Pathophysiology of ARDS

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The Pathophysiology of ARDS
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Chest x-ray of patient showing bilateral pulmonary infiltrates

Chest x-ray of patient showing bilateral pulmonary infiltrates

### ARDS Patient Presentation

#### Scenario

An 85 year old, obese, African American, male presented to the Emergency Department in Columbus, Ohio with shortness of breath, a productive cough, and periods of dizziness that have lasted over a week. The nurse assessed the patient as pale and diaphoretic. The patient did claim a history of pancreatitis, COPD, diabetes, hyperension, 30 years of smoking two packs of cigarettes a day, current everyday alcohol drinker, and worsening radiation therapy for esophageal cancer. Patient states that he has been having trouble swallowing certain foods since radiation.

Vital signs were obtained by the nurse, and the patient’s heart rate revealed 130 beats per minute, oral temperature was 102.3 degrees Fahrenheit, blood pressure 90/42, oxygen saturation 85%, and respirations 36. The patient did appear to be using accessory muscles while breathing, therefore, his chest x-ray was placed on the ICU to obtain an oxygen saturation above 90%. The nurse quickly identified IV access and obtained routine labs. A chest x-ray discovered bilateral pulmonary infiltrates (see image in bottom left corner).

The arterial blood gas (ABG) showed pH 7.12, PaCO2 60, PaO2 26 demonstrating the patient was experiencing respiratory acidosis. The patient’s work of breathing started to increase after several hours, therefore the patient was rapidly placed on a mechanical ventilator and sent to the ICU for further management.

The patient was determined to be septic due to pneumonia and aspiration in the proliferative phase of ARDS. Sepsis is the most common cause of ARDS (Modrykamien & Gupta, 2015). Over the next ten days in the ICU the medical team worked diligently to save this patient’s quality of life (see nursing implication column). The nurses monitored the patient’s vital signs, labs, and fluid status. The nurses flipped the patient from supine position to prone positioning. Approximately, two-thirds of patients with ARDS demonstrate better oxygenation and ventilation from prone positioning (Drakevuk & Custer, 2015). However, the disease progressed, and the patient passed away. Mortality in patients experiencing sepsis with ARDS is 40.6%. The male gender, African American race, high body mass index, and history of alcoholism are associated with a higher mortality rate (Modrykamien & Gupta, 2015).

### Underlying Pathophysiology

#### Lung

Early stage of ARDS in the exudative phase is associated with diffuse alveolar damage, neutrophil infiltration, hemorrhage and the accumulation of a protein-rich pulmonary edema


ARDS is a progressive disease that can be categorized into three different phases according to the new adopted ARDS definition (Butt et al, 2016). See algorithm below for a quick version of significant pathophyiology events.

1. The first phase called the acute exudative phase begins one to seven days after the initial injury. After the injury occurs, the body releases a system immune response and triggers inflammatory mediators called cytokines. This response causes the pulmonary vasculature to become permeable and release extra fluid into the lungs. Fluid in the lungs increase, leading to other issues.

2. Cardiogenic pulmonary edema occurs within the alveoli, causing the blood to leave the heart without being oxygenated (hypoxemia). At this point, increasing the oxygen dose does not improve overall oxygenation status (refractory hypoxia) causing a lack of oxygen to the tissues (hypoxia). The surfactant in the lungs decreases and the alveoli begin to collapse causing compromised gas exchange. These events cause the patient’s work of breathing to increase. Some patients can recover during this phase, but others will progress to the next phase.

3. The second phase called the proliferative phase happens during seven days to 14 days after the injury. The compromised gas exchange gets worse, causing increasing refractory hypoxia with tissue injury and scarring. As the body attempts to compensate, the vasoconstrictors resulting in pulmonary hypertension and right sided heart failure.

The final phase of ARDS happens during days 14-21. It is called the fibrinous phase because the lungs are grossly compromised by thick pulmonary fibrosis. All previous mechanisms worsen and the lungs begin to collapse. Approximately, two-thirds of patients with ARDS passed away.

### Clinical Manifestations

#### Phases

**Acute or Inflammatory**

**Prophylactic**

**Fibrotic**

**Timeframe**

Within 48 Hours

4-10 Days

24 to 26 Days

**Clinical Manifestations**

- Dyspnea
- Tachypnea
- Tachycardia
- Fatigue
- Atrial Hypoxia
- Respiratory Acidosis
- Bilateral alveolar infiltrates on chest x-ray
- Diaphoresis

- Increased work of breathing
- Respiratory distress
- Cyanosis
- Mental status change
- White lung on chest x-ray
- Pulmonary hypertension
- Right heart failure
- Diffuse fibrotic tissue
- Death

- Profound respiratory distress
- Critical refractory hypoxemia
- Tachycardia
- Hypoxemia
- Hypercarbia

**Significance of Pathophysiology**

It is evident that early recognition of ARDS is crucial. If ARDS is detected and treated in the early phase, then that could prevent the disease from progressing and ultimately avoid death. ARDS is made due to evidence of lung injury, physical assessment, ABG analysis, and chest radiographs (McCanne & Hatcher, 2018). It is imperative that all healthcare providers understand the underlying pathophysiology and diagnosis to pinpoint signs and symptoms of ARDS.

### Implications for Nursing Care

- **Frequent respiratory assessment**
- **Frequent evaluation of vital signs, especially respiratory rate, oxygen saturation**
- **Arterial blood gas blood work**
- **Aseptic techniques and infection with any nursing care**
- **Assess for cardiac dysrhythmias and signs for decreased cardiac output**
- **Monitor routine labs and replace electrolyte imbalances**
- **Mechanical ventilator care**
- **Mechanical ventilator play a role in the Pathogenesis of the acute lung injury**

### Additional Resources


### References Cited


**Conclusion**

Acute respiratory distress syndrome is a critical respiratory disease that progresses quickly through three different phases. If prevented or recognized early, the patient will experience a promising outcome. Additionally, there are current studies investigating new ways and strategies to treat ARDS. Some possible treatments being tested include gene therapy, prophylic immunotherapy, surfactant replacement, various immunotherapy medications, stem cell replacements, among several other therapies (McCanne & Hatcher, 2018). It is imperative that all health care providers understand signs, nursing implications for early detection and ongoing advancements for the best treatment available.