

Role of prone ventilation in the management of patients with acute respiratory distress syndrome

Acute respiratory distress syndrome and acute lung injury were defined at the North American-European Consensus Conference in 1994 (Bernard et al, 1994). They both have acute onsets of refractory hypoxaemia and are spectrums of the same syndrome, with the more severe acute respiratory distress syndrome having a ratio of partial pressure of arterial oxygen to the fraction of inspired oxygen (P/F) of ≤ 200 mmHg and acute lung injury having a P/F of ≤ 300 mmHg. To fulfil the definition, there must also be bilateral pulmonary infiltrates in the absence of left atrial hypertension. Acute respiratory distress syndrome has a mortality of approximately 40% and in those who survive to discharge there is frequently persistent morbidity.

Mechanical ventilation is the mainstay of supportive interventions for patients with acute respiratory distress syndrome. A large number of trials have been carried out in this patient group, but only the use of low tidal volume has been shown to reduce mortality. The search for other ventilatory strategies in patients with acute respiratory distress syndrome has led to interest in ventilating patients in the prone position. The physiological rationale of prone ventilation is that it optimizes lung recruitment and ventilation perfusion matching while preventing alveolar over-inflation and allowing better postural drainage.

Prone ventilation should be used

A number of randomized controlled trials have shown that prone ventilation improves oxygenation, but have failed to show mortality benefit. These trials enrolled patients with a wide spectrum of pathologies and severity of hypoxia. In addition, different treatment protocols were used with no consensus on initiation,

frequency and duration of time in the prone position.

A post-hoc analysis in the randomized controlled trial performed by Gattinoni et al (2001) showed improved mortality in a subset of patients with severe hypoxaemia. Subsequently, Taccone et al (2009) demonstrated a trend for improved 28-day mortality using prone ventilation for patients with severe hypoxia.

A large meta-analysis compared patients with severe (P/F < 100 mmHg) and moderate (P/F ≥ 100 mmHg) hypoxaemia who had received prone ventilation (Sud et al, 2010). This improved oxygenation by 27–39% over the first 3 days and reduced the incidence of ventilator-associated pneumonia. A significant mortality benefit was seen for patients receiving prone ventilation with P/F < 100 mmHg but not in patients with a P/F ≥ 100 mmHg. Furthermore, prone ventilation is free and can be readily implemented in any intensive care unit.

Prone ventilation should not be used

Only a single meta-analysis (Sud et al, 2010) combining randomized controlled trials with heterogeneous methodologies and patient groups has been able to demonstrate mortality benefit in the subgroup of patients with severe hypoxia (P/F < 100 mmHg). Although potentially important, this finding requires confirmation in adequately powered randomized controlled trials in selected subgroups that are hypothesized a priori to likely benefit with prone ventilation before it can be used as a standard strategy.

Prone ventilation is associated with increased sedation, muscle paralysis, and haemodynamic instability (Taccone et al, 2009). The meta-analysis by Sud et al (2010) also demonstrated that prone positioning increases the risk of pressure ulcers (relative risk=1.29), endotracheal tube obstruction (relative risk=1.58) and chest tube dislodgement (relative risk=3.14). These complications increase with time spent in the prone position and therefore

repeated meticulous observations of the patient while prone are essential. Such complications are potentially catastrophic in critically ill patients, particularly those with the lowest P/F ratios.

There is no consensus on when to place the patient in the prone position, the daily frequency of turning, the duration of the prone position or the duration of the treatment. Prone positioning is relatively contraindicated in patients with unstable fractures of the face, pelvis or spine, early after sternotomy, in cardiovascular instability, pregnancy and with intracranial hypertension. Such infrequently performed and inconsistently used manoeuvres may best be initiated in centres with greater experience. If the benefit of prone ventilation is of alveolar recruitability it can be performed without the hazards of prone positioning. It is still unclear why prone ventilation should only benefit the subgroup with severe hypoxaemia.

Conclusions

Given the associated risks prone ventilation should not be used in every patient with acute respiratory distress syndrome. However, it should be considered as a strategy in severe cases and a P/F < 100 mmHg can be used as a guide. **BJHM**

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