

Trendelenburg in Acute Respiratory Distress Syndrome: Should We Do More than Proning?

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We read with interest the article by Kodamanchili et al.¹ describing the use of Trendelenburg position for improvement of respiratory mechanics in acute respiratory distress syndrome (ARDS). A 25-year-old lady with ARDS benefitted from head-down position with an improvement in delivered tidal volume, CO₂ removal, and improvement in static lung compliance. While the observation is interesting, the theories suggested by the authors to explain the same need further examination.

The authors suggest that the lower functional residual capacity (FRC) caused by cranial displacement of the diaphragm and cephalad migration of the abdominal contents would translate to a higher tidal volume (TV) when the lungs are inflated to total lung capacity (TLC). The TLC is the sum of the FRC, TV, and inspiratory reserve volume (IRV). In ARDS, we ventilate patients with tidal volumes of 4–6 mL/kg. Even in the case described, the improvement of the lung compliance resulted in a tidal volume of 300–320 cc, which is not anywhere near the lungs getting inflated to TLC. Therefore, improvement in ventilation due to the lungs getting inflated to TLC seems unlikely.

While Trendelenburg position leads to a decrease in FRC, it will not lead to an improved tidal volume delivery for the same pressures, unless there is an associated improvement in lung compliance. Trendelenburg position led to a worsening in the lung compliance and resistance in patients ventilated with 15° head down tilt in elective surgery.² In the study cited by the Kodamanchili et al., Trendelenburg position decreased the total lung compliance by 17% when head-down position reached 20° in anesthetized children.³ However, these were subjects with otherwise normal lungs and not the stiff lungs we frequently encounter in ARDS.

The parachute theory proposed by the authors regarding reconfiguration of the diaphragm in Trendelenburg position improving mechanical efficiency is seen in spontaneously breathing patients with low cervical spinal cord injury.⁴ While ARDS patients on mechanical ventilation may have varying degree of diaphragmatic thinning and dysfunction, they are physiologically different from patients with spinal cord injury. The benefit of diaphragmatic reconfiguration in head down could benefit only if the patients were spontaneously breathing and not when they are paralyzed by neuromuscular blockers.

The question is why did the authors observe such an improvement with Trendelenburg position. Bellani et al.⁵ described a case of 63-year-old lady who showed similar improvement in the lung compliance (from 12 to 14 mL/cm of H₂O) with Trendelenburg position. They used electrical impedance tomography (EIT) and found that head-down position from supine led to a decrease in

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overdistention of the lung by 21%, and an improvement in stress index of the lung. Essentially, the decrease in end-expiratory lung volume (EELV) in Trendelenburg position resulted in the lungs moving to a more compliant position on the pressure volume curve. This led to a decrease in tidal overinflation that was reflected by an improvement in compliance and driving pressures. The decrease in lung overdistension was seen mainly in the nondependent lung areas. A recent observational study by Marrazzo et al.⁶ noted similar improvement in the lung compliance in 20 patients with COVID-19-related ARDS when the head position was lowered from 40° head up to flat-supine position. Based on these observations, the “rigid chest wall” theory suggested by Kodamanchili et al. may have some merit, although the amount of lung recruitment might vary between dependent and nondependent lung zones.

Therefore, ARDS patients showing improvement in respiratory mechanics following head down position should alert us to the possibility of tidal overinflation. This could serve as an indicator for PEEP titration with significant improvement in compliance in head-down position indicating a need to reduce PEEP. This appears to be an exciting area of research for optimizing ventilation in ARDS patients.

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