Rush University
Division of Respiratory Care
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What’s New About Proning?

Rush Medical College • College of Nursing • College of Health Sciences • The Graduate College
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Conflict of Interest

I have no real or perceived conflict of interest that relates to this presentation. Any use of brand names is not in any way meant to be an endorsement of a specific product, but to merely illustrate a point of emphasis.
Objectives

• Review the rationale and current literature support for prone positioning in hypoxemic respiratory failure
• Discuss the process of prone positioning
• Describe common challenges with prone positioning
What is prone positioning?

• Prone position is a term that indicates the body position is *face-down*.
Prone Position Mechanical Ventilation

• Mechanical ventilation is usually delivered to patients in supine or Semi-Fowlers (head of bed ~30°)
  – “Yes, I am aware... duh?”

• Prone position mechanical ventilation is not new!
  – Papers date back to the late 1970’s

• Sound physiologic rationale
Prone Position Mechanical Ventilation

• How does it work?
  – Alters mechanics and physiology of gas exchange
  – Improves the ventral-dorsal transpulmonary pressure difference
  – Improves lung perfusion
  – Reduces dorsal lung compression
Mechanism of Action

• Supine Position
  – Increased regional pressure at the “bottom” due to vertical pressure
  – Heart is superior to lung injury -- compresses lung tissue
  – Close of gravity-dependent dorsal lung regions
  – Low V/Q and increased shunt -- ↓ PaO$_2$
  – Increased possibility of opening - closing injury
Proposed Mechanisms for Effectiveness of Prone Ventilation

**SUPINE**

1. Weight of heart upon lungs
2. Perfusion is dorsal
3. Higher compressive pressure due to vertical pressure gradient in dorsal region

**PRONE**

1. Heart below lungs
2. Perfusion persists dorsal
3. Tractive pressure in dorsal region
**Mechanism of Action**

**Prone Position**

– Reduces difference between dorsal and ventral transpulmonary pressure
  
  • Ventilation becomes more homogeneous

![Diagram showing comparison between supine and prone ventiilation](image)
Mechanism of Action

– Decreases alveolar overinflation and dorsal alveolar collapse
  • Resultant decrease in alveolar overdistention and cyclic atelectasis *(injury)*
– Promotes lung recruitment
– V/Q improves -- ↑ PaO₂
– FRC may increase
  • May change distribution of extravascular lung water
  • May change distribution of secretions
– Perfusion becomes less gravity dependent and tends to persist dorsally
Mechanism of Action

- **Supine position**
  - Ventral lung (overdistended)
  - Dorsal lung (collapsed)
  - PTP: + + +
  - Blood flow: ↓

- **Prone position**
  - Ventral lung (decreased overdistention)
  - Dorsal lung (decreased collapse)
  - PTP: +
  - Blood flow: ↑

Image from UptoDate® 2017
Prone Position Mechanical Ventilation

• Several past studies (RCTs) have shown ↑↑ in oxygenation
  – Up to 70% of patients respond with improvement in oxygenation
    • Allows for reduction in $F_1O_2$
Patient factors that predict improved oxygenation w/prone positioning

- Diffuse pulmonary edema and dependent alveolar collapse → better than predominately anterior abnormalities, marked consolidation, and fibrosis
- Extrapulmonary causes of ARDS
- Elevated intra-abdominal pressure vs. normal
- Patients with chest wall compliance decrease from supine to prone
So... why aren’t we doing it?

- Several past studies have shown prone can prevent ventilator-induced lung injury (VILI)

  But...

- In most trials, the physiologic benefits did not mean better patient outcomes
- No improvement in survival/mortality
But wait!

Prone positioning improves survival in severe ARDS: a pathophysiologic review and individual patient meta-analysis

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ABSTRACT

Prone positioning has been used for over 30 years in the management of patients with acute respiratory distress syndrome (ARDS). This maneuver has consistently proven capable of improving oxygenation in patients with acute respiratory failure. Several mechanisms can explain this observation, including possible intervening net recruitment and more homogeneously distributed alveolar inflation. It is also progressively becoming clear that prone positioning may reduce the nonphysiological stress and strain associated with mechanical ventilation, thus decreasing the risk of ventilator-induced lung injury, which is known to adversely impact patient survival. The available randomized clinical trials, however, have failed to demonstrate that prone positioning improves the outcomes of patients with ARDS overall. In contrast, the individual patient meta-analysis of the four major clinical trials available clearly shows that with prone positioning, the absolute mortality of severely hypoxemic ARDS patients may be reduced by approximately 10%. On the other hand, all data suggest that long-term prone positioning may expose patients with less severe ARDS to unnecessary complications.

(Minerva Anestesiol 2010;76:448-54)

Key words: Respiratory distress syndrome, adult - Prone position - Respiration, artificial - Ventilator-induced lung injury.
Prone ventilation reduces mortality in patients with acute respiratory failure and severe hypoxemia: systematic review and meta-analysis
between-trial heterogeneity for most clinical outcomes. Conclusions: Prone ventilation reduces mortality in patients with severe hypoxemia. Given associated risks, this approach should not be routine in all patients with AHRF, but may be considered for severely hypoxemic patients.
An updated study-level meta-analysis of randomised controlled trials on proning in ARDS and acute lung injury

Fekri Abroug¹, Lamia Ouanes-Besbes¹, Fahmi Dachraoui¹, Islem Ouanes¹, Laurent Brochard²,³,⁴
Abstract

Introduction: In patients with acute lung injury (ALI) and/or acute respiratory distress syndrome (ARDS), recent randomised controlled trials (RCTs) showed a consistent trend of mortality reduction with prone ventilation. We updated a meta-analysis on this topic.

Methods: RCTs that compared ventilation of adult patients with ALI/ARDS in prone versus supine position were included in this study-level meta-analysis. Analysis was made by a random-effects model. The effect size on intensive care unit (ICU) mortality was computed in the overall included studies and in two subgroups of studies: those that included all ALI or hypoxemic patients, and those that restricted inclusion to only ARDS patients. A relationship between studies’ effect size and daily prone duration was sought with meta-regression. We also computed the effects of prone positioning on major adverse airway complications.

Results: Seven RCTs (including 1,675 adult patients, of whom 862 were ventilated in the prone position) were included. The four most recent trials included only ARDS patients, and also applied the longest proning durations and used lung-protective ventilation. The effects of prone positioning differed according to the type of study. Overall, prone ventilation did not reduce ICU mortality (odds ratio = 0.91, 95% confidence interval = 0.75 to 1.2; $P = 0.39$), but it significantly reduced the ICU mortality in the four recent studies that enrolled only patients with ARDS (odds ratio = 0.71; 95% confidence interval = 0.5 to 0.99; $P = 0.048$; number needed to treat = 11). Meta-regression on all studies disclosed only a trend to explain effect variation by prone duration ($P = 0.06$). Prone positioning was not associated with a statistical increase in major airway complications.

Conclusions: Long duration of ventilation in prone position significantly reduces ICU mortality when only ARDS patients are considered.
Prone Positioning in Severe Acute Respiratory Distress Syndrome

Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D., Pascal Beuret, M.D., Arnaud Gacouin, M.D., Thierry Boulain, M.D., Emmanuelle Mercier, M.D., Michel Badet, M.D., Alain Mercat, M.D., Ph.D., Olivier Baudin, M.D., Marc Clavel, M.D., Delphine Chatellier, M.D., Samir Jaber, M.D., Ph.D., Sylvène Rosselli, M.D., Jordi Mancebo, M.D., Ph.D., Michel Sirodot, M.D., Gilles Hilbert, M.D., Ph.D., Christian Bengler, M.D., Jack Richecoeur, M.D., Marc Gainnier, M.D., Ph.D., Frédérique Bayle, M.D., Gael Bourdin, M.D., Véronique Leray, M.D., Raphaele Girard, M.D., Loredana Baboi, Ph.D., and Louis Ayzac, M.D., for the PROSEVA Study Group*
• What is known?
  – Use for over 3 decades to treat hypoxic respiratory failure
  – Ventilation/perfusion matching may improve, pleural pressure gradients are more uniform, and compression of lung volume from the heart and abdomen is reduced
  – Several studies have shown improvements in oxygenation and reductions in ventilator-induced lung injury

• Why was the study done?
  – Physiologic improvements were seen, but prone positioning failed to show mortality benefits
Hypothesis

- The early application of prone positioning will improve survival among patients with ARDS who, at the time of enrollment, were receiving mechanical ventilation with a PEEP of at least 5 cm H₂O and in whom the P/F ratio was < 150 mm Hg
Objectives

• Primary end point
  – Mortality at day 28

• Secondary end points
  – Mortality at day 90
  – The rate of successful extubation
    • Defined as no reintubation or use of NIV in the 48 hours after extubation
  – The time to successful extubation
  – Length of stay in the ICU
  – Complications
  – Use of noninvasive ventilation
  – Tracheostomy rate
  – Number of days free from organ dysfunction
  – Ventilator settings
  – ABGs
  – Respiratory system mechanics

❖ In trach’d patients, successful weaning was defined as the ability to breath unassisted through a tracheostomy tube for at least 24 hours
Methods: Design

• What type of study was done?
  • Prospective, multicenter, randomized controlled trial

• Randomization was computer-generated and stratified according to ICU
  – Patients randomly assigned to the prone group or supine group
  – A web-based management system (Clininfo) used to help for randomization
Methods: Setting

- 26 ICUs in France/1 ICU in Spain
- All ICUs had at least 5 years of prone positioning experience
- Adult patients meeting the following criteria:
  - Diagnosed with ARDS (using American-European Consensus Conference criteria)
  - Endotracheal intubation and MV for ARDS for < 36 hours
  - Severe ARDS (P/F ratio < 150 mm Hg, $F_1O_2 \geq 0.60$, PEEP $\geq 5$ cm H$_2$O, on tidal volumes of 6 ml/kg of PBW)
Methods: Interventions

• Prone group
  – Placed completely prone for at least 16 consecutive hours
  – Standard ICU beds were used for all patients

• Supine group
  – Remained in a semirecumbent position

✔ Mechanical ventilation was VCV with volume target of 6 ml/kg PBW
✔ PEEP selected from PEEP/F1O2 table
✔ Goals: Pplat < 30 cm H2O
  ✔ pH 7.20-7.45
Results

• The two groups were similar at inclusion except: SOFA scores and use of neuromuscular blockers and vasopressors
• Ventilator settings, respiratory mechanics, and ABG measurements were similar in the two groups
• On average, prone group patients were prone positioned 4 times/patient
  – Mean duration $17 \pm 3$ hours
  ❖ Prone group patients were ventilated 73% of the 22,334 patient-hours spent in the ICU from the start of the first session to the end of the last
<table>
<thead>
<tr>
<th></th>
<th>Supine Group</th>
<th>Prone Group</th>
<th>Hazard Ratio or Odds Ratio with the Prone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mortality — no. (% [95% CI])</strong></td>
<td></td>
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<tr>
<td>At day 28</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Not adjusted</td>
<td>75 (32.8 [26.4–38.6])</td>
<td>38 (16.0 [11.3–20.7])</td>
<td>0.39 (0.25–0.63)</td>
</tr>
<tr>
<td>Adjusted for SOFA score†</td>
<td>94 (41.0 [34.6–47.4])</td>
<td>56 (23.6 [18.2–29.0])</td>
<td>0.44 (0.29–0.67)</td>
</tr>
<tr>
<td>Adjusted for SOFA score†</td>
<td></td>
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<tr>
<td>Successful extubation at day 90 — no./total no. (% [95% CI])</td>
<td>145/223 (65.0 [58.7–71.3])</td>
<td>186/231 (80.5 [75.4–85.6])</td>
<td>0.45 (0.29–0.70)</td>
</tr>
<tr>
<td>Time to successful extubation, assessed at day 90 — days</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Survivors</td>
<td>19±11</td>
<td>17±16</td>
<td>0.87</td>
</tr>
<tr>
<td>Nonsurvivors</td>
<td>16±11</td>
<td>18±14</td>
<td></td>
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<tr>
<td>Length of ICU stay, assessed at day 90 — days</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Survivors</td>
<td>26±27</td>
<td>24±22</td>
<td>0.05</td>
</tr>
<tr>
<td>Nonsurvivors</td>
<td>18±15</td>
<td>21±20</td>
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<tr>
<td>Ventilation-free days</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>At day 28</td>
<td>10±10</td>
<td>14±9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>At day 90</td>
<td>43±38</td>
<td>57±34</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pneumothorax — no. (% [95% CI])</td>
<td>13 (5.7 [3.9–7.5])</td>
<td>15 (6.3 [4.9–7.7])</td>
<td>0.89 (0.39–2.02)</td>
</tr>
<tr>
<td>Noninvasive ventilation — no./total no. (% [95% CI])</td>
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<tr>
<td>At day 28</td>
<td>10/212 (4.7 [1.9–7.5])</td>
<td>4/228 (1.8 [0.1–3.5])</td>
<td>0.36 (0.07–3.50)</td>
</tr>
<tr>
<td>At day 90</td>
<td>3/206 (1.5 [0.2–3.2])</td>
<td>4/225 (1.8 [0.1–3.5])</td>
<td>1.22 (0.23–6.97)</td>
</tr>
<tr>
<td>Tracheotomy — no./total no. (% [95% CI])</td>
<td></td>
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<tr>
<td>At day 28</td>
<td>12/229 (5.2 [2.3–8.1])</td>
<td>9/237 (3.8 [1.4–6.0])</td>
<td>0.71 (0.27–1.86)</td>
</tr>
<tr>
<td>At day 90</td>
<td>18/223 (8.1 [4.5–11.7])</td>
<td>15/235 (6.4 [3.3–9.5])</td>
<td>0.78 (0.36–1.67)</td>
</tr>
</tbody>
</table>

* Plus–minus values are means ±SD. Hazard ratios are shown for mortality and successful extubation; odds ratios are shown for other outcomes. CI denotes confidence interval.
† There were no significant differences between the groups in organ dysfunction as assessed from the SOFA score (Table S4 in the Supplementary Appendix).
Kaplan–Meier Plot of the Probability of Survival from Randomization to Day 90.

Conclusions

- Patients with ARDS and severe hypoxemia can benefit from prone treatment when used early and in relatively long sessions.
Treatment of ARDS With Prone Positioning

Eric L. Scholten, MD; Jeremy R. Beitler, MD, MPH; G. Kim Prisk, PhD, DSc; and Atul Malhotra, MD

CHEST 2017; 151(1):215-224
In summary, clinical trial evidence suggests that to achieve improved survival with prone positioning, one needs patients with severe ARDS treated early in their course, a long duration of prone positioning (> 16 h/d), physiologically driven criteria for cessation of daily prone positioning (eg, minimal ventilator requirements), the concurrent use of lung-protective therapies for ARDS, and experienced staff able to minimize procedural risks. Interested readers may review other 42 58 66 71.
TABLE 2  Summary Recommendations for Prone Ventilation

<table>
<thead>
<tr>
<th>Who to place in prone position?</th>
<th>Who not to place in prone position?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with severe ARDS (Pao$_2$/FiO$_2$ &lt; 150 mm Hg) Early in the course (ideally within 48 h) Best outcomes reported when prone positioning is used in combination with both low tidal volume ventilation (6 cc/kg) and neuromuscular blockade</td>
<td>Patients with facial/neck trauma or spinal instability Patients with recent sternotomy or large ventral surface burn Patients with elevated intracranial pressure Patients with massive hemoptysis Patients at high risk of requiring CPR or defibrillation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How to place patient in prone position?</th>
<th>Potential complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires 3-5 people, close attention to endotracheal tube (ETT) and central lines; a demonstration video and checklist are available$^{9,73}$ Preparation: preoxygenation, empty stomach, suction ETT/oral cavity, remove ECG leads and reattach to back, repeated zeroing of hemodynamic transducers Support and frequently reposition pressure points: face, shoulder, anterior pelvis</td>
<td>Temporary increase in oral and tracheal secretions occluding airway ETT migration or kinking Vascular catheter kinking Elevated intraabdominal pressure Increased gastric residuals Facial pressure ulcers, facial edema, lip trauma from ETT, brachial plexus injury (arm extension)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How long to have patient in prone position each day?</th>
<th>When to stop?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful trials use at least 16 hours of daily proning Long prone positioning sessions likely avoid derecruitment</td>
<td>In PROSEVA, prone positioning was stopped when Pao$_2$/FiO$_2$ remained &gt; 150 mm Hg 4 h after supinating (with PEEP &lt; 10 cm H$_2$O and FiO$_2$ &lt; 0.6) Optimal strategy is unclear: consider continuing prone positioning until clear improvement in gas exchange, mechanics, and overall clinical course.</td>
</tr>
</tbody>
</table>

CPR = cardiopulmonary resuscitation; PEEP = positive end-expiratory pressure. See Table 1 legend for expansion of other abbreviation.
Why is prone positioning so unpopular?

Jason Chertoff
Why so unpopular?

- Burdensome
- Cumbersome
- Additional human resources
- Adverse events
  - Accidental extubation
  - Pressure ulcers
  - Losing lines/drains, etc

Real evidence or just anecdotal evidence?
How do we do it?

• Two ways:
  – Manual
  – Specialized bed
    • RotoProne®
Evaluation of a Training Method to Improve Knowledge, Skills and Increase the Clinical Use of Prone Positioning

Adel Aljoaid BS RRT, J. Brady Scott MSc RRT-ACCS, Sara H. Mirza MD MSc, Meagan N. Dubosky MSc RRT-ACCS NPS AE-C, David L. Vines MHS RRT FAARC

Introduction
Patients with moderate to severe acute respiratory distress syndrome (ARDS) are typically managed by low tidal volume, lung protective mechanical ventilation. Several methods have been evaluated in an attempt to better understand best practices in the care of patients with severe ARDS but none have shown a mortality benefit. In June of 2013, a multicenter, prospective, randomized, controlled trial demonstrated that the early use of prolonged prone-positioning sessions significantly decreased mortality in cases of severe ARDS.¹ Because of this, our institution sought to establish guidelines and training to support the implementation of prone positioning for the treatment of severe ARDS.

Purpose
The primary aim of this study is to determine if discussion, video, and human simulation laboratory exercises improves knowledge, confidence, and skill associated with prone positioning which may result in an increase in its clinical use.

Methods
Critical care respiratory therapists, nurses, and physicians were invited to participate in an educational interventional study that was approved by the IRB. This study included written cognitive examinations to assess knowledge and affective evaluations to assess self-confidence that were administered before and after the educational intervention. The participants received instructions on prone positioning procedure through three methods: reviewing/discussing printed guidelines and protocols outlining the associated policy and procedure, video demonstration of a correct method to place a patient in the prone position, and hands-on human simulation until competency was achieved.

Results
Twenty-three subjects were enrolled in the study that completed all activities. Of these, 12 were physicians, 5 were nurses, and 6 were respiratory therapists; 12 men and 11 women. The pre-affective survey revealed that 22% of the participants had prone positioning experience. Significant improvements were observed in participant confidence (Figure 1) and cognitive scores (Figure 2) for all disciplines. The cumulative knowledge score on written pre-test was 61%. Knowledge increased following the education intervention by 23% with post-training written test score of 84%, (p<0.05).

Conclusion
Our study was able to show
• A significant improvement in knowledge and confidence following our educational intervention.
• This improvement was seen across all disciplines of health care.
• Improvement was seen even in the group claiming to have had prior experience with proning.

Early data is suggestive of increased utilization of this modality at our institution following educational intervention.

Reference:
Procedure for prone positioning

Preparation
1. Check for contraindications.
   a. Facial or pelvic fractures
   b. Burns or open wounds on the ventral body surface
   c. Conditions associated with spinal instability (e.g., rheumatoid arthritis, trauma)
   d. Conditions associated with increased intracranial pressure
   e. Life-threatening arrhythmias
2. Consider possible adverse effects of prone positioning on chest tube drainage.
3. Whenever possible, explain the maneuver to the patient and/or their family.
4. Confirm from a recent chest roentgenogram that the tip of the endotracheal tube is located 2 to 4 cm above the main carina.
5. Inspect and confirm that the endotracheal tube and all central and large bore peripheral catheters are firmly secured.
6. Consider exactly how the patient’s head, neck, and shoulder girdle will be supported after they are turned prone.
7. Stop tube feeding, check for residual, fully evacuate the stomach, and cap or clamp the feeding and gastric tubes.
8. Prepare endotracheal suctioning equipment, and review what the process will be if copious airway secretions abruptly interfere with ventilation.
9. Decide whether the turn will be rightward or leftward.
10. Prepare all intravenous tubing and other catheters and tubing for connection when the patient is prone.
    a. Assure sufficient tubing length
    b. Relocate all drainage bags on the opposite side of the bed
    c. Move chest tube drains between the legs
    d. Reposition intravenous tubing toward the patient’s head, on the opposite side of the bed

Turning procedure
1. Place one (or more) people on both sides of the bed (to be responsible for the turning processes) and another at the head of the bed (to assure the central lines and the endotracheal tube do not become dislodged or kinked).
2. Increase the FIO₂ to 1 and note the mode of ventilation, the tidal volume, the minute ventilation, and the peak and plateau airway pressures.
3. Pull the patient to the edge of the bed furthest from whichever lateral decubitus position will be used while turning.
4. Place a new draw sheet on the side of the bed that the patient will face when in this lateral decubitus position. Leave most of the sheet hanging.
5. Turn the patient to the lateral decubitus position with the dependent arm tucked slightly under the thorax. As the turning progresses the nondependent arm can be raised in a cocked position over the patient’s head. Alternatively, the turn can progress using a log rolling procedure.
6. Remove ECG leads and patches. Suction the airway, mouth, and nasal passages if necessary.
7. Continue turning to the prone position.
8. Reposition in the center of the bed using the new draw sheet.
9. If the patient is on a standard hospital bed, turn his/her face toward the ventilator. Assure that the airway is not kinked and has not migrated during the turning process. Suction the airway if necessary.
10. Support the face and shoulders appropriately avoiding any contact of the supporting padding with the orbits or the eyes.
11. Position the arms for patient comfort. If the patient cannot communicate, avoid any type of arm extension that might result in a brachial plexus injury.
12. Auscultate the chest to check for right mainstem intubation. Reassess the tidal volume and minute ventilation.
13. Adjust all tubing and reestablish connections and function.
14. Reattach ECG patches and leads to the back.
15. Tilt the patient into reverse Trendelenburg. Slight, intermittent lateral repositioning (20 to 30°) should also be used, changing sides at least every two hours.

FIO₂: fraction of inspired oxygen.
Prone Position Mechanical Ventilation

• Ventilation strategy similar to ARDSnet
• Optimal PEEP setting is unknown

• **Note:**
  - Peak and plateau pressures may increase immediately!
    • Likely related to decreased chest wall compliance
    • Mobilization of secretions

  ➢ The subsequent decrease probably related to progressive alveolar recruitment
Prone Position: Assessing Response

- Improvement in gas exchange (>10 mm Hg increase in PaO$_2$)
- Evidence of lung recruitment (decrease in plateau pressure for given tidal volume)
- Can be noted in first hour, but may take longer
# Prone position: Contraindications and complications

<table>
<thead>
<tr>
<th><strong>Contraindications</strong></th>
<th><strong>Complications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock (eg, persistent mean arterial pressure &lt;65 mmHg)</td>
<td>Nerve compression (eg, brachial plexus injury)</td>
</tr>
<tr>
<td>Acute bleeding (eg, hemorrhagic shock, massive hemoptyis)</td>
<td>Crush injury</td>
</tr>
<tr>
<td>Multiple fractures or trauma (eg, unstable fractures of femur, pelvis, face)</td>
<td>Venous stasis (eg, facial edema)</td>
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<tr>
<td>Spinal instability</td>
<td>Dislodging endotracheal tube</td>
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<tr>
<td>Pregnancy</td>
<td>Diaphragm limitation</td>
</tr>
<tr>
<td>Raised intracranial pressure &gt;30 mmHg or cerebral perfusion pressure &lt;60 mmHg</td>
<td>Pressure sores (eg, facial)</td>
</tr>
<tr>
<td>Tracheal surgery or sternotomy within two weeks</td>
<td>Dislodging vascular catheters or drainage tubes</td>
</tr>
<tr>
<td><strong>Relative contraindications</strong></td>
<td>Retinal damage</td>
</tr>
<tr>
<td>Recent DVT treated for &lt;2 days*</td>
<td>Transient reduction in arterial oxygen saturation</td>
</tr>
<tr>
<td>Anterior chest tube(s) with air leaks*</td>
<td>Vomiting</td>
</tr>
<tr>
<td>Major abdominal surgery</td>
<td>Transient arrhythmias</td>
</tr>
<tr>
<td>Recent pacemaker*</td>
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<tr>
<td>Clinical conditions limiting life expectancy* (eg, oxygen or ventilator-dependent respiratory failure)</td>
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<tr>
<td>Severe burns*</td>
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<tr>
<td>Lung transplant recipient*</td>
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<tr>
<td>Prior use of rescue therapies*</td>
<td></td>
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</tbody>
</table>

DVT: deep vein thrombosis.

* Based upon exclusion criteria from the Prone Positioning in Severe ARDS trial (PROSEVA).

† Patients in whom benefit is not assured include: patients on inhaled nitric oxide, on almitrine bimesylate, extracorporeal membrane oxygenation (ECMO), or noninvasive ventilation (NIV) prior to intubation.

Data from:
References available upon request
Thank You!

Questions/Discussion

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