IMPLEMENTING A PRONING PROTOCOL

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Disclosures for Kathleen Vollman

- Consultant-Michigan Hospital Association Keystone Center
- Subject matter expert CAUTI, CLABSI, HAPU, Sepsis, Safety culture for HRET
- Consultant and speaker bureau for Sage Products a Business unit of Stryker
- Consultant for Baxter Healthcare
Objectives

- Describe the logistics of designing and implementing a proning protocol
First Reported Use Of Prone Position to Improve Oxygenation

The Process

- Review latest evidence for using prone positioning
  - Inclusion and exclusion criteria
  - Methodology
  - Equipment
  - Staffing
- Perform a gap analysis of knowledge and practice
- Create a guideline
- Reviewed by stakeholders for feedback and buy-in
The Why: Lung Protection in the Prone Position

- Attenuate mechanical lung injury
  - Improves dependent aeration recruiting alveoli
  - Non-dependant regions shows dramatic reduction in hyperinflation
  - Results in more homogenous lung aeration which reduces regional shear strain…less VILI
  - Also decrease barotrauma and atelectrauma by recruiting and reducing over distension that occurs with higher PEEP
  - Potential reduction in infection from drainage

The Why:
ATS & SCCM Guidelines for Mechanical Ventilation of ARDS Patients

• Strong recommendation for:
  – Using lower tidal volumes (4-8ml/kg PBW) & lower inspiratory pressures (plateau pressures < 30 cm H2O)
  – Severe ARDS prone positioning for > 12 h/d
  – Against the routine use of HFOV

Prone positioning was only used in 19% of patient with severe ARDS LUNG SAFE study


European Prevalence Study: Use of PP for mild 5.9%, moderate 10.3%, severe 32.9%
the APRONET study

PROSEVA Trail: Proning Severe ARDS Patients

- RCT 466 patients with severe ARDS (26 ICU’s in France/1 Spain)
  - Severe ARDS P/F ratio < 150 mm Hg, with Fio2 0.6, PEEP of at least 5 cm of water, & a Vt of 6 ml per kg of PBW
  - Initiation 12-24hrs
- Prone-positioning 16hrs/or supine position/ (proned within 1hr of randomization)
- NMB used 5 days
- Stopping prone treatment
  - After 4hrs in supine meeting oxygenation criteria
  - ↓ in PaO2/FiO2 ratio of 20% (after 2 consecutive prone positions)
  - Complications leading to immediate interruption
- Applied for 28 days, then clinician discretion

Results: Guerin C, et. al. Prone Study

- Baseline characteristics similar except for vasopressors (S), sepsis related SOFA score (S) & use of NMB’s (P)
- Prone 16% mortality, supine 32.8% p< 0.0001
- Prone group ↓ ICU LOS (2 days, & ↑ VFD (4 days) (NS)
- No differences in complications except > cardiac arrest in supine position (31 S vs. 16 P)

Who to Place in Prone Position?

- Patients with severe ARDS (PaO2/FiO2 < 150 mm Hg)
- Early in the course (12-24hrs)
- Best outcomes reported when prone positioning is used in combination with both low tidal volume ventilation (6 cc/kg) and neuromuscular blockade (48 hrs)
- “Unless otherwise contraindicated prone positioning should be applied as first line therapy to any patient with moderate or severe ARDS and applied as early as possible after identification of hypoxemic ARDS

Reaching Consensus

• Inclusion Criteria
  – < 48 hours after onset of ARDS and meets all the following criteria: Target 12-24 hrs
    a. PaO2/FIO2 ratio < 150 mm Hg
    b. FIO2 > 0.60 mm Hg
    c. PEEP > 10 cm H2O
  – Mean arterial pressure > 65 mm Hg (with or without medications)

• Exclusion Criteria
  – Trauma: unstable cervical, thoracic, lumbar, pelvic, skull, or facial fractures
  – Neurologic: uncontrolled intracranial pressure, cerebral edema, or frequent seizures
  – Hematologic: venous thromboembolism treated < 48 hours
  – Goals of care: allow natural death (do not resuscitate) with treatment limitations

Relative Considerations

- ENT: raised intraocular pressure or recent ophthalmic surgery, facial trauma, or recent oral maxillofacial surgery in last 15 days
- Cardiac: severe hemodynamic instability, unstable cardiac rhythms, ventricular assist device, intra-aortic balloon pump, recent sternotomy, new pacemaker < 48 hours
- Pulmonary: hemoptysis, unstable airway (double lumen endotracheal tube), new tracheostomy < 15 days, bronchopleural fistula, lung transplant
- Abdomen: second or third trimester pregnancy, grossly distended abdomen, ischemic bowel, abdominal compartment syndrome, recent abdominal surgery or stoma, extensive inguinal or abdominal soft tissue injury
- Musculoskeletal: chest wall abnormalities, kyphoscoliosis, or advanced arthritis
- Skin: burns on more than 20% body surface
- Other underlying disease with a life expectancy of less than a year

The Process

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AACN Procedural Manual-7th ed

- Chapter 18: Pronation Therapy
- Authors
  - Kathleen Vollman
  - Jan Powers
  - Sharon Dickinson
Rotoprone

Prone positioner
No longer sold
Manual Proning
Manual Prone Positioning Made Easier

Positioning systems
Manual Prone Positioning Made Easier

Shear resistant textile

Air turn and position System
<table>
<thead>
<tr>
<th>Staff Member</th>
<th>Duties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider</td>
<td>Consult with the team, order from intensivist, explain purpose to pt/family, Consider need for additional therapies (NMBA, catheters, sedation, prokinetic, eye ointment, WOC consult</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Determine position to turn (towards the ventilator), pre prone gases, location of ET tube, airway pressure and CO2 concentration Pre-oxygenate with 100% before the turn Position self at head of the bed to manage airway</td>
</tr>
<tr>
<td>RN position turn lead</td>
<td>Ensure patient and family education, gather supplies (sheets or positioning aid, electrodes, packet of pressure prevention dressings, pillow or wedges), monitor patient condition before and after the turn, tube feeding off 1 hr before the turn, Align tubes, empty drains or ostomies, placement of dressing over boney prominences (forehead, chin, chest, shoulders, pelvis, knees, elbows). Ensure the tongue is inside patient’s mouth</td>
</tr>
</tbody>
</table>

Prone Positioning: The How

Step 1: With a flat sheet, pull the patient to side of bed opposite the ventilator using 4 staff. The Respiratory Therapist should be at the head of the bed to hold the ET tube.

Step 2: Place the flat sheet around the arm that will pull through, (side you are turning toward). Turn towards the ventilator.
Step 3: A second flat sheet is placed on the bed and tucked under the patient. This sheet will pull through as you are turning the patient. During this lateral turn, one nurse places the electrodes on the back.

Step 4: Using the sheet turn the patient over toward the ventilator and position them prone. The arm and sheet will pull across the bed.
Step 5: Pull and center the patient. Discard the sheet that was used to supine patient. Straighten lines and tubes.

Chest and/or pelvic support can be done by placing a pillow at the abdomen before completing the turn.
Positioning Schedule & Maintenance Care

- Consider every 16hrs uninterrupted (more freq turn back may cause decruitment)
- Frequent oral hygiene and suctioning and as needed, restart feeding
- Move head slightly every hour or q 2-ensure ET tube is not kinked
- ROM of arms every 2 hours/change position of the arms (Swim position)
- Support feet in correct anatomical alignment
- If hemodynamic monitoring, level the zero-reference point at the right atrium
- Double secure endotracheal tube
- Eye care-if taping preform horizontal
- Consider time periods in reverse trendelenburg to address facial edema and reduce risk of vomiting

Returning to Supine: The How

Step 1: Using a flat sheet, pull the patient to one side of the bed. Again, RT at head of bed holding the ET tube.

Step 2: Place the flat sheet around the arm that will pull through, (side you are turning toward).

Step 3: A second flat sheet is placed on the bed and tucked under the patient. This sheet will pull through as you are turning the patient.
Returning to Supine: The How

Step 4: Using the sheet turn the patient over and position them supine. The arm and sheet will pull across the bed.

Step 5: Discard the sheet that was used to supine patient (A). Straighten lines and tubes (B).
When to Stop Prone Positioning?

- In PROSEVA, prone positioning was stopped when PaO2/FiO2 remained > 150 mm Hg 4 h after supinating (with PEEP < 10 cm H2O and FiO2 < 0.6)
- Optimal strategy is unclear: consider continuing prone positioning until clear improvement in gas exchange, mechanics, and overall clinical course.

What’s are the Challenges and Issues?
<table>
<thead>
<tr>
<th>Adverse Events</th>
<th>No. of Trials Reporting the Outcome</th>
<th>Events/Prone</th>
<th>Events/Supine</th>
<th>OR (95% CI)</th>
<th>p</th>
<th>Number Needed to Treat/Number Needed to Harm</th>
<th>Heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator-associated pneumonia</td>
<td>6</td>
<td>120/567</td>
<td>128/513</td>
<td>0.76 (0.44–1.33)</td>
<td>0.343</td>
<td>26</td>
<td>34.4</td>
</tr>
<tr>
<td>Pressure ulcers</td>
<td>6</td>
<td>294/698</td>
<td>218/646</td>
<td>1.49 (1.18–1.89)</td>
<td>0.001</td>
<td>12</td>
<td>0.0</td>
</tr>
<tr>
<td>Major airway problem</td>
<td>9</td>
<td>255/1,104</td>
<td>180/1,063</td>
<td>1.55 (1.10–2.17)</td>
<td>0.012</td>
<td>16</td>
<td>32.7</td>
</tr>
<tr>
<td>Unplanned extubation</td>
<td>7</td>
<td>113/1,091</td>
<td>98/1,050</td>
<td>1.17 (0.80–1.73)</td>
<td>0.421</td>
<td>98</td>
<td>25.5</td>
</tr>
<tr>
<td>Selective intubation</td>
<td>2</td>
<td>12/642</td>
<td>5/615</td>
<td>2.73 (0.29–25.46)</td>
<td>0.378</td>
<td>95</td>
<td>55.9</td>
</tr>
<tr>
<td>Endotracheal tube obstruction</td>
<td>4</td>
<td>130/823</td>
<td>77/802</td>
<td>2.16 (1.53–3.05)</td>
<td>&lt;0.001</td>
<td>16</td>
<td>0.0</td>
</tr>
<tr>
<td>Loss of venous or arterial access</td>
<td>4</td>
<td>36/407</td>
<td>22/397</td>
<td>1.34 (0.29–6.26)</td>
<td>0.712</td>
<td>30</td>
<td>75.5</td>
</tr>
<tr>
<td>Thoracostomy tube dislodgement or kinking</td>
<td>4</td>
<td>14/407</td>
<td>14/397</td>
<td>1.14 (0.35–3.75)</td>
<td>0.827</td>
<td>1,154</td>
<td>42.6</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>4</td>
<td>29/513</td>
<td>33/462</td>
<td>0.77 (0.46–1.30)</td>
<td>0.333</td>
<td>67</td>
<td>0.0</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>3</td>
<td>104/718</td>
<td>119/675</td>
<td>0.74 (0.47–1.17)</td>
<td>0.197</td>
<td>32</td>
<td>30.3</td>
</tr>
<tr>
<td>Tachyarrhythmia or bradyarrhythmia</td>
<td>3</td>
<td>115/663</td>
<td>102/634</td>
<td>1.08 (0.78–1.50)</td>
<td>0.643</td>
<td>80</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Additional Complications

- Temporary increase in oral and tracheal secretions occluding airway
- Vascular catheter kinking
- Elevated intraabdominal pressure
- Increased gastric residuals
- Facial pressure ulcers, facial edema, lip trauma from ETT,
- Brachial plexus injury (arm extension)

How do you screen for ARDS severity
Does your ICU have a process for assessing P/F ratios routinely

<table>
<thead>
<tr>
<th>Oxygenation</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 200 PaO₂/FiO₂ or &lt; 300 with PEEP/CPAP ≥ 5 cm H₂O</td>
<td>&lt; 100 PaO₂/FiO₂ or &lt; 200 with PEEP ≥ 5 cm H₂O</td>
<td>≤ 100 PaO₂/FiO₂ with PEEP ≥ 5 cm H₂O</td>
<td></td>
</tr>
</tbody>
</table>
How do you screen for ARDS severity and Hemodynamic Instability?
Challenges to Mobilizing Critically Ill Patients

Potentially Modifiable Barriers

• Patient-related barriers (50%)
  – Hemodynamic instability, ICU devices, physical & neuropsychological

• Structural (18%)
  – Human or technological resources

• ICU culture (18%)
  – Knowledge/priority/habits

• Process-related (14%)
  – Service delivery/lack of coordination
  – Clinician function

Challenges to Mobilizing Critically Ill Patients

- Patient-related barriers (50%)
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Potentially Modifiable Barriers

The Role of Hemodynamic Instability in Positioning¹,²

- Lateral turn results in a 3%-9% decrease in SVO₂, which takes 5-10 minutes to return to baseline
- Appears the act of turning has the greatest impact on any instability seen
- Minimize factors that contribute to imbalances in oxygen supply and demand

- Factors that put patients at risk for intolerance to positioning:³
  - Elderly
  - Diabetes with neuropathy
  - Prolonged bed rest
  - Low hemoglobin and cardiovascular reserve
  - Prolonged gravitational equilibrium

Decision-Making Tree for Patients Who Are Hemodynamically Unstable With Movement¹,²

Screen for mobility readiness within 8 hrs of admission to ICU & daily initiate in-bed mobility strategies as soon as possible

Is the patient hemodynamically unstable with manual turning?
- \( O_2 \) saturation < 90%
- New onset cardiac arrhythmias or ischemia
- HR < 60 <120
- MAP < 55 >140
- SPB < 90 >180
- New or increasing vasopressor infusion

- Yes
  - Begin continuous lateral rotation therapy via a protocol to train the patient to tolerate turning

- No
  - Begin in-bed mobility techniques and progress out-of-bed mobility as the patient tolerates

Is the patient still hemodynamically unstable after allowing 5-10 minutes’ adaption post-position change before determining tolerance?

- Yes
  - Begin in-bed mobility techniques and progress out-of-bed mobility as the patient tolerates

- No
  - Allow the patient a minimum of 10 minutes of rest between activities, then try again to determine tolerance

Screen for mobility readiness within 8 hrs of admission to ICU & daily initiate in-bed mobility strategies as soon as possible

Has the manual position turn or HOB elevation been performed slowly?

- Yes
  - Begin in-bed mobility techniques and progress out-of-bed mobility as the patient tolerates

- No
  - Allow the patient a minimum of 10 minutes of rest between activities, then try again to determine tolerance

HOB=head of bed; HR=heart rate; MAP=mean arterial pressure; SPB=systolic blood pressure.
How do you screen for ARDS severity?

- Hemodynamic Instability
- NMBA
Neuromuscular Blockade in Early ARDS

- Multicenter, double blind trial
- 340 patients with ARDS within 48hrs of admitted to ICU
- ARDS defined as P/F ratio of < 150
  PEEP 5cm & Vt of 6-8 ml/kg PBW
- Randomized to receive 48hrs of cisatracurium or placebo
- Study did not use train of 4

Results:
- After risk adjustment NMB group showed improved mortality at 90 days (31.6% vs. 40.7%)
- Also significant at 28 days
- ↑time off vent
- No difference in muscle weakness

Neuromuscular Blocking Agents in ARDS: Systematic Review and Meta-analysis

- 3 trials (431 patients; 20 centers; all from the same research group in France)
- All trials assessed 48-hour infusions of cisatracurium besylate.
- Lower risk of barotrauma
- No increase in vents days or risk of ICU acquired weakness

Figure 2 Mortality. Forest plot comparing neuromuscular blockers and placebo for the following outcomes: 28 days, ICU, and hospital (truncated at 90 days). Results are shown by using random-effects model with relative risk and 95% confidence interval.

Alhazzani W, et al. Critical Care, 2013;17:R43
The ROSE trial at 90-day follow-up in patients with moderate-to-severe ARDS, 42.5% of the intervention group and 42.8% of the control group died before hospital discharge (between group difference -0.3%, 95% CI -6.4 to 5, \( P=0.93 \)), -study stopped early.

Angus D, et al NEJM May 19th 2019

Prone Positioning used 15.8%. Equal use in both groups
Overview of ARDS Ventilator Management Strategies
University Hospital Respiratory Care
University of Michigan Hospitals & Health Centers

**Patient with ARDS**

Use a Basic Lung Protective Ventilation Strategy (see #1)

**Dyssynchrony?**
- Yes
  - Improved?
    - Yes
    - See #3
    - No
  - See #2
- No
  - See #4

**Failing? (see #4)**
- Yes
  - Per clinical situation, consider:
    - Recruitment Maneuvers
    - Prone Positioning (16 hr, 1600-1000)
- No
  - Per clinical situation, consider:
    - Inhaled Nitric Oxide
    - APRV
    - HFOV

**Failing? (see #4)**
- No
  - Per clinical situation, consider:
    - Neuromuscular Blockade
  - Consider a short course (48 hr) of Neuromuscular Blockade
- Yes
  - Consider ECMO

**Recruitment Maneuvers**

- ARDS Network ventilation strategy:
  - Using VCV or PCV and targeting VT 4-6 mL/kg PBW
  - Maintain Pplat ≤30 cm H2O
  - PEEP/FiO2 per table (see back page)

**Prone Positioning**

- Use unit specific rotation frequency, but evidence suggests majority of day in prone position, if tolerated
- Recommend a 48 hr trial, stop if no improvement, as evidenced by:
  - Reduced FiO2 by 0.10
  - Increase PaO2/FiO2 by 30
- Discontinue when:
  - Instability
  - PaO2/FiO2 >150; reduced FiO2 of 0.60

**Airway Pressure Release Ventilation (APRV)**

Refer to Respiratory Care policy

**Esophageal Pressure (Pes) Guided Therapy**

- Requires switch to AVEA ventilator & placement of Pes catheter
- Informs of transpulmonary end-inspiratory (Ptp-plat) and end-expiratory (Ptp-PEEP) pressures

**High Frequency Oscillatory Ventilation (HFOV)**

Refer to Respiratory Care policy (policy follows Oscillate protocol)

**Inhaled Nitric Oxide (iNO)**

- NO Test
  - 20-60 minute test on 20 ppm
  - Positive response: increase in PaO2/FiO2 of >10
- If positive response, reduce to 10 ppm, then FiO2 to 0.6, then tit rate iNO down. Consider flolan or iloprost, per Respiratory Care Policy
- If no response, discuss with team to consider stopping

**Extracorporeal Membrane Oxygenation (ECMO)**

- Absolute contraindications: irreversible pulmonary process and inability to anticoagulate
- Evaluate, but lower survival if on vent 7-10 days pre-ECMO
Roll Out and Integration

- User friendly step by step reference sheet
- Video for easy review
- Web based education
- Simulation training
- Create super users/champions
- Incorporate into orientation for all disciplines

"HAPPY TURNING"