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Chronic Obstructive Pulmonary Disease

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a gradually progressive disease that affects the airways or pulmonary parenchyma, or both, and results in airflow obstruction (Qaseem et al. 2011). COPD is a set of diseases that limit air flow, causes difficulty breathing, and include both emphysema and chronic bronchitis (CDC, 2017). "In the United States, COPD affects more than 5% of the adult population; it is the third leading cause of death and the 12th leading cause of morbidity. The total economic cost of COPD in the United States were estimated to be \$49.9 billion in 2010, and the total direct cost of medical care is approximately \$29.5 billion per year" (Qaseem et al. 2011, p.180). Advanced practice nurses can play an important role in helping to manage these patients. This student nurse practitioner chose this topic because of its prevalence and because of personally caring for a family member with COPD from early disease exacerbations through progression to end of life. The purpose of this paper is to provide advanced practice nurses a review of the pathophysiology of COPD and provide current clinical guidelines for diagnosis and the management of this chronic disease. Although this paper will include some information on both emphysema and bronchitis, the primary focus will be on emphysema.

Risk Factors, Signs & Symptoms

According to the World Health Organization (WHO, 2017) risk factors associated with COPD include;

- Smoking (the primary cause) which includes second-hand or passive exposure
- Indoor air pollution
- Occupational dusts and chemicals
- Recurrent lower respiratory infections in childhood

The prevalent symptoms associated with a COPD diagnosis in patients over the age of 35 years with a risk factor (usually smoking) include (Mitchell, 2015);

- Shortness of breath with exertion
- Chronic cough
- Regular sputum production
- Frequent winter bronchitis
- Respiratory wheeze

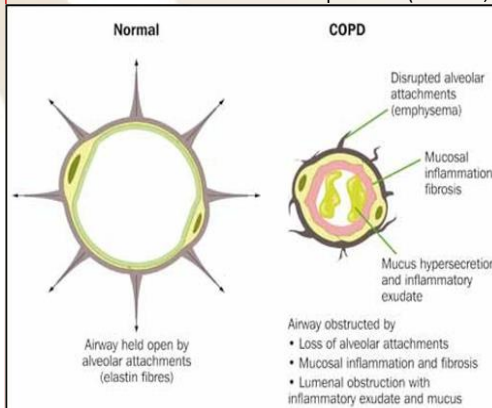


Figure 1. Depicts airway limitations in COPD (Mitchell, 2015).

Pathophysiological Processes

Underlying Pathophysiology

A characteristic of COPD is the on-going inflammation affecting central airways, peripheral airways, lung parenchyma and the alveoli, as well as the pulmonary vasculature (Mitchell, 2015). These characteristics combined result in narrowing and remodeling of the airways, an augmented number of goblet cells, amplification of the mucus-secreting glands of the central airways and subsequent vascular bed changes leading to pulmonary hypertension (Mitchell, 2015).

The primary feature of COPD is airflow limitation that is not fully reversible (figure 1.) For those patients with emphysema, the smooth muscle in the airways becomes thickened and constricted which results in a narrowing of the airway. These narrowed airways are prone to collapse, particularly during expiration (Mitchell, 2015).

In emphysema, the surface area for gaseous exchange is severely reduced, resulting in the damage of pulmonary capillaries which restricts the diffusion of gases, resulting in a mismatch between ventilation, and perfusion (Mitchell, 2015).

According to Mitchell (2015), gas exchange (known as external respirations) takes place at the extremely thin alveolar capillary membranes by diffusion. Oxygen moves from the alveoli into the pulmonary capillaries as shown in figure 2; therefore blood leaving the lungs to go to the pulmonary veins and the left side of the heart should be saturated with oxygen and have dumped CO₂ to be exhaled and eliminated by the body (p.445). Alveolar dead space (dead space ventilation) takes place when air remains in the conducting airways and is unable to reach the alveoli, due to alveolar damage. This then, is air that does not take part in alveolar ventilation (Mitchell, 2015).

Contraction of smooth bronchial muscle (bronchoconstriction), in addition to limitation in airflow from inflammation and mucus production, attribute to noisy musical sounds known as 'wheezing'. This occurs mainly with expiration (Mitchell, 2015). Over secretion of mucous along with ciliary dysfunction leads to the chronic cough and sputum production most COPD patients experience (Mitchell, 2015).

Coughing is initiated by irritant receptors in response to chemical, inflammatory, or mechanical stimuli and is a defense mechanism to protect our airways. Coughing results in bronchoconstriction and hypersecretion of mucous. Chronic cough due to COPD manifests as prolonged bouts of productive cough caused by the increased activity in mucous-secreting goblet cells in the mucous glands of the bronchial wall. Fatigue is a factor in ineffective coughing with COPD patients as well (Mitchell, 2015).

Dyspnea is the most prominent symptom in COPD patients and is typically the reason the patient seeks medical help (Mitchell, 2015). Changes in respiratory rate, pattern, depth, and degree of shortness of breath, are challenging for the APRN to assess because of the chronic nature of the disease as well as the subjective experience of dyspnea. Oxygen saturation is the 'fifth vital sign' and in COPD patients, dyspnea is to be considered a sixth vital sign (Mitchell, 2015).

Significance of Pathophysiology

Gas exchange at the alveoli changes over time in some COPD patients; this is due to hypoxic pulmonary vasoconstriction (Mitchell, 2015). Mitchell (2015) further discusses that this change happens with the body's protective mechanism in an attempt to equalize ventilation with perfusion This causes the pulmonary arteries to narrow because of low oxygen levels, diverting blood away from the poorly ventilated alveoli (p. 446).

When alveoli are unventilated (airless), full of fluid or infection (debris), or low in oxygen, blood is diverted within the pulmonary capillaries to more ventilated alveoli with a higher level of oxygen to limit what is termed 'shunting' (low blood oxygen levels) resulting in blood circumventing alveoli and returning to the left ventricles unoxygenated (hypoxaemic) (Mitchell, 2015). Hypoxaemia results when the oxygen levels within the arterial blood are low, whereas hypoxia results when there is low oxygen levels at the cellular tissue level (Peate & Dutton, 2014, Ch. 5).

Implications for Nursing Care

COPD is a disabling disease. Repetitive exacerbations result in a higher use of our health resources, especially among those patients with advanced COPD and comorbidities (Bourbeau & Saad, 2012). Bourbeau & Saad (2012) point out that the sooner the patient with COPD can learn and understand the disease process; the better it will be for them. They discuss ways to achieve this mastery is by implementing self-management programs while following fundamental principles with respect to the patients' needs and abilities (p. 99). To achieve this, Bourbeau & Saad note "the patient has to become more knowledgeable, and he has to develop the confidence, that is, self-efficacy, with respect to specific health behaviours and the recognized skills needed to cope on a day-to-day basis with this disease...also require the provision of continuity of care at the location where the patient lives" p. 99). A self-management intervention that includes an action plan in the event of an exacerbation and an integrated health-care system coordinated by a case manager for educational sessions and regular communication reinforces the premise that if patients receive effective self-management support then they can be empowered to assume healthy behaviors and many of the unfortunate outcomes related to chronic disease can be avoided (Bourbeau & Saad, 2012).

Conclusion

Current guidelines recommend screening spirometry in smokers and those patients at risk because of the extensive impairment of small airway function, progressive morbidity and reduced life-expectancy associated with COPD (Elbehairy, Webb, Neder & O'Donnell, 2013). Smoking cessation is a pivotal intervention and is known to favorably change the natural course of COPD (Elbehairy, Webb, Neder & O'Donnell, 2013). The care giver must use best clinical judgement regarding treatment options on a case-by-case basis for these patients. Primary care nurses (APRNs) are ideally placed to provide the ongoing education and close monitoring to recognize symptoms and act on them early and accordingly.

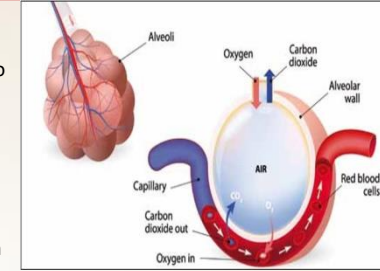


Figure 2. Illustrates the normal process of gas exchange at the alveoli (Mitchell, 2015).

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