Respiratory Function Case Study

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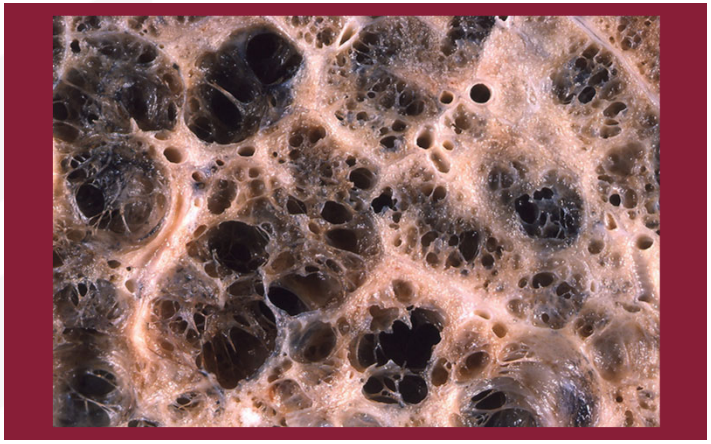
Case Study

Mr. Dan Griffith is a 65-year-old male who presented to the emergency department with shortness of breath and chest tightness of recent onset. He has a 7-year history of chronic obstructive pulmonary disease and is on oxygen at home. Physical assessment reveals a respiratory rate of 32 and slightly labored, temperature of 98.9°F, and SpO_2 of 86% while on oxygen via nasal cannula at 2 L/min (Story, 2018a, p158).

Mr. Griffith is admitted to the pulmonary unit with acute exacerbation of emphysema. Six hours after arriving on the floor, you notice that his respiration rate has dropped from 28 to 8 breaths/min. The nurse notes that Mr. Griffith's oxygen is set at 8 L/min via nasal cannula (Story, 2018a, p. 158).

Name & Definition of Disorder

Emphysema: is an obstructive respiratory disorder that results in the destruction of the alveolar walls, leading to large, permanently inflated alveoli; most severe type of COPD (Story, 2018a, p. 146; Vera, 2013).



Courtesy: Rosen, 2009

Pathophysiology

Emphysema is recurrent inflammation that gradually turns the alveoli into large, irregular pockets with gaping holes, which in turn limits the amount of oxygen entering the bloodstream. The elastic fibers and surfactant that normally keep the alveoli open are slowly destroyed, so the alveoli collapse during expiration, trapping air in the lungs (Story, 2018a, p. 146; Vera, 2013).

Etiology

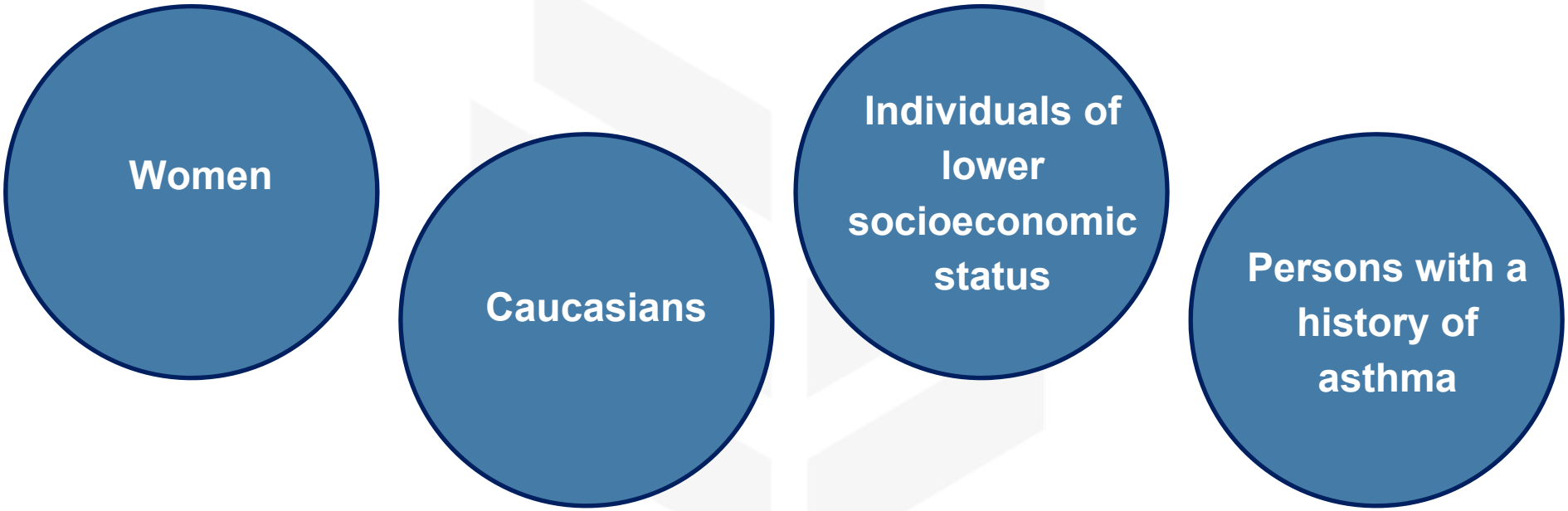
- **Primary**: Long-term exposure to airborne irritants such as, tobacco smoke, marijuana smoke, air pollution, chemical fumes and dust. Symptoms typically present around 60 years old (Mayo Clinic Staff, 2017; Story, 2018a, p. 144).
- **Rare**: an inherited deficiency of a protein that protects the elastic structures in the lungs called alpha-1-antitrypsin deficiency. Symptoms typically present around 30 - 40 years old (Mayo Clinic Staff, 2017; Story, 2018a, p. 144).

Risk Factors

- Cigarette smoking [most significant] (Story, 2018a, p. 144)
- Exposure to secondhand smoke (Mayo Clinic Staff, 2017)
- Inhalation of pollution and chemical irritants (Story, 2018a, p. 144)
- Enzyme deficiency, may result from genetic predisposition [<2% of cases] (Story, 2018a, p. 146)

Courtesy: jprarts.com

Epidemiology



(Story, 2018a, p. 144)

Clinical Manifestation: Signs & Symptoms

- Dyspnea upon exertion
- Diminished breath sounds
- Wheezing
- Chest tightness
- Tachypnea
- Hypoxia
- Hypercapnia
- Barrel chest {increased anterior-posterior thoracic diameter}
- Activity intolerance
- Anorexia
- Malaise

(Story, 2018a, p. 146)

Clinical Manifestation: Laboratory Results

- **Hypoxemia**: decreased PaO_2 [95-100 mm Hg]
- **Hypercapnia**: elevated $PaCO_2$ [35-45 mm Hg]
- **Compensatory metabolic alkalosis**: elevated HCO_3^- [22-26 mEq/L]
- **Polycythemia**: elevated hematocrit [Women: 37%-47%, Men: 42%-52%]

(Boka, 2016; North Carolina Central University, 2018; Story, 2018b, p. 179)

Clinical Manifestation: Diagnostic Studies

LABORATORY STUDIES

- **Arterial blood gas (ABG) analysis**: Patients with chronic obstructive pulmonary disease (COPD) & emphysema have some decreased level of hypoxemia. As the disease progresses, hypoxemia worsens and hypercapnia develops (Boka, 2016).
- **Serum bicarbonate**: Chronic respiratory acidosis leads to compensatory metabolic alkalosis. In the absence of blood gas measurements, serum bicarbonate levels are useful for following disease progression (Boka, 2016).
- **Hematocrit**: Chronic hypoxemia may lead to polycythemia. An elevated hematocrit value is indicative of this condition. Patients should be evaluated for hypoxemia at four times: at rest, with ambulation, with exertion, and during sleep. Correction of hypoxemia should reduce secondary polycythemia in patients who have quit smoking (Boka, 2016).

Clinical Manifestation: Diagnostic Studies

- **Serum alpha-1-antitrypsin**: Of the approximately 75 different alleles for alpha1-antitrypsin (AAT) deficiency variants, 10-15 are associated with serum levels below the protective threshold of 11 mmol/L. The most common severe variant is the Z allele, which accounts for 95% of the clinically recognized cases of severe AAT deficiency. The diagnosis of severe AAT deficiency is confirmed when the serum level falls below the protective threshold value (ie, 3-7 mmol/L). Specific phenotyping is reserved for patients in whom serum levels are 7-11 mmol/L or when genetic counseling or family analysis is needed (Boka, 2016).

Clinical Manifestation: Diagnostic Studies

IMAGING STUDIES

- **Chest radiograph:** frontal and lateral chest radiographs reveal signs of hyperinflation. Rapid tapering vascular shadows accompanied by hyperlucency of the lungs are signs of emphysema. With complicating pulmonary hypertension, the hilar vascular shadows become prominent; right ventricular enlargement and an opacity in the lower retrosternal air space may also occur (Boka, 2016).
- **CT scan**: high-resolution CT (HRCT) scanning is more sensitive than standard chest radiography. HRCT scanning is highly specific for diagnosing emphysema and outlines bullae that are not always observed on radiographs. A CT scan is only indicated when the patient is being considered for a surgical intervention such as bullectomy or lung-volume reduction surgery, not in routine care (Boka, 2016).

Clinical Manifestation: Diagnostic Studies

OTHER STUDIES

- **Pulmonary function tests**: these measurements are necessary for the diagnosis of obstructive airway disease and for assessments of its severity. In addition, spirometry is helpful for assessing responses to treatment and disease progression (Boka, 2016).
- **Echocardiogram (ECG)**: these tests can detect signs of right heart failure, a complication of emphysema and COPD (Virtual Medical Centre, 2018).

Complications

- **Collapsed lung [pneumothorax]**: a collapsed lung can be life-threatening in people who have severe emphysema, because the function of their lungs is already so compromised. This is uncommon but serious when it occurs (Mayo Clinic Staff, 2017).
- **Coronary artery disease (CAD)**: inflammation associated with COPD can cause the blood vessels that supply the heart with nutrients, oxygen, and blood to become hardened and narrowed (Bennington-Castro, 2018).
- **Cor pulmonale**: emphysema can increase the pressure in the arteries that connect the heart and lungs. This can cause a right-sided heart failure condition, in which a section of the heart expands and weakens (Mayo Clinic Staff, 2017).

Complications

- **Large holes in the lungs [bullae]**: some people with emphysema develop empty spaces in the lungs called bullae. They can be as large as half the lung. In addition to reducing the amount of space available for the lung to expand, giant bullae can increase your risk of pneumothorax (Mayo Clinic Staff, 2017).
- **Lung cancer**: COPD is associated with a two-to-four-fold increase in the risk for lung cancer independent of smoking. Research suggests that chronic inflammation associated with COPD may play a role in the development of lung cancer, just as chronic inflammation can be a contributing factor to malignancies in other organs (Bennington-Castro, 2018).

Complications

- **Malnutrition:** people with COPD often have weight issues and poor nutrition, which is frequently associated with the increased energy (calories) and effort required to breathe (Bennington-Castro, 2018).
- **Osteoporosis &/or Osteopenia**: issues related to COPD, including inactivity, inflammation, vitamin D deficiency, and corticosteroid use as part of a treatment plan, can put people at a higher risk for bone-density loss [osteopenia] and osteoporosis (Bennington-Castro, 2018).
- **Pulmonary hypertension**: hypoxia also affects the blood vessels inside the lungs (the pulmonary arteries), causing them to narrow and increase blood pressure (Bennington-Castro, 2018).

Complications

- **Pneumonia**: this is an infection of the alveoli and bronchioles. People with emphysema are more prone to pneumonia (Department of Health & Human Services, State Government of Victoria, Australia, 2018).
- **Respiratory acidosis:** develops when the lungs do not expel carbon dioxide adequately [inadequate ventilation]. This leads to an increase in carbon dioxide due to decreased gas exchange in the lungs (Lewis, 2018; Story, 2018b, p. 181).
- **Respiratory failure**: Often caused by acute infections of the lungs (Virtual Medical Centre, 2018).
- **Secondary polycythaemia**: abnormally high amount of red blood cells causing sluggish blood flow and an increased risk of clotting (Virtual Medical Centre, 2018).

Nursing Diagnosis

1. Impaired gas exchange related to alveoli destruction as evidenced by tachypnea (respiratory rate of 32 breaths/min), hypoxemia (SpO_2 of 86%), dyspnea (slightly labored), and shortness of breath.
1. Ineffective breathing pattern related to bronchoconstriction as evidenced by shortness of breath, dyspnea (slightly labored), tachypnea (respiratory rate of 32 breaths/min), hypoxemia (SpO_2 of 86%), and barrel chest.
1. Deficient knowledge related to the use of oxygen therapy as evidenced by oxygen being set to 8 L/min.

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