

ARDS/Mechanical Ventilation

Pathophysiology:

Scattered, nonhomogeneous alveolar damage that leads to oxygenation (V/Q mismatch) problems

Diagnosis:

- Onset: within one week of a known clinical insult, or new or worsening respiratory symptoms
- Imaging: bilateral infiltrates on CXR not fully explained by effusions, nodules, or lung collapse
- Origin: respiratory failure not fully explained by cardiac failure or fluid overload. An objective assessment (eg ECHO) is required to exclude pulmonary edema if no ARDS risk factors are present
- Oxygenation: (on ventilator settings that include PEEP or CPAP >5cm H₂O)
 - Mild ARDS: PaO₂/FiO₂ ratio 200-300 mmHg
 - Moderate ARDS: PaO₂/FiO₂ ratio 100-200 mmHg
 - Severe ARDS: PaO₂/FiO₂ ratio <100 mmHg

Etiology:

- Direct lung injury: Pneumonia, aspiration, pulmonary contusion, fat emboli, near-drowning, inhalational injury, post lung transplantation, or hematopoietic stem cell transplant
- Indirect lung injury: Sepsis, severe trauma, shock, drug overdose, DIC, pancreatitis, cardiopulmonary bypass, transfusion of blood products (TRALI)

Management:

- Mechanical ventilation:
 - Goal: Maintain adequate gas exchange until the inflammation and edema subside and minimize ventilator-induced lung injury
 - ARDSnet protocol (ARMA Trial): low tidal volume (4-6 ml/kg) and low airway pressure (P_{plat} <30 mmHg)
- Additional therapeutic considerations
 - "Conservative" fluid management: FACTT trial showed that it improves oxygenation and shortens the duration of mechanical ventilation and intensive care but does not

improve 60 day mortality. Goal CVP <4, PCWP <8. Excluded patients with hypotension, pressures, HD, oliguric renal failure.

- Early neuromuscular blockade in severe ARDS: ACURASYS trial (single randomized trial) showed the use of cisatracurium in patients with severe ARDS resulted in a reduction in 90 day mortality and an increase in ventilator free days. ROSE trial did not reproduce this mortality benefit.
- Prone positioning PROSEVA randomized trial showed a reduction in mortality in patients with severe ARDS; recommended for patients with P/F < 100, consider if P/F < 150
- ECMO and high frequency oscillatory ventilation: further studies are required to evaluate high frequency oscillatory ventilation and extra-corporeal membrane oxygenation. There are no consensus guidelines but consider in P/F <80.
- Steroids should NOT be initiated in late ARDS (14 days or longer). The impact of earlier steroid therapy on mortality is uncertain, as the DEXA-ARDS trial showed reduced mortality and improved liberation from the vent but previous studies were less clear.
- Recombinant surfactant does not improve survival or ventilator free days
- Low-dose nitric oxide temporarily improves oxygenation but not mortality
- Overall care
 - Identify and treat underlying causes
 - Ensure adequate nutrition (preferably enteral)
 - Provide GI and DVT prophylaxis
 - Prevent and treat nosocomial infections early

Indications for intubation

- Is there failure of airway maintenance or protection?
 - Upper airway obstruction, airway protection
- Is there a failure of oxygenation or ventilation?
 - Uncorrectable hypoxemia (pO₂ <70 mmHg on 100% O₂ NRB)
 - Hypercapnea (pCO₂ >55 mmHg) with acidosis [clinical judgement for pCO₂ in COPD]
 - Ineffective respiration (max inspiratory force <25 cm H₂O)
- Does the anticipated clinical course require intubation?
 - Fatigue (RR>35 with increasing pCO₂)

Initial ventilator settings

- ARDS
 - Initial TV 6ml/kg PBW (range 4-8 ml/kg)
 - Ventilator rate 14-22 breaths per minute
 - Initial PEEP of 5 cm H₂O, up to 24 cm H₂O
- Non-ARDS
 - Initial TV between 6-8 ml/kg PBW reasonable,
 - Ventilator rate 12-16 breaths per minute

- PEEP between 3-5 cm H₂O

Ware LB, Matthay MA. The acute respiratory distress syndrome. N Engl J Med 2000; 342:1334-49.

<https://www.uptodate.com/contents/acute-respiratory-distress-syndrome-clinical-features-diagnosis-and-complications-in-adults>

<https://www.uptodate.com/contents/ventilator-management-strategies-for-adults-with-acute-respiratory-distress-syndrome>

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