworkers [13], it may be concluded that air-cushioned mattresses must be used to prevent increased IAP during prone positioning. It is noteworthy that those authors and previous clinical studies [6-9] investigated changes in IAP during prone positioning in patients with normal to moderately increased IAP. It is not yet clear whether air-cushioned mattresses are sufficient to prevent further increases in IAP during prone positioning in patients with intra-abdominal hypertension. Intra-abdominal hypertension has been observed to be present frequently in extrapulmonary induced ARDS when compared with pulmonary induced ARDS [15]. When these patients must be turned prone to ensure adequate gas exchange, IAP should be measured because IAP above 12 mmHg combined with abdominal perfusion pressure below 65 mmHg has been found to be associated with increased incidence of organ dysfunction and death. In agreement with this, Michelet and coworkers [13] demonstrated a reduction in PDRICG from 17 to 12% with an increase in IAP from 7 to 14 mmHg. However, in that study and in the studies by Hering and coworkers [8,9], prone positioning on air-cushioned mattresses resulted in an IAP of 12 to 15 mmHg, which was not associated with renal or hepatosplanchnic dysfunction. The short time period of prone positioning in those studies may be another important factor preventing organ dysfunction.

Michelet and coworkers [13] highlight another important argument in favour of broad use of air-cushioned mattresses, namely that this approach may reduce the incidence of pressure ulcers during prolonged periods of prone positioning. Because air-cushioned mattresses lower interface pressure to a greater extent than do foam mattresses, a reduction in the incidence of skin lesions during prone positioning may be anticipated with air-cushioned mattresses. Michelet and coworkers did not investigate the incidence of skin lesions during prone positioning. Therefore, their suggestion that further research be concentrated on the occurrence of skin lesions during prone positioning must be supported.

Competing interests

The author(s) declare that they have no competing interests.

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