Acute Respiratory Distress Syndrome (ARDS) Diagnosis and Management Tip Sheet for Providers

Berlin Definition of ARDS
Timing: Within 1 week of insult
Imaging: Bilateral opacities
Origin of Edema: Not due to heart failure
Severity:
  *on ≥ 5 PEEP
  Mild: PaO₂:FIO₂: 200-300
  Moderate: PaO₂:FIO₂: 100-200
  Severe: PaO₂:FIO₂ < 100

Goals of Mechanical Ventilation in ARDS
- Maintain oxygenation: PaO₂ goal 55-80 mmHg
- Minimize volutrauma: Tidal Volume (Vₜ) goal 6 cc/kg
- Minimize barotrauma: Plateau pressure (Pplat) ≤ 30
- Permissive hypercapnia: pH ≥ 7.2

Initial Ventilator Settings in ARDS
Mode: Assist Control-Volume Control (AC-VC)
Tidal Volume (Vₜ): 6 cc/kg (IBW)
Respiratory Rate (RR): Match pre-intubation RR
FiO₂: 100%
PEEP: 10 cm H₂O (5 if hypotensive)

Ideal Body Weight (IBW) Table for Vₜ, 6cc/kg

<table>
<thead>
<tr>
<th>Height (in)</th>
<th>5'0&quot;</th>
<th>5'1&quot;</th>
<th>5'2&quot;</th>
<th>5'3&quot;</th>
<th>5'4&quot;</th>
<th>5'5&quot;</th>
<th>5'6&quot;</th>
<th>5'7&quot;</th>
<th>5'8&quot;</th>
<th>5'9&quot;</th>
<th>5'10&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>300</td>
<td>310</td>
<td>320</td>
<td>330</td>
<td>340</td>
<td>350</td>
<td>360</td>
<td>370</td>
<td>380</td>
<td>390</td>
<td>400</td>
</tr>
<tr>
<td>Female</td>
<td>270</td>
<td>290</td>
<td>300</td>
<td>310</td>
<td>320</td>
<td>330</td>
<td>340</td>
<td>350</td>
<td>360</td>
<td>370</td>
<td>380</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height (in)</th>
<th>5'11&quot;</th>
<th>6'0&quot;</th>
<th>6'1&quot;</th>
<th>6'2&quot;</th>
<th>6'3&quot;</th>
<th>6'4&quot;</th>
<th>6'5&quot;</th>
<th>6'6&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>410</td>
<td>420</td>
<td>430</td>
<td>440</td>
<td>450</td>
<td>460</td>
<td>470</td>
<td>480</td>
</tr>
<tr>
<td>Female</td>
<td>380</td>
<td>400</td>
<td>410</td>
<td>420</td>
<td>440</td>
<td>450</td>
<td>470</td>
<td>480</td>
</tr>
</tbody>
</table>

Sedation and Analgesia
- Ensure sedation plan includes both analgesic + sedation
- Can wean to analgesia alone if not paralyzed
- Target RASS -2 to -3 initially; target 0-1 once improving
- Discuss medication shortages / alternatives with pharmacy

Medication Class | Dosing | Notable SEs
--- | --- | ---
Fentanyl | Analgesic | Bolus 25-50 mcg Gt 50-200 mcg | Caution in renal/liver failure
Midazolam | Sedative | Start with 0.5-4mg Gt 2-8 mg/hr | Caution in renal/liver failure; accumulates in adipose, ↑ delirium
Propofol | Sedative | 5-80 mg/hr | ↓ BPs, ↓ HRs, ↑ TGs; PRIS

Ventilator Adjustments in ARDS

**Step 1:** Ensure you are meeting your oxygenation goals (PaO₂ 55-80, or SpO₂ 88-96%)
- Ensure Vent Synchrony
  - Assess sedation requirements
  - Goal RASS -2 to -3 initially
- PEEP Titration
  - Use ARDSNet table or driving pressure to set optimal PEEP
  - Monitor for hypotension as PEEP increases

ARDSDnet PEEP TABLES
Consider incremental FiO₂/PEEP combinations as shown below to achieve PaO₂ or SpO₂ goal

<table>
<thead>
<tr>
<th>FiO₂</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
<th>0.8</th>
<th>0.9</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>5</td>
<td>5-8</td>
<td>8-10</td>
<td>10</td>
<td>10-12</td>
<td>12-14</td>
<td>18</td>
<td>18-24</td>
</tr>
</tbody>
</table>

**Driving Pressure Titration for PEEP**
Driving pressure = P_{plat} – PEEP
- Goal is to find PEEP that minimizes Driving Pressure

**Step 1:** measure P_{plat} with inspiratory pause
**Step 2:** Increase PEEP by 2-4
**Step 3:** After 20 sec remeasure P_{plat}
**Step 4:** If decrease in driving pressure, repeat 1-3. If increased or hypotension, return to prior PEEP

Is P_{plat} at goal < 30 mm Hg?

**YES**
1. Ensure Vent Synchrony
2. Lower Vₜ below 6 cc/kg
3. Repeat inspiratory pause

**NO**
Continue current settings, proceed to Step 3

**Step 3:** Check Blood Gas 15 to 20 minutes after changes to assess adequacy of ventilation
- If pH < 7.2: Increase RR, monitor for auto-PEEP
- If pH 7.2 – 7.40: No changes, permissive hypercapnia OK to allow for low Vₜ
- If pH > 7.40: Reduce set RR, assess for analgesia/sedation needs

**Step 4:** Reassess to ensure achieving ARDS ventilation goals
- PaO₂ 60-80 mm Hg, SpO₂ (90-94%)
- Vₜ 6 cc/kg, P_{plat} (30), and pH (> 7.2)
- Triturate down FiO₂ for PaO₂ 60-80 mm Hg, SpO₂ (90-94%)

Refractory Hypoxemia

PRONE POSITIONING
- Mortality Benefit for Moderate-Severe ARDS (PaO₂:FIO₂< 150)
- Caution if: HD instability; facial/pelvic fractures; arrhythmias
  1) Pre-proning huddle: establish roles*, don airborne PPE
  2) Prone for at least 16 hours
  3) Turn supine for 4-8 hours, then reassess candidacy for proning
  4) Repeat steps 2-3 if PaO₂:FIO₂ remains < 150 after 4 hours supine
- * Monitor lines, ET tube, vent connections, hemodynamics

ECMO (Extracorporeal Membrane Oxygention)
- Call ECMO team if PaO₂ < 80 on FiO₂ 100% despite prone, hemodynamic instability X 12 hours
- Exclusions: BMI > 45, Age > 65, > 30 pack year smoking history

NEUROMUSCULAR BLOCKADE
- Ensure adequate sedation (RASS <-4) before staring paralytic
- Discuss medication shortages / alternatives with pharmacy
- Cisatracium – dosing 0.1-0.2 mg/kg bolus, 2-10 mcg/kg/min gtt
- Can use either bolus dosing or bolus followed by infusion
- Trend TOF (train of four) to assess adequacy of paralysis
- Note: Paralysis is NOT necessary for proning

inhaled Vasodilators
- Inhaled Nitric Oxide
  - Initial dosing 40 ppm. Titration up to 80ppm
  - Avoid epoprostenol (Flolan) in COVID/PUI, clogs viral filter

RECRUITMENT MANEUVERS
- Set PEEP to 30 for 30 seconds (“30 for 30”) or “40 for 40”
- Caution: Potential ↑ mortality, risk of ↓ BPs and barotrauma

Additional Considerations for ARDS
- Plan for line placement on same side for safer proning
- Steroids not recommended for ARDS management unless concomitant refractory septic shock
- Conserved fluid strategy and/or diuresis for negative 24-hour fluid balance, even if requiring low dose vasopressors

Visit the Penn COVID-19 Learning Center Site
Check out the Mechanical Ventilation Tip Sheet