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Pathophysiology of Acute Asthma Exacerbation

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Pathophysiology

- Asthma is characterized by two interrelated abnormalities: airway inflammation and airway hyper-responsiveness. This disease is heterogeneous and chronic, with acute exacerbations (Donahue and Jain 2013, p 944).
- Triggers for the airway inflammation and hyper-responsiveness that occurs with asthma include; exercise and numerous exogenous factors such as aeroallergens, infections, cigarette smoke and other irritants.
- Airway inflammation results from the activation of mast cells and antigen-specific Th2 cells, resulting in the production of cytokines, including interleukin (IL)-4, IL-5 and IL-13 (Donahue and Jain 2013, p 945).
- During an acute asthma exacerbation or, "attack", a trigger is encountered and causes the airways to restrict and become narrow leading to hypoxia, hypercapnia, and acidosis.
- Airway occlusion results from smooth muscle bronchoconstriction, airway edema and inflammation. In addition to less air passing in and out of the lungs, excess mucus accumulates in the airway further impeding proper gas exchange (Dhankani, Girase, Chavan, & Pawar S. 2013, p 413).
- Causes of asthma are multifactorial and are influenced by both environmental and genetic causes.
- Allergic inflammation is well known to be a causative factor contributing to this disease. Asthma is influenced by inflammatory molecules such as Interleukin 6 (IL-6) (Nakajima et al 2017, p 125).
- The Johns Hopkins Asthma and Allergy Center conducted a study that found that between 85 and 95% of patients with asthma had allergic rhinitis (Khan 2014, p 358).
- Genetics play a distinct role in the patient's susceptibility to developing asthma (Melen and Pershagen 2012, p 117).
- Asthma is thought to be influenced by alterations in the microbiome of the lungs. Further research regarding the microbiota in asthmatic patients may lead to exciting new developments in asthma interventions (Sullivan et al. 2016, p 1).

Signs and Symptoms of Acute Asthma Exacerbation

Airway inflammation can lead to the following clinical presentation:

- Dyspnea
- Cough
- Chest tightness
- Wheezing
- Airflow obstruction
- Any combination of these symptoms

- Evaluation of peak flow may be useful during asthma exacerbation, but only if patient's individualized peak flow baseline is current and known during the time of treatment (Fanta 2017, p 1).

- An asthma exacerbation can usually be presented in the clinical setting under one of two subcategories; severe, or respiratory arrest imminent.

- Severe: characterized by dyspnea at rest that interferes with conversation, peak expiratory flow rate (PEFR) <40% predicted, usually requires emergency department (ED) visit and likely hospitalization. Patient experiences partial relief from frequent inhaled short-acting beta-agonists

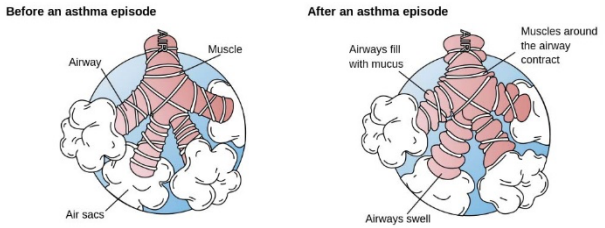
- Respiratory Arrest Imminent: Patient is too dyspneic to speak; sweating, PEFR <25% predicted, requires ED/hospitalization; possible ICU, minimal or no relief from frequent inhaler, intravenous corticosteroids, and/or adjunctive therapies.

Red flags of impending respiratory failure:

- Tachypnea
- Tachycardia
- Use of accessory muscles

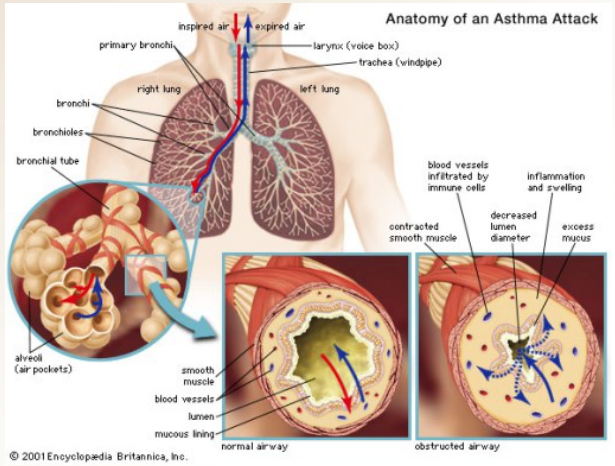
- The presence of pulsus paradoxus in patients with acute severe asthma is an indication of ventilatory muscle fatigue and impending respiratory failure (Restrepo, et al, p 523).

- Use of mechanical ventilation is indicated when other therapies fail to improve the patient's symptoms and the patient has had a decrease in respiratory effort, change in mental status, or exhibits hypercapnia and respiratory acidosis (Fanta 2017, p 6).



Introduction

- Asthma is a chronic respiratory disorder that affects over 300 million people worldwide.
- This disorder is characterized by airway hyper-responsiveness and inflammation.
- Asthma is seen in patients across the lifespan.
- Asthma continues to increase in prevalence and is one of the most common lung disorders seen and treated in the healthcare setting (Fehrenbach, Wagner, and Wegmann 2017, p 551).
- The original presentation or development of asthma may occur in children or adults
- Acute asthma exacerbation may be gradual or sudden in onset, depending on the phenotype (Restrepo, et al, p 534).
- be seen in pediatric patients, or it may have a new onset in adulthood.
- Effective management is multi-factorial
- This topic was chosen due to it's relevance in the healthcare setting, and applicability to the practice of the APN.
- APN's must understand and be prepared to encounter this common illness.



Significance of Pathophysiology

- Asthma is thought to have two phenotypes; gradual onset and sudden onset. Depending on the phenotype, the response to interventions may be different. For example, in gradual onset there is mucus plugging in the airway, and a slower response to treatment. Sudden onset typically does not have mucus plugging, and responds more rapidly to treatment (Restrepo, et al, p 522). This is one example of why understanding the complex pathophysiological processes is crucial when diagnosing and treating patients.
- Understanding the pathophysiology of asthma supports the ability to prevent acute attacks by avoiding triggers, or intervening early when symptoms begin.
- Early recognition and treatment of acute asthma exacerbation has direct effect on morbidity and mortality in these patients.
- Understanding of the physiologic process occurring in asthmatic patients is critical in order to understand how therapeutic interventions impact the patient's disease process.

Nursing Implications

- Presence of strong assessment skills in order to recognize this condition and intervene appropriately. Ability to identify abnormal lung sounds and recognize respiratory difficulty or distress.
- Facilitate communication with interdisciplinary care team as needed (i.e. Respiratory therapy). Other disciplines, such as radiology or laboratory, may be involved as well depending on presentation of the patient and physician's orders.

Be knowledgeable regarding potential therapeutic interventions:

- Positioning patient
- Use of oxygen and oxygen delivery methods
- Use of nebulizer, inhaler and spacer device.
- Oxygen titrated to maintain SpO2 of >92%.
- Selective beta 2 agonists Antimuscarinics
- Corticosteroids
- Magnesium sulfate when indicated (Hazeldine 2013, p 48).
- The nurse should be knowledgeable regarding potential side effects or adverse effects of the administered medications, such as tachycardia in response to inhaled albuterol.

Educating patients on the following:

- Risk factors
- Avoidance of triggers
- Proper use of rescue inhaler
- Spacer use
- Asthma action plan
- Smoking cessation and/or second hand smoke avoidance
- When to seek emergency medical care during an acute attack

- Understanding of peak flow meter use and interpretation
- In severe cases, the nurse must be prepared for, and understand their role in, either non-invasive ventilation or invasive ventilation (intubation) of the patient.
- The patient should be kept NPO during the acute phase in order to prevent potential aspiration in the event of endotracheal intubation.

Conclusion

- Thorough and effective patient education is a key factor in preventing an acute exacerbation of asthma.
- Early intervention for patients experiencing acute asthma exacerbation is critical for positive outcomes.
- With proper management and evidence based practice, mortality for patient's with mild to moderate acute asthma exacerbation is low.
- However, approximately 10 to 30% of patients may still require positive pressure ventilation for severe acute asthma and mortality could be as high as 22% (Restrepo, et al, p532).
- Recognizing the signs and symptoms quickly will assist the APN in initiating the appropriate treatments in a timely manner.
- Although Asthma has the ability to produce severe acute exacerbations that may become life threatening, this chronic illness can be properly managed with proper trigger/allergen identification, maintenance medications, asthma action plan, and periodic monitoring of the patient's respiratory status using peak flow.

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