

The Use of Prone Positioning in Acute Respiratory Distress Syndrome: An Evidence Based Review

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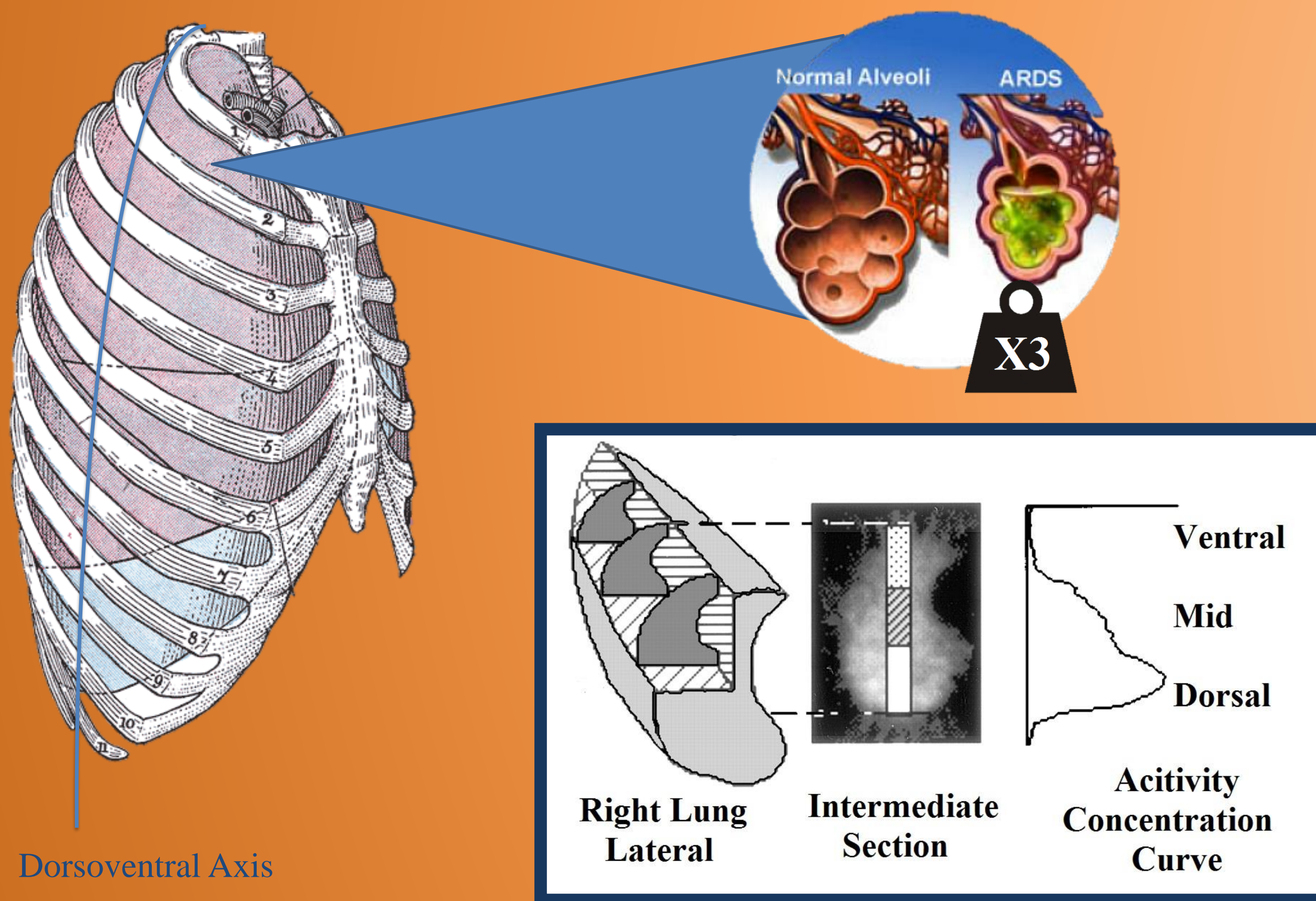
ABSTRACT

Acute Respiratory Distress Syndrome (ARDS) is a form of acute lung injury (ALI) characterized by non-cardiogenic pulmonary edema resulting in stiff, non-compliant alveoli and impaired gas exchange from either direct or indirect lung injury. Research estimates that 20 to 75 per every 100,000 persons each year are affected by ALI such as ARDS. ARDS can have mortality rates as high as 90%. This complex condition is further associated with high rates of morbidity and increased healthcare costs. No current standardized treatment guidelines exist for ARDS. Treatment may involve intubation, mechanical ventilation using low tidal volumes and increased peak end-expiratory pressure (PEEP), fluid management, systemic support, pharmacological intervention, kinetic therapy, and most notably prone positioning. Thirty-day mortality is lower in those patients with severe ARDS placed in the prone position.

Understanding Prone Positioning

By utilizing gravity and the weight of the lung itself, which is 2-3 times greater in patients with ARDS, prone positioning is believed to:

- Increase elasticity of the chest wall.
- Shift pressure of the heart off of the lungs.
- Alter distribution of alveolar inflation and make use of the greater number of alveoli in dorsal lung regions.



Methods

Database search of MEDLINE and the cumulative Index to Nursing and Allied Health (CINHAL) using (prone OR prone positioning) AND (ARDS OR Respiratory Distress) AND (mortality OR survival)

Search yielded 85 English results within the last five years.

77 Sources removed for not meeting criteria:
• Non-research sources
• Mortality greater than 30-days

Results narrowed to 8 sources. Data was compiled into a table and evaluated using the Rating System for Hierarchy of Evidence for Intervention/Treatment Question

Author(s) and Year of Publication	(n=x)	Findings	Level
Lee, et al., 2014	2,246	Prone positioning accompanied by mechanical ventilation reduced overall mortality in the random-effect model, odd ratio (OR) 0.77, in cases of severe ARDS.	I
Beitler, et al., 2014	2,119	Risk ratio (RR) of death was 0.66 when proning was paired with low-tidal volumes and 1.00 with high-tidal volumes.	I
Gattinoni, et al., 2010	1,573	All-cause mortality is approximately 10% lower in patients with the most severe cases of ARDS.	I
Sud, et al., 2010	1,563	RR of death for baseline PaO ₂ /FiO ₂ <100 0.84 and 1.07 for PaO ₂ /FiO ₂ >100. RR for complications: pressure ulcers (1.29); ETT complications (1.58); tube dislodgement (3.14).	I
Kopterides, Siempos, & Armaganidis, 2009	1,146	All-cause mortality is approximately 4% lower in patients with the most severe cases of ARDS. Occurrence of complications: Pressures Ulcers (3-91%); ETT Complications (2-20%); Pneumothorax (5-7%).	I
Guérin, et al., 2013	466	All-cause mortality is approximately 16.8% lower in patients with the most severe cases of ARDS.	II
Taccone, et al., 2009	344	All-cause mortality is approximately 10% lower in patients with the most severe cases of ARDS. Occurrence of complications: Tube Dislodgement (2.9-10.9%); Need for Sedation/Muscle Paralysis (66.7-69.3%).	II
Hale, et al., 2014	18	Prone positioning was shown to improve oxygenation in patients with ARDS secondary to severe burns by evaluating PaO ₂ /FiO ₂ . Further, 28-day survival was 67%.	IV



Mortality

- A review of current evidence reveals that *overall* prone positioning does not improve 30-day mortality in any statistically significant way; however, all-cause mortality is up to 16.8% lower in patients with the most *severe* cases of ARDS who are proned.
- Severe cases of ARDS are defined as those with a baseline PaO₂/FiO₂ less than 100 mmHg.
- Evidence further supports low-tidal volumes paired with prone positioning may decrease mortality.

Factors Impacting Mortality

Potential Benefits of Prone Positioning:

- Evidence suggest that utilizing prone positioning in severe cases of ARDS may decrease the occurrence of Ventilator Acquired Pneumonia (VAP) and Ventilator-Induced Lung Injury (VILI).

Potential Risks/Complications of Prone Positioning:

- Risks/complications of prone positioning:
 - Dislodgement of tubes and equipment (chest tubes, ventilator tubing, and central and arterial lines) (2.9-10.9%)
 - New or worsening pressure ulcers (3-91%)
 - Obstruction of endotracheal tube (2-20%)
 - Need form r further sedation or muscle paralysis (66.7-69.3%)
- However, evidence is inconsistent as to what rate these risks/complications may occur.
- Evidence further indicates that adverse effects are *less* likely to occur in ICUs where prone positioning has been implemented and where staff are familiar with equipment.

Recommendations

- Overcome obstacles that prevent implementation of prone positioning:
 - Standardize treatment for ARDS.
 - Educating healthcare providers and nurses about the current evidence on prone positioning.
- Implement prone positioning earlier for the most severe cases of ARDS (baseline PaO₂/FiO₂ less than 100 mmHg).
- Ensure prone positioning is implemented by a well-equipped and highly trained healthcare team.
- Further research:
 - Long-term effects of prone positioning on mortality and morbidity.
 - Risk/Benefits of prone positioning.

References

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