ETIOLOGY:
An acute and life-threatening inflammatory pulmonary reaction to systemic insult or injury. Causes:
- Pneumonia (bacterial or viral)
- Non-pulmonary sepsis
- Major trauma (esp. if ≥3 long bone fractures)
- Aspiration of gastric contents
- Pulmonary contusion
- Pancreatitis
- Inhalational injury
- Severe burns
- (Non-cardiogenic) shock
- Drug overdose
- Transfusion related (TRALI)
- Pulmonary vasculitis
- near-Drowning

DEFINITION: (requires all 4)
- Timing - within one week of known insult
- Imaging - bilateral opacities not explained by another process
- Origin of Edema - respiratory failure not explained entirely by volume overload or CHF
- Impaired Oxygenation PaO2/FiO2 (P/F) ratio < 300

SEVERITY of ARDS is determined by P/F ratio
- Mild (200-300)
- Moderate (100-200)
- Severe (<100)

PATHOPHYSIOLOGY: ARDS lungs develop reduced compliance; making ventilation difficult. Mechanical ventilator can cause further damage; Ventilator Induced Lung Injury (VILI) causes:
- Barotrauma → too much pressure
- Volutrauma → too much volume
- Atelectrauma → repetitive cycles of alveoli recruiting/de-recruiting

Consider conditions that can mimic ARDS
- Acute Eosinophilic pneumonia (AEP) - idiopathic, drugs
- Acute Interstitial pneumonia (AIP) – idiopathic, CVD, drugs
- Organizing Pneumonia (BOOP) – CVD, drugs, radiation, infxn
- Diffuse Alveolar Hemorrhage (DAH) – vasculitis, ABMA, CVD

THE EIGHT P’S FOR ARDS TREATMENT:

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protective ventilation &amp; PEEing</td>
<td>Paralysis &amp; Proning &amp; Prednisone</td>
<td>Prostacyclin &amp; ECMO</td>
</tr>
</tbody>
</table>

PEEP / LUNG PROTECTIVE VENTILATION (LPV)
Mxn: High PEEP low tidal volume ventilator strategy avoids VILI by limiting volumes & pressure, and keeping alveoli open w/ PEEP. Reduces mortality.
Approach:
- Set RR to maintain MV; adjusting rate up to 35 to maintain goal pH > 7.3
- Initial Tidal Volume (TV) = 6 cc/kg PBW; Measure Plateau Pressure (Pplat) every 4 hours and adjust TV for goal Pplat < 30 cmH2O, decreasing TV down to 4 cc/kg PBW if Pplat elevated; if pH is <7.2, may need to increase TV and Pplat may need to be higher than 30 cmH2O.
- Adjust PEEP and FiO2 for goal SpO2 > 90% or PaO2 > 55 mmHg; use either a LOW or HIGH PEEP “ladder” to protocolize PEEP/FiO2 titration

PARALYSIS (e.g. NEUROMUSCULAR BLOCKADE)
Mxn: Improves ventilator compliance; decreases oxygen consumption; most effective if initiated early
Approach:
- Sedate deeply (e.g. RASS -4)
- Use infusion of cisatracurium or vecuronium to achieve and maintain neuromuscular blockade (NMB)
- Repeat clinical assessments including train of four stimulation to avoid excess NMB. Wean dose as tolerated

INHALED PROSTACYCLIN/INO
Mxn: Dilates blood vessels in areas of the lungs that are well ventilated, improves V/Q matching
Approach:
- Start inhaled EPO at high dose and wean as tolerated. If patients respond, they generally have >20% increase in PaO2 within 10 min.

PLEURAL EVACUATION (THORACENTESIS)
Mxn: Improves oxygenation by reducing collapsed lung due to effusions.
Approach:
- Look for large pleural effusions using POCUS; if present consider drainage using thoracentesis.

PERIPHERAL OXYGENATION (ECMO)
Mxn: directly oxygenate blood, remove carbon dioxide, and provide mechanical circulatory support (VA ECMO only). It should be used for selected patients who have the highest probability of benefit; consider using a scoring system to assess the potential risk/benefit: RESPscore (VV ECMO) or SAVEScore (VA ECMO)
Approach
- ECMO should be performed by experienced providers; consider transfer if local experience/resources are insufficient

PRONE POSITIONING
Mxn: By moving from a supine to prone position, we can reduce dependent edema, increases lung volumes (from reduced atelectasis), and improve secretion clearance
Approach: follow a checklist
- Apply soft pads, secure all tubes/lines, place pillows on chest and wrap with sheets (e.g. burrito technique)
- Using a team (ideally 6 or more people) rotate the patient as a unit; supinate once per day for 4-6 hrs

PEEING (e.g. DIURESIS)
Mxn: reduce extravascular water in lungs by minimizing Ins & maximizing outs. (dry lungs are happy lungs) Approach:
- Use a conservative fluid strategy if possible (e.g. concentrate IV meds, use PO electrolyte repletion, and avoid blood product transfusions unless essential.)
- Begin diuresis as hemodynamics permit.

PREDNISONES (e.g. CORTICOSTEROIDS)
Mxn: the anti-inflammatory & immunomodulatory effects of glucocorticoids may mitigate the early exudative phase of ARDS. Approach:
- Start early in ARDS (e.g. within 14 days)
- Methylprednisone 1 mg/kg for 21 days then taper or Dexamethasone 20 mg daily for 10 days then 10mg daily for 5 days.
- There is evidence for lower doses in COVID19 (e.g. 6 mg Dexamethasone IV or PO daily)

CXR showing severe ARDS due to COVID-19