ACUTE RESPIRATORY DISTRESS SYNDROME

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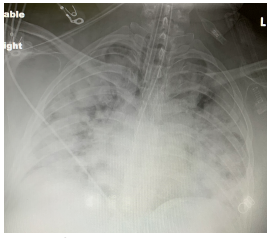
Acute Respiratory Distress Syndrome (ARDS):

An acute and life-threatening inflammatory pulmonary reaction to systemic insult or injury. Causes:

- Pneumonia (bacterial or viral)
- Non-pulmonary sepsis
- Aspiration of gastric contents
- Major trauma (esp. if ≥3 long bone fractures)
- Pulmonary contusion
- Pancreatitis
- Inhalational injury
- Severe burns
- (Non-cardiogenic) shock
- Drug overdose
- Transfusion related (TRALI)
- Pulmonary vasculitis
- near-Drowning



CXR showing severe ARDS due to COVID-19

Definition: (requires all 4)

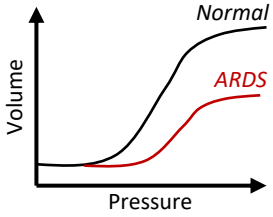
- **Timing** - within one week of known insult
- **Imaging** - bilateral opacities not explained by another process
- **Origin of Edema** - respiratory failure not explained entirely by volume overload or CHF
- **Impaired Oxygenation** PaO2/FiO2 (P/F) ratio < 300

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) can be caused by:

- 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

v1.0 2020-03-30

Seven 'P's for ARDS Treatment:

Mild	Moderate	Severe
Protective ventilation & Peeing		
	Paralysis & Proning	
		Prostacyclin & ECMO

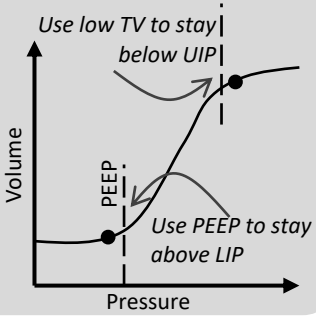
PEEP / Lung Protective Ventilation (LPV)

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 cmH_2O, 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 cmH_2O.
- 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

In terms of compliance curve



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

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

Inhaled Prostacyclin/Nitric Oxide

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 (e.g. 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.

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.

Peripheral Oxygenation (ECMO)

Indication: Consider when inhaled vasodilators (prostacyclins or NO) and for patients with refractory severe ARDS.

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 or resources are insufficient