Acute Resp. Failure/Acute Lung Injury

ARF: *sudden deterioration in pulmonary gas exchange = CO_2 retention & inadequate oxygenation*

paO_2 < 60 mmHg	(should be 80-100)
$paCO_2$ 60 mmHg	(should be 35-45)
arterial pH < 7.35	(pts usually acidotic)

Causes

Direct	Indirect
Aspiration	Sepsis
Pneumonia	Burns
Contusions/trauma	Truama
Upper airway obstruction	TRALI
Toxic inhalation	Drug reaction/OD
SARS	Cardiopulm. bypass
	Pancreatitis
	Multiple fractures
	Lung/bone marrow tx

Stages of ARF

Stage 1: *inc. SOB, RR, few CXR changes... within 24 hr → signs of ARDS (CXR changes)*
- Tachypneic, dyspneic

Stage 2 (Exudative): *vent. required*
- Address underlying issues

Stage 3 (Proliferative): *hemodynamically unstable*
- Can't maintain BP, tachy, compen. mechanisms, inflammation & cascade of events

Stage 4 (Fibrotic): *lung fibrosis issues; vent. management issues*
- Dec. compliance, stiffness

Types of Respiratory Failure

Type 1 - Acute Hypoxemic: *abnl. transport of O_2 w/ resultant inadequate oxygenation*

Type 2 - Hypercapnic: *inadequate alveolar ventilation; marked elevation in $paCO_2$*

Type 3 - Mixed Hypoxemic-Hypercapnic: *inadequate alveolar ventilation & abnormal O_2 transport*
- Often most common type

Management of ARF

Warrants immediate intervention!

GOALS:
Correct the cause
Alleviate hypoxemia & hypercapnia

Indications for Intubation

Altered mental status or coma

Severe respiratory distress

Extremely low or agonal RR (gasping)
- Cerebral issue r/t O_2

Obvious respiratory muscle fatigue - r/t inc. work of breathing = mechanical vent.

Peripheral cyanosis - fingers, lips dusky

Impending cardiopulm. arrest - heart starts to compensate (tachy, arrythmias) → cardiac arrest

Better to intubate electively rather than emergently!
Mechanical vent. - helps to breathe, protects airway

Systemic Inflammatory Response Syndrome (SIRS)

2+ of...

Temp. > 100.4°F (38°C) or 98.6°F (36°C)

HR > 90 bpm

RR > 20 breaths/min or **$paCO_2$ < 32**

WBC > 12,000 or < 4,000 or/ >10% bands

Older adults - inc. risk for MODS w/ less chance of recovery from ARDS

Acute Respiratory Distress Syndrome (ARDS)

Severe end of continuum

Complex syndrome w/ high mortality risk

Precipitated by *direct* or *indirect* lung injury

Pathophysiology:
Lung injury → Dec. blood flow to lungs *(inflamm. mediators thin lung lining)* → **Alveolar membrane damage** *(membranes thicken, gases can't exchange)* → **Inc. membrane protein permeability** *("Leak syndrome"; changes osmotic pressure)* → **Interstitial & intra-alveolar edema** *(alveolar area flooded = pulm. edema)* → **Further impaired oxygenation → Pulm. edema → Inflamm. changes can lead to fibrosis** *(may cause permanent lung change)*

Surfactant gets lost & makes process worse...
- Dec. gas exchange
- Dec. lung compliance (resistance, pressure)

ARDS (cont.)

Symptoms can develop very quickly after lung insult

Assessment:

- Accessory muscle use
- **Tachypneic**
- **Tachycardia**
- Restless, air hunger = change in O_2
- Confusion
- New/worsening lung sounds (crackles, wheezes) → steroids
- Change in SpO_2
- Lethargy (lose ability to protect airway)
- **Dyspnea**
- At risk for arrythmias
- Change in renal status

Bolded are the earliest signs

By **Maria K** (mkravatz)
cheatography.com/mkravatz/

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ARDS Diagnostic Criteria

paO2-FiO2 ratio < 200 - *shunt formula; normally > 300*

B/L infiltrates on CXR - *white out*

Elevated serum lactate levels - *indicates anaerobic metabolism, tissue hypoxia*

No cariac etiology for pulm. edema

Deterioration of ABG's despite intervention - *resistant to O2*

ARDS Management

GOALS:
- *Correct the cause*
- *Prevent further damage*
- *Supportive care*

Care bundles to improve outcomes

5 P's of ARDS:
- **Perfusion** (max O2 transport)
- **Position**
- **Protective** lung vent.
- **Protocol** weaning
- **Prevent** complications

Mechanical ventilation

Fluid status: *RA/CVP, JVD,* ***BP****, urinary output*

Mechanical Ventilation

Improves O2, figures out CO2, buys time

Lowest FiO2 possible, smallest TV possible

Modes of MV:

- **Volume cycled**: *pushes air in until preset volume delivered*

- **Time cycled**: *pushes air in until preset time reached*

- **Assist modes**: *pt can assist but vent can take over work of breathing*

- **Pressure support**: *weaning mode; depends on pt's breathing (used for weaning)*

- **Pressure control**: *preset volume (based on age, sex, height)*

- **Airway Pressure-Release Ventilation (APRV)**

Mechanical Ventilation (cont)

Weaning ASAP!
- Infection
- Dependent on machine
- Muscles dependent
- Vent may cause trauma (barotrauma, pressure trauma)

Positive End Expiratory Pressure (PEEP): *back pressure prevents alveolar collapse; helps to keep fluid out of alveoli*

- Inc. PEEP = inc. intrathoracic pressure → dec. perfusion = dec. CO
- Affected intrathoracic pressure = organ failure

Management of Ventilated Patients

3 Priorities:

1) Monitor & evaluate pt response
- Vent setting, trach appropriately
- Assess s/s of distress *(lung sounds, chest expansion, ABC & disynchrony r/t proper setting [change vent settings])*

2) Manage vent safely
- Not alone, daily CXR for placement

3) Prevent complications
- Oral care *(dec. bacteria)*, turn & repo. *(changes lung perfusion)*, VAP protocol *(elevate HOB >30°, aspiration precautions)*, DVT prophylaxis, skin care

Note:
- Breath sounds should be equal & symm.
- Document safety, measurement

Proning: *no shock, inc. ICP, unstable spine*

Pharmacotherapy:
- **Antibiotics** *(if known microorganism)*
- **Bronchodilators** *(airway patency)*
- **Surfactant?** *(not really used, expensive)*
- **Corticosteroids?** *(immunosuppressed, glycemic control)*
- **Diuretics** *(dec. lung/general edema, watch electrolytes)*
- **Neuromuscular blocking agents** *(paralytic agents, sedatives = dec. work of breathing)*
- **Flolan?** *(new; inc. flow, V/Q mismatch)*
- **Epinephrine**
- **Low dose dopamine**

Management of Ventilated Patients (cont)

Ex. Neuromuscular Blocking Agents - propophol, Nimbex, + inotropes
+ Inotropes: dilate vascular bed = inc. CO (dibutamine, watch for dec. BP - r/t dose; vasopressors)

Nutrition:
- Dec. mortality, days of not eating → prophylactic enzyme release
- Avoid inc. carb feeds

Prevent complications - VAP, SIRS, MODS, DVT, infection, skin breakdown

Nursing Diagnoses

ARDS	Mechanical Vent
Impaired gas exchange	Risk for infection
Dec. tissue perfusion	Risk for injury - r/t airway
Airway clearance	Risk for injury - r/t immobility

NO ineffective breathing pattern