

Getting to the Heart of ARDS: Clinical Insights and Intervention Strategies

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Objectives



- Describe the pathophysiology of ARDS and its impact on pulmonary and cardiac function.



- Identify early clinical signs and diagnostic indicators of ARDS.



- Explain evidence-based clinical strategies to optimize respiratory support while minimizing complications.



- Discuss key nursing responsibilities and considerations in the assessment, monitoring, and interdisciplinary management of patients with ARDS.

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Acute Respiratory Distress Syndrome (ARDS)



“Acute, diffuse, inflammatory form of lung injury associated with a *variety of etiologies.*”

- Acute onset
- Noncardiogenic pulmonary edema
- Refractory hypoxemia
- Non-compliant or “stiff” lungs
- Intrapulmonary shunting

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ARDS Causes



Direct vs. Indirect



Pneumonia

Sepsis

Aspiration pneumonitis

Pulmonary contusion

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Berlin - Criteria (2012)

Acute Onset	<div style="background-color: #008080; color: white; padding: 10px; border: 1px dashed white; display: inline-block;"> PaO_2 (ABG) FiO_2 </div>
< 7 days	
Bilateral Infiltrates	<p style="color: red; font-size: small;">● Mortality based on P/F Ratio</p>
Consistent with pulmonary edema	
Exclusion	<p style="font-size: small;">Mild (200 - 300) Moderate (100 - 200) Severe (\leq 100)</p>
Cardiogenic or hypovolemia edema	
P/F Ratio	
< 300 mm Hg 5 cm of PEEP	

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The Global Definition

Criteria for *Specific* ARDS Categories related to Oxygenation status

• If ABG not available can use $\text{SpO}_2 : \text{FiO}_2$ as surrogate as long as SpO_2 has adequate waveform and value is < 97%

Nonintubated ARDS	Intubated ARDS	Limited Resources
<ul style="list-style-type: none"> • P/F ratio < 300 mm HG • $\text{SpO}_2 : \text{FiO}_2$ < 315 on: <ul style="list-style-type: none"> ▪ HFNC with > 30 L/min ▪ or NIPPV/CPAP with PEEP > 5 cm H_2O 	<ul style="list-style-type: none"> • Severity based on P/F ratio on at least PEEP of 5 cm H_2O. • Mild: <ul style="list-style-type: none"> ◦ P/F ratio 200 - 300 ◦ $\text{SpO}_2 : \text{FiO}_2$ 235 - 315 • Moderate: <ul style="list-style-type: none"> ◦ P/F ratio 100 - 200 ◦ $\text{SpO}_2 : \text{FiO}_2$ 200 - 235 • Severe: <ul style="list-style-type: none"> ◦ P/F ratio \leq 100 ◦ $\text{SpO}_2 : \text{FiO}_2$ 100 - 148 	<ul style="list-style-type: none"> • $\text{SpO}_2 : \text{FiO}_2$ < 315 <p style="font-size: small; margin-top: 10px;">PEEP <i>nor</i> minimum flow rate of O_2 is needed for the diagnosis in a resource-limited settings.</p>

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Pathophysiology



Direct pulmonary or indirect extrapulmonary insult

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Exudative phase: 7 - 10 days

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Proliferative phase: 10 days to 2 - 3 weeks

3

Fibrotic phase: > 3 - 4 weeks

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Pathophysiology

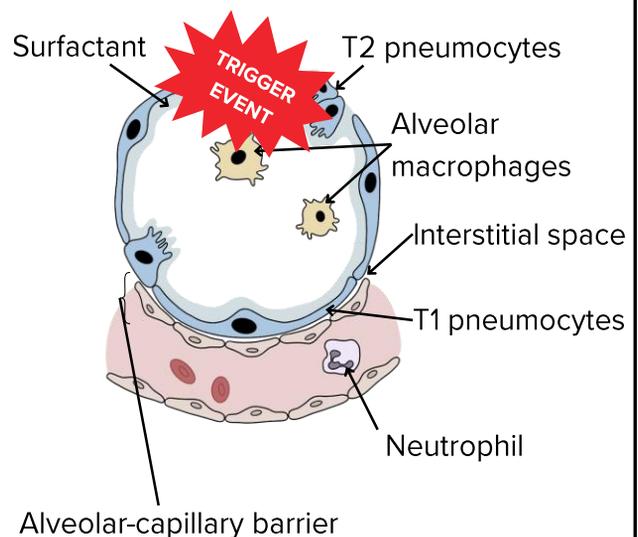
Type 1 pneumocytes:

- Gas exchange

Type 2 pneumocytes:

- Produce surfactant
- Epithelial repair
- “Defenders”
- Mobilize alveolar fluid

Healthy Alveolus

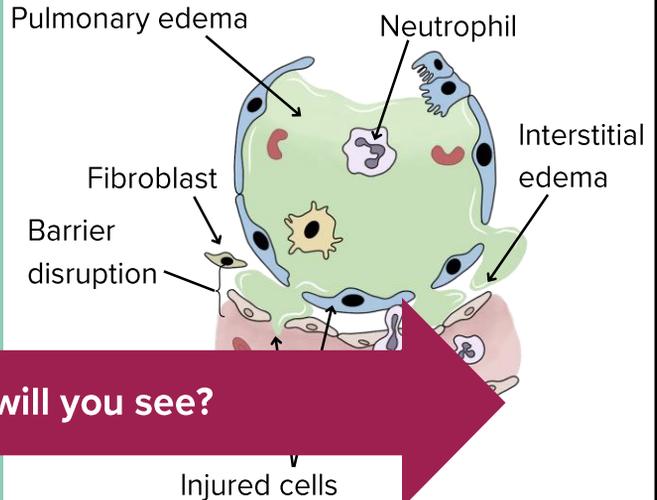


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Pathophysiology

- Diffuse alveolar damage
- Reduced lung compliance
- Intrapulmonary shunting
- Refractory hypoxemia
- Pulmonary hypertension

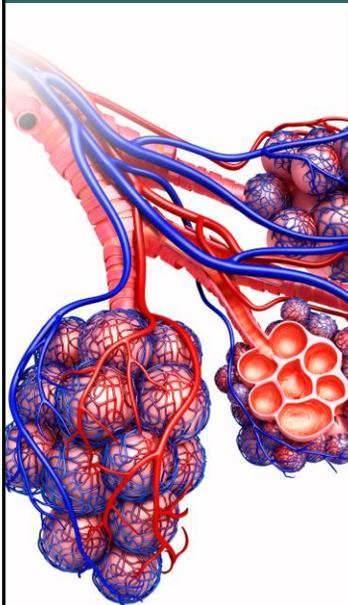
Exudative Phase Alveolus



What clinical s/s will you see?

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Clinical Sign and Symptoms



Early

- Tachycardia
- Tachypnea
- Hypoxemia
- Dyspnea
- ↓ PaCO₂
- Anxiety, agitation
- Clear lungs

Late

- Cyanosis
- Tachycardia
- Tachypnea/bradypnea
- **Refractory hypoxemia**
- ↑ PaCO₂
- Obtunded, comatose
- Bilateral rales
- ↑Pplat / Ppeak
- Ventilator dyssynchrony
- Right heart failure

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Overall Management of ARDS



Overall goals:

- Reduce shunt fraction
- Increase O₂ delivery
- Decrease O₂ consumption
- Avoid additional/further injury

Treat underlying cause

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Lung Protective Ventilation

Tidal Volume

- 4 - 6 mL/kg x PBW

Plateau Pressure (Pplat)

- Pplat ≤ 30 cm H₂O

Driving Pressure

- Driving pressure < 15 cm H₂O

Permissive Hypercapnia

- pH 7.30 - 7.45 ; RR ≤ 35

**Prevent volutrauma /
barotrauma**

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PEEP Titration (ARDSnet Protocol)

- Prevent atelectrauma & ↑ O₂ needs
- Limits O₂ toxicity
- **Goal:** PaO₂ 55 - 80 mmHg or SpO₂ 88 - 95%
- PEEP ≥ 12 associated with decreased mortality in patients with moderate-severe ARDS
- **WATCH HEMODYNAMICS!**

PEEP Titration:

FiO ₂	0.3	0.4	0.5	0.5 - 0.8	0.8	0.9	1.0
PEEP	5 - 14	14 - 16	16 - 18	20	22	22	24

Chart adopted from ARDSnet Study. ARDSnet.org

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ARDS Management



Avoid fluid overload

- Dynamic measurements
- CRRT?
- Diuretics



Steroids

- Within 14 days of moderate to severe ARDS



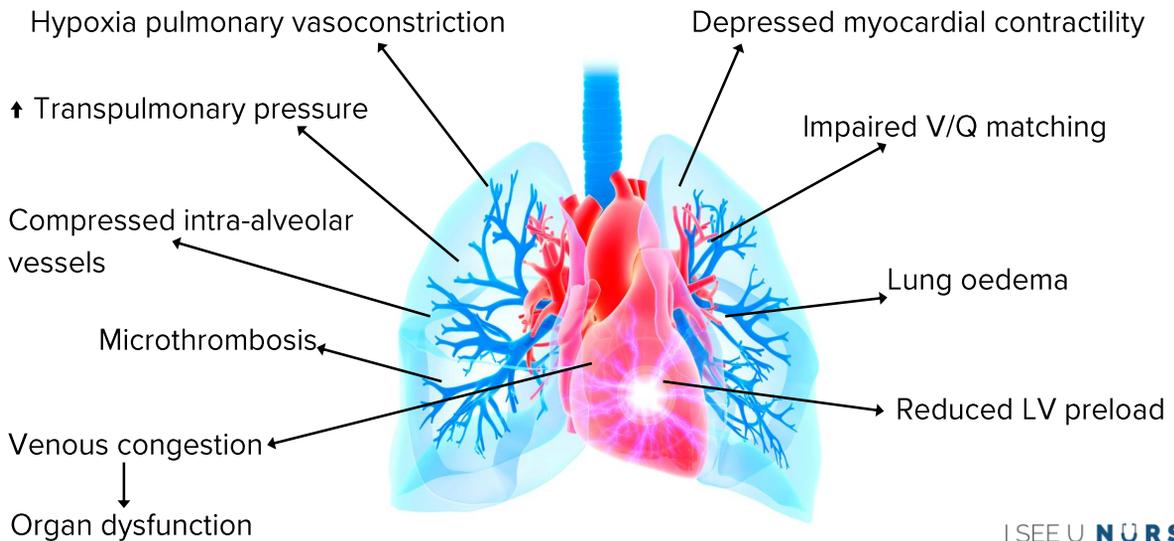
Monitor right heart involvement

- May need + inotropes



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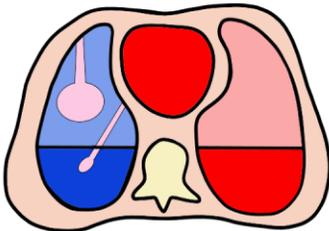
The Right Heart Dysfunction in ARDS



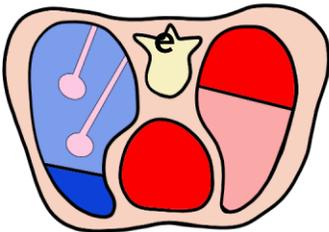
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Prone Therapy

Supine



Pron



P/F ratio < 150 on $\text{FiO}_2 \geq 0.6$ + PEEP ≥ 5 cm H_2O

- Redistributes pressure within the thorax.
- Greater expansion of dorsal lung fields.
- Increased alveoli recruitments.
- Improved V/Q mismatching
- Improvement in secretion drainage.

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PROSEVA trial

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Prone Positioning in Severe Acute Respiratory Distress Syndrome

Claude Guerin, M.D., Ph.D., Jean Regnier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D., Pascal Bouret, M.D., Arnaud Garcia, M.D., Thierry Boulianne, M.D., Emmanuelle Mercier, M.D., Michel Badier, M.D., Alain Mercat, M.D., Ph.D., Olivier Baudin, M.D., Marc Clavel, M.D., Delphine Chastellier, M.D., Samir Jaber, M.D., Ph.D., Sylvène Roselli, M.D., Jordi Manicoba, M.D., Ph.D., Michel Simodot, M.D., Gilles Hilbert, M.D., Ph.D., Christian Bengler, M.D., Jack Richetens, M.D., Marc Garmer, M.D., Ph.D., Frédérique Sapin, M.D., Gaël Boudin, M.D., Veronique Leray, M.D., Raphaële Girard, M.D., Loredana Baboi, Ph.D., and Louis Ayzac, M.D., for the PROSEVA Study Group*

28-Day Mortality	90-Day Mortality
Supine: 32.8%	Supine 41%
Prone: 16%	Prone: 23.6%



Multicenter, prospective, RCT



466 adults with severe ARDS



≥ 16 hours prone vs supine



Initiated within ~ 36 hrs onset

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The Four P's of Prone Positioning

1 Prepare

2 Protect

3 Position

4 Post

Absolute Contraindications

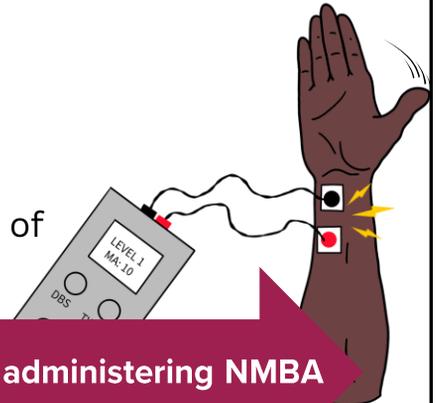
- Neck or spinal trauma & instability.
- ICP >30 mmHg or CPP <60 mmHg
- Multiple fractures or traumas (unstable pelvis, femur, face)
- Acute shock
- Anterior → burns / chest tubes / open wounds
- Recent tracheal surgery or sternotomy within 2 weeks

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Neuromuscular Blocking Agents

P/F ratio < 100; refractory vent dyssynchrony

- **NOT** for routine use
- Early > later
- Sedate first (BIS 40 - 60)
- Obtain baseline TO4
- Monitor for *clinical signs* of paralysis



Always make sure your patient is SEDATED before administering NMBA

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Advanced Modes of Invasive Mechanical Ventilation

BiLevel / APRV / Bi-Vent



- Rescue modes of ventilation
- Inverse I:E ratio
- Spontaneous breathing
- **Monitor Vt & MVe**
- P high with T high
 - Recruit alveoli
- P low with T low
 - Ventilation

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Inhaled Pulmonary Vasodilators

Nitric Oxide (iNO) / epoprostenol (Velitri)

- **Not** shown to reduce mortality/morbidity
- *IF* response → usually within 24 hrs
 - P/F ratio improved by 10-20%
- Wean medication SLOWLY
- Do not abruptly discontinue
- Monitor for rebound pulmonary HTN



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V-V ECMO

Veno-Venous Extracorporeal Membrane Oxygenation

- Failed conventional management
- Contraindication to prone therapy
- Early → < 7 days in ARDS course
- Support oxygenation & manage CO₂
 - P/F ratio < 80 mmHg for > 6 hours
 - pH < 7.25 & PaCO₂ ≥ 60 mmHg for > 6 hours



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Resources:

http://www.ardsnet.org/files/ventilator_protocol_2008-07.pdf

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