

Prone to ventilate in ARDS ?

Nepean WTET summary 17/3/20

Rationale

- Anatomically a larger volume of lung parenchyma is distributed posteriorly as compared to anteriorly in the chest. This in combination with the effects of gravity and the mass effects of anterior (superior when supine) mediastinal structures lead to poor ventilation-perfusion (VQ) matching in this area in supine patients -by means of increased atelectasis, collapse and regional dependent oedema culminating in significant shunt and worsening hypoxia, most markedly so in those patients already at risk eg acute respiratory distress syndrome (ARDS)
- Prone ventilation promotes a more homogeneous aeration of the lung, by placing mediastinal structures now inferiorly and allowing effects of gravity to pull open previously collapsed regions of the lung and improving secretion drainage. Perfusion remains high in the posterior (now non-dependent) portions of lungs primarily due to anatomy and a predominance of blood flow to these areas. This enables better VQ matching, reduced shunt and marked improvement in oxygenation (hypoxia in the presence of high shunt fractions responds poorly to increases in FiO₂ –which may paradoxically cause PaO₂ to fall!)
- But it is more than just improvement in gas exchange. Improved recruitment of lung parenchyma facilitates better lung protective ventilation strategies (and likely also reduce overdistension of healthy alveoli) by minimising atelectotrauma and improved compliance (may appear to fall initially immediately after proning due to reduced chest wall compliance; but subsequently it improves) leading to less ventilator induced lung injury, and is associated with an improved response to recruitment maneuvers. Furthermore, there is a reduction in RV afterload (and thus reduced RV dilatation and septal dysfunction) and an increase in preload and CO
- Therefore proning is a particularly attractive strategy for lung pathologies that are acute, diffuse and reversible. Those that have most to gain are those with highest shunt fractions and so are usually 'severely' hypoxic, with poor lung compliance and an RV that is therefore acutely pressure overloaded. Hence this strategy may be appropriate for early severe ARDS

Indications and contraindications

- Indications;
 - Moderate-severe ARDS (P/F<150)
 - May also be used for patients with posterior burns or wounds that are safer managed in the prone position
- Contraindications;
 - Severe facial or c-spine trauma, unstable spine or pelvis, raised ICP, arrhythmias or a high chance the patient will need CPR (CVS instability)
 - Pregnancy (although successful reports in even as late as 3rd trimester reported), open abdomen or concerns for intraabdominal hypertension (to include extreme obesity)
 - Large ventral burns, recent sternotomy (post cardiothoracic surgery)

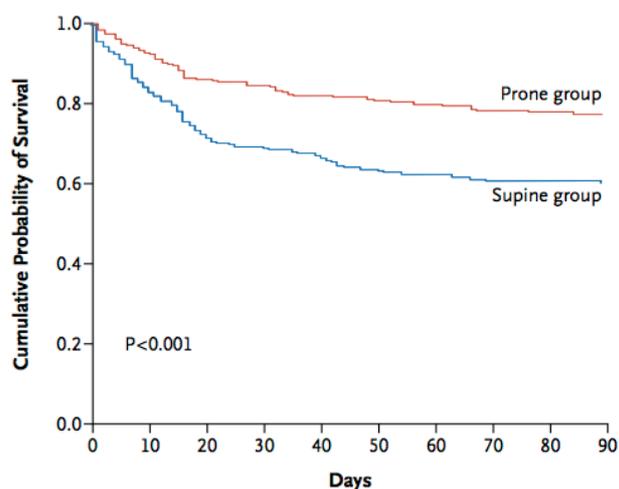
- Risks;
 - ETT displacement (including loss of airway), neuropraxia and pressure injuries (particularly ocular and genitals), increased ICP, reduced nutrition

Evidence

- Small studies initially demonstrated an improvement in oxygenation without associated translation to improved mortality; these were limited by small sample sizes, cross-over between groups, non-standardised ventilatory strategies (often high tidal volumes) and inclusion of patients with mild disease
- PROSEVA (2013 NEJM)
 - MC RCT France (+1 ICU Spain); EARLY prone vs supine (semirecumbant) in; ARDS (<36h of invasive ventilation) P/F<150, FiO₂ >0.6, PEEP>5 after a 12-24h stabilisation period, stratified by ICU
 - Prone protocol; 16+ h, continued til P/F>150 with FiO₂ <=0.6 and PEEP<=10 sustained for at least 4h after last prone session (average no. was 4+/-4 sessions)
 - n=466, with lung protective ventilatory strategy for all (VT 6ml/kg PBW)
 - 28d mortality (16% vs 32.8% P<0.001) and 90d mortality (23.6% vs 41%, P<0.001); higher incidence of cardiac arrest in SUPINE group
- No trials since (unethical) comparing prone to supine ventilation in this patient group
- Despite this LUNG-SAFE data showed only 16.4% of severe ARDS are proned
- Trials comparing prone ventilation to VV ECMO;-controversial results (discuss in later WTET)

Summary (my practice)

- Few treatments in ICU are free. Even fewer have shown to 1/2 mortality with a NNT6
- I am therefore vigilant for and consider prone ventilation EARLY in patients with moderate to severe ARDS P/F<150 unless absolute contraindications exist
- I will prone for a period of 16h or more and will continue usually for a period of 5 days or more or until significant and sustained improvement negates the need for further sessions; I use this in combination with a lung protective ventilatory strategy
- I aim to time proning when there is adequate number and seniority of staff but avoid significant delays as the efficacy of late proning is not as well established; major complications of proning are uncommon with a disproportionate fear of these
- Staff training and exposure important to maintain skill and safety and a unit protocol should exist for reference for all staff to pre-empt and minimise recognised complications



No. at Risk	0	10	20	30	40	50	60	70	80	90
Prone group	237	202	191	186	182					
Supine group	229	163	150	139	136					