Common Respiratory Problems: Pulmonary Embolism, Pneumothorax

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Lecture Outlines

• Pulmonary Embolism
  – Etiology & pathophysiology
  – Deep vein thrombosis
  – Hemodynamic effect
  – Assessment
  – Nursing diagnoses
  – Collaborative management

• Pneumothorax
  – Etiology & pathophysiology
  – Deep vein thrombosis
  – Hemodynamic effect
  – Assessment
  – Nursing diagnoses
  – Collaborative management
Etiology & Pathophysiology

• Pulmonary Embolism (PE) occurs when the pulmonary vasculature is completely or partially occluded by nonsoluble material.
• Most of PE caused by a dislodged venous thrombus
  – most pulmonary emboli (80% to 90%) arise from venous thrombi that extend into the proximal veins (popliteal and iliofemoral) of the lower extremities
• 65% occurs in both lungs, 25% in the Rt lung & 10% in Lt lung
• Women are affected more than men
• Origins of PE varies
  – DVT
  – Fat embolism
  – Air embolism
  – Amniotic embolism
  – Septic embolism
  – Tumor embolism
  – Rt heart embolism
  – Foreign materials
Etiology & Pathophysiology

- Deep Vein Thrombosis
- Virchow’s triad:
  - Vein wall alteration
    - IV catheter
    - Infection & inflammation
    - Varicose veins
    - Major body burs
  - Blood alteration
    - Hyperviscosity
    - Surgery
    - Oral contraceptives
    - Anticoagulant deficiency, protein S&C
  - Blood flow alteration
    - Prolonged bed rest & prolonged surgery
    - Obesity
    - Sickle cell anemia
    - Invasive devices
Etiology & Pathophysiology

• Relationship of deep vein thrombosis and PE

• DVT can be dislodged by various ways:
  – Sudden jarring or movement, especially with 1st ambulation after several days of inactivity
  – Coughing, sneezing, unstable hemodynamic BP
  – Deep leg muscle massage

• The embolus travels through the venous system into the inferior vena cava, Rt atrium, Rt ventricles, then into the pulmonary artery
Etiology & Pathophysiology

- Blood flow to distal lung tissue is impaired
- No gas exchange with occur in these tissue → CO2 from systemic circulation can not enter the alveoli → smooth muscle contraction, bronchospasm, atelectasis
- These changes will affect the nonperfused alveoli and the surrounding tissues
- V/Q mismatch, local tissue hypoxia, systematic hypoxemia, & hypercapnea
- Within 2 – 3 hrs, ↓ production of surfactant → alveolar collapse
- Vasoactive substances such as thromboxanes, histamine, prostaglandin, & serotonin are released
Etiology & Pathophysiology

- Hemodynamic changes is determined by the size the location of the emboli
- Pulmonary hypertension and increased workload of the Rt ventricle → Rt ventricular failure → backward & forward effects

  - **Backward effects:**
    - Rt ventricle hypertrophy
    - Neck vein distention
    - Peripheral edema & ascites

  - **Forward effects:**
    - Lt ventricle does not receive enough blood
    - Reduced CO
    - Bulging of the interventricular septum → ↓Lt ventricle size
    - ↓ in perfusion of coronary artery, brain, renal, systems
Etiology & Pathophysiology

- PE can occur in terminal small pulmonary vessels and results in pulmonary infraction.
- Pulmonary infraction may result from variance in blood flow that leads to break of large emboli to smaller one that occlude the distal end branches.
- These area develop necrosis abscess and scarring & fibrosis.
- Massive PE can result sudden death.
- Two-thirds of patients with fatal PE die within 1 hr of the onset of the symptoms.
Assessment

- History
- Physical presentation (see Box 26-6.)
- Diagnostic findings for DVT (Figure 26-4.)
  - Impedance plethysmography
    - Noninvasive method of measuring changes in volume in the extremities
    - Normally volume and pressure in leg veins increased with inspiration & decreased with expiration
  - Venous duplex doppler studies
    - Evaluate the patency of veins using ultrasound waves
    - Speed and direction of flow can be determined
    - It is considered very accurate (90-100%)
  - Venography
    - Use of radiopaque dye into the dorsum of the foot
  - Magnetic resonance imaging and computed tomography
Plethysmography
Venography

Catheter is inserted into the vein and contrast material is injected.
Diagnostic findings for pulmonary embolus

- Ventilation-perfusion lung scan
  - The initial and specific diagnostic examination for PE
  - Injection of radioisotopes of technetium-99m or iodine-131
  - Ventilation scan is one with inhalation of radioactive aerosol (e.g. xenon)

- Pulmonary angiography
  - Rt heart catheterization
  - Recommended for patients whose clinical assessment and perfusion scan are discordant

- Chest X-ray
  - May be normal with the first 24hrs
  - Non specific findings such as, enlarged Rt heart shadow, atelectasis, enlarged descending pulmonary artery

- Blood test
  - ABG: decrease CO2, PaO2 and elevated pH
  - A-a O2 gradient = 147 – [1.2 x PCO2) + PaO2]; normally should not be higher than 1/10 of patient’s age plus 10

- ECG
  - ST depression in V1& V2,
  - PR segment elevation or depression & T inversion V1-V4
Nursing diagnoses

• Pain
• Impaired gas exchange
• Ineffective breathing pattern
• Decreased cardiac output
• Alter tissue perfusion (see table 19-5)
Collaborative Management

• Maintaining optimal oxygenation (see Table 26-5)
  – May require 100% nonrebreathing mask
  – Inhaled & intravenous bronchodilators are given
  – **AVOIDE** chest physiotherapy and ambulation
  – Analgesic (Morphine sulfate)
  – Maintain high or semi-fowler position
  – Maintain Lt position with head lower than the body in case of air embolism
  – In case of hemodynamic instability intubation may be needed with PEEP
  – Close monitoring of vital signs is required
Collaborative Management

• Restoring perfusion
  – Prevention
    • Good hydration
    • Anticoagulation therapy
    • Thromboembolic compression stockings
    • Leg elevation with passive leg exercises
    • Early ambulation
  – Anticoagulant therapy
    • Heparin is the drug of choice
    • Heparin should be started as soon as possible
    • Warfarin should be started within 24hr of the diagnosis & continue for 6 weeks to 3 months
    • PT is maintained within 1.5 to 2.5 times the control
Collaborative Management

• Restoring perfusion
  – Thrombolytic therapy
    • Contraindications are the same of those for thrombolytic therapy in AMI
    • They are effective through a 2-week window
  – Embolectomy
    • Maybe indicated for those have not respond to anticoagulants and thrombolytic therapies
    • More successful if performed within 24 hrs

• Maintaining hemodynamic stability
  – Fluid management
    • Volume expansion (e.g. dextran 40 or 70) to ensure Lt ventricular filling
    • In case of Rt side HF, diuresis may be indicated
    • Close monitoring of the pulmonary pressure
Collaborative Management

– Vasoactive support
  • Hydralazine, nifedipine, captopril, & amionophylline are used to decrease pulmonary resistance
  • Dobutamine infusion is used to increase the contractility
  • Norepinephrine may be used in patients with profound decrease BP

– Observing complication
  • Cardiovascular
  • Pulmonary
  • Neurologic
  • GI
  • Metabolic or renal
Pneumothorax

- Usually occurred outside the clinical setting as result of accidental trauma, motor vehicle accidents, falls, gunshots, or stabbings
- It is a condition in which air leaks into the pleural space and the lung collapse
- Visceral pleura and parietal pleura are separated by a potential space contain small amount of pleural fluid
- The plural space has a negative subatmospheric pressure
- When continuity of these pleurae is broken, atmospheric air rushes into the negative pressure
- This result in lung collapse & decreased lung compliance, VC, TLC
- Hypoxia may result from V/Q mismatch
Spontaneous Pneumothorax

• Primary spontaneous pneumothorax:
  – Idiopathic
  – More common in males
  – Peak age occurrence 20 – 40
  – May be due to rupture of a previously undetected bulla

• Secondary spontaneous pneumothorax
  – More common in males
  – Due to underlying pulmonary disease
  – Peak age group 45 – 65
  – May associated with COPD as result of slow destruction of the alveolar walls and poor pulmonary recoil
  – In malignant pulmonary disease, rapid neoplastic growth can cause pleural perforation or it can cause bronchial, alveolar distention
  – Common in AIDS patient because of Pneumocystis carinii pneumonia
  – Common in cystic fibrosis and tuberculosis
Traumatic Pneumothorax

- Open sucking chest wound
- Blunt injury
- May be associated with medical procedures such as transbronchial biopsy, central line placement, thoracentesis, pleural biopsy, chest tube placement
- With traumatic pneumothorax, blood vessels can be injured resulting in hemothorax
- Chylothorax occurs when lymph fluid collects in the pleural space
Tension Pneumothorax

- Air is trapped in the intrapleural space and cause pressures to be higher than those of lung
- Caused by the “one-way” valve effect
- During inspiration enters into intrapleural space and can’t escape during expiration
- Increased pressure causes compression on the lung tissue, trachea, major vessels, & heart
- Blood flow and CO is significantly altered and the pressure must be released quickly
Assessment

- **History**
  - Underlying Pulmonary diseases
  - Medical procedure (see table 19-7)

- **Physical presentation**
  - Sudden pain
  - Shortness of breath
  - Asymmetric chest movement
  - Absent or decreased breathing
  - Emphysema in the surrounding tissues
  - Distended neck veins

- **Diagnostic findings**
  - Chest x-ray
  - CT scan
  - ABG
Nursing Diagnoses

• Pain
• Ineffective breathing pattern
• Impaired gas exchange
• Risk for infection (see table 19-8)
Collaborative Management

- **Oxygenation**
  - O2 by nasal cannula 5 L per min
  - Maintain O2 saturation at least 90%
  - Semi-fowler or Fowler position

- **Pulmonary Reexpansion**
  - Spontaneous pneumothorax of 15 – 25% is usually left untreated
  - Simple aspiration of air with Taflon catheter is considered in emergency
  - Chest tube placement is done when the pneumothorax is large

- **Pleurodesis**
  - Pleurodesis: bedside procedure that create pleural adhesion by the introduction of irritating agents into the plural space through chest tube
  - If the chest tube was not enough to reexpand the lung surgical procedure should be considered
  - Pleurectomy or pleural abrasion is required
  - Thoracotomy or thoracoscopy is performed to maintain plural adhesion
Collaborative Management

• Intrapleural Fibrinolysis
  – In case of loculated hemothorax
  – Very useful for patients with underlying pulmonary disease who may poorly tolerate general anesthesia
  – Instilling Urokinase or streptokinase into the chest tube, clamping the tube for 4 hrs, rotate the patient in different position
  – 92% success rate

• Video-Assisted Thoracic Surgery (Thoracoscopy)
  – Direct visualization of the defects
  – Samples and biopsy can be obtained
  – Removal of blood clots
  – Thoracic duct ligation
  – Lung repair

• Observing for complication
  – Infection & lung abscess
  – atelectasis
  – Respiratory failure
  – ARDS
Questions and answers