

An Overview of Asthma Diagnosis and Management Approach

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ABSTRACT

Background: Asthma is a condition characterized by episodic wheezes. The condition can present either acutely with an exacerbation or as a chronic condition the patient had been suffering for years from. It is one of the most common conditions worldwide, affecting individuals of all ages. While it classically causes reversible airway narrowing, permanent damage may occur in uncontrolled cases. **Objectives:** We aimed to review the literature reviewing Asthma, along with the pathophysiology, clinical features, diagnosis, and management in both the acute setting and definitively. **Methodology:** PubMed database was used for article selection, and the papers were obtained and reviewed. **Conclusion:** Asthma diagnosis can be challenging, especially in young children. Hence, proper history, physical exams, and testing to determine the reversibility of airway narrowing are a must to reach the diagnosis. The global initiative for asthma has designed guidelines to combat this condition. Physicians should be familiar with these guidelines to manage this common condition.

Keywords: Asthma, Asthma exacerbation, Spirometry.

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INTRODUCTION

Asthma is one of the most common and significant health issues worldwide [1-4]. Its prevalence ranges from 1-18% depending on the country. [5] Proper clinical diagnosis and management up to the most recent guidelines are essential to prevent acute exacerbations of the disease and long-term control of the chronic airway narrowing that follows the disease. [6] In this review, we will cover the pathophysiology of this condition, along with the epidemiology,

clinical manifestations, diagnosis, management, and complications.

METHODOLOGY

PubMed database was used for articles selection, and the following keys used in the mesh: (((Asthma) AND (Diagnosis)) OR (Management)) OR (Exacerbation). In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics; Asthma, Acute exacerbation, Diagnosis, Man-

agement. Exclusion criteria were all other articles that did not have one of these topics as their primary endpoint.

Review:

Epidemiology

Typically, asthma has been seen at higher rates in higher-income countries. [5] Asthma diagnosis rates have gone up during the past two decades and have reached a plateau over the recent years. This is most likely due to the establishment of better diagnostic criteria and better recognition of the condition. [7] While asthma numbers are rising, the recent literature puts worldwide prevalence at 4.3% and in the US it goes as high as 8.4%. [8]

Pathogenesis

Asthma pathogenesis involves multiple pathways and processes for the condition to develop. The most studied mechanisms involve airway inflammation and narrowing. [9]

Mast cells play an important role in the pathway of airway inflammation. When someone gets inhaled an allergen for the first time, such as pollen, they may not develop an immediate reaction. The reason is that those allergens must be identified first. This will lead to the development of specific IgE for those particular allergens. [9, 10] Any contact after the first time, those IgE antibodies will activate the pathological pathway. During the early phase, mast cells degranulate and release a burst of histamine and other cytokines into the bloodstream and local tissue. [9] This will lead to the immediate airway narrowing after the exposure to the allergen. If the histamine release during the early phase is high enough, this can lead to generalized anaphylactic attack characterized by airway obstruction due to laryngeal edema. [11] With time, the airways of the asthmatic patient will become hyper-sensitive. The exact pathophysiological mechanism is unclear, but it could be linked to long-term damage to the bronchial airway along with a change in the smooth muscle function and mass of the airways. This makes asthmatic patients 10-times or even 100-times, in severe cases, more sensitive to allergens than normal individuals. [11, 12]

Another interesting phenomenon that occurs in asthmatic patients is that they may experience an exacerbation of symptoms after a few hours

of their exposure to an allergen. This is best known as a late-phase reaction. [13] This is due to the recruitment of inflammatory cells by the release of cytokines from mast cells during the acute phase. Most notably, eosinophils are the most characteristic cells to be found in asthmatic patients. Other cells of note include basophils, Th2 lymphocytes, and natural killer cells. [9] It is believed that during this late phase, changes to the structural integrity of the airways occur, along with changes to the epithelium and smooth muscles of the airway. [9] During the late phase, eosinophils are responsible for muscle contractions and airway narrowing, explaining why patients develop symptoms after hours of exposure. This is due to the release of eosinophil granules that contain leukotrienes and platelet-activating factors that ultimately lead to smooth muscle contraction. [9, 10] Other cells will ultimately lead to permanent changes in the airway of asthmatic patients.

Clinical Features

Classically, asthma presents with intermittent symptoms, the main one being wheezing. [14] Another symptom of particular importance is coughing, especially at night. [10] Wheezing is a high-pitched noise with a musical tone that is produced when air is forced through narrow airways, particularly during expiration. If the wheezes are biphasic, i.e., heard during both inspiration and expiration, it indicates a severe exacerbation of the disease. [13, 15] Coughing can be the sole presentation of asthma and, in some cases, can present in the absence of wheezing. [10, 16] Symptoms of asthma are mostly episodic with some patients reporting seasonal variation. Most patients know what their symptoms' triggers are. Those triggers vary from region to region and depending on the population. [11, 17] Common triggers include weather changes, tobacco smoke, house dust mite, pet exposure, pollens, and molds. [18] Because of the chronicity of the condition, some patients may develop anxiety, sleep deprivation, poor school performance, and limitation of social meetings. [19, 20]

During the acute attack, patients will be dyspneic, may complain of chest pain, and audible biphasic wheezes. Oxygen saturation is essential to determine the severity of the attack. While patients may not be able to talk, the physician

must determine whether the patient had been diagnosed with asthma previously or not, what are medications he is on, and the level of control. [11, 15, 21]

Diagnosis

Any child or adolescent that presents with symptoms suggestive of asthma should be questioned with a focus on the presence of the symptoms, the typical pattern, precipitating factors, and any risk factors. [6, 19] Additional points include the school performance, physical activity, and adherence to therapy if he was already diagnosed. These points will classify patients into their asthma status which would change the therapy indicated. [10, 16] To confirm the diagnosis of asthma, four key elements must be established. These are the characteristic symptoms of asthma, documentation of reversible obstruction, variable expiratory airflow variation, and exclusion of other differential diagnoses. [22] In most cases, the diagnosis of asthma can be made based on the suggestive history and physical examination whether during the attack or afterward. [23] When the diagnosis is questionable, additional tests can be done to reach it. These tests include spirometry, bronchoprovocation testing, allergy testing, chest radiograph, sweat chloride test, and peak expiratory flow. [15, 17] Spirometry is the most reliable test that can be done. Once it demonstrates reversible airflow obstruction, a diagnosis can be established. The value of spirometry lies not only in the diagnosis but also in the categorization of the severity of the condition. [15, 17] Spirometry measures two values, forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1). Airway obstruction is defined as FEV_1 reduced less than 80% of the predicted value and an $FEV_1/FVC < 85\%$. [14] FEV_1 is useful to estimate the risk of exacerbations, while the latter measures impairment better. [24] Spirometry readings should be recorded before and after the administration of bronchodilators to establish reversibility. Reversibility is significant if the FEV_1 improves by $>12\%$ and $>8\%$ in adults and children, respectively. [25]

The other tests are only indicated in case of a challenging diagnosis or the spirometry results were inconclusive with high clinical suspicion of asthma. For instance, sweat chloride testing is

done to rule out cystic fibrosis that could mimic asthma in children. [11, 21]

Management

The goals of asthma management can be classified into two categories, to control the symptoms and prevent future risk, whether it is exacerbation or permanent decline in lung functions. [26] Asthma control can be determined based on these factors: frequency and severity of daytime symptoms per week, nighttime awakening due to the symptoms per month, number of exacerbations requiring oral glucocorticoids per year, and lung function tests. [21, 26, 27] Based on these factors, asthma severity can be classified into intermittent, mild persistent, moderate persistent, and severe persistent. [21, 26, 27] Based on the severity of the disease, the global initiative for asthma (GINA) has revised the literature and put forth guidelines to manage them.

During the acute exacerbation, all patients must receive short-acting beta-agonists (SABA) to reduce the symptoms. If the SABA fails to alleviate the symptoms, administration of a short course of glucocorticoids may help. It is generally accepted that we must delay the ventilation for asthmatic patients as much as possible, as ventilation may increase the risk of developing pneumothorax due to the blocked airway. [11, 15] Long term therapy must be initiated in line with the management of acute exacerbation.

As for long term therapy, it depends on the classification of the patient. For patients with intermittent asthma, two general strategies can be given. We can either give SABA with inhaled glucocorticoid on the per-needed principle, or we can give long-acting beta-agonists (LABA) + inhaled glucocorticoid formula as per-needed. [26] This is considered step one in the therapy ladder. For mild persistent asthma, we usually start with a low dose inhaled corticosteroid + LABA formula with SABA when needed. Leukotriene modifiers can be given to children younger than 5 years of age as LABA is not as effective. [26] For moderate persistent asthma, they can be given the same regimen as for mild persistent asthma. For patients who cannot tolerate LABA, the addition of a long-acting muscarinic antagonist (LAMA) has proven to be effective. Another strategy is to increase the dose of the inhaled glucocorticoid to a medium dose rather than a

low dose one. [26] For severe persistent asthma, the administration of medium- or high-dose inhaled corticosteroid with LABA is generally advised. In these patients, biologic agents could be indicated. [26]

Patient education is essential for therapy. If the patient cannot use the inhaler properly, symptoms will worsen with time and this may lead to a false diagnosis of inappropriately treated asthma, stepping up the treatment ladder. [28] One must always teach patients the best way to use their inhalers. If possible, the addition of a spacer may improve drug intake and adherence to the therapy. [6, 19] During every follow visit, always assess adherence to the therapy, reevaluate the stage of asthma, and assess the patient's technique using the inhalers. If the symptoms are controlled on the same regimen, one must put forth an effort to reduce the step of the treatment. [6, 19]

CONCLUSION

Asthma is one of the most common conditions affecting children, adolescents, and adults worldwide. Its symptoms may range from innocent nighttime coughing to an acute exacerbation with hypoxemia. The diagnosis of asthma is primarily clinical, but other tests can be used to reach the diagnosis. The GINA guidelines help doctors decide on which therapy should be administered to which patient. With proper management and follow up, asthma can be controlled with improved lung function, reduced exacerbation, and better quality of life for patients.

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