

Asthma

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1 Overview

1. Asthma is a chronic lung disease affecting people of all ages. It can affect both children and adults, but is the most common chronic disease among children.
2. It is caused by inflammation and muscle tightening around the airways, which makes it harder to breathe. Narrowing of the small airways in the lungs cause asthma symptoms, which can be any combination of cough, wheeze, shortness of breath and chest tightness. These symptoms can be mild or severe and can come and go over time
3. Inhaled medication can control asthma symptoms and allow people with asthma to lead a normal, active life.
4. Avoiding asthma triggers can also help to reduce asthma symptoms.

2 Introduction

Asthma is a chronic inflammatory airway disease characterized by **reversible**, intermittent airway obstruction and **hyper-reactivity**.

The chronic inflammation is associated with airway hyper-responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing, particularly at night or in early morning. These episodes are usually associated with widespread, but

variable, airflow obstruction within lung that is often reversible either spontaneously or with the treatment.

3 Etiology

Asthma has a variety of heterogeneous phenotypes. Factors that influence the risk of asthma can be divided into those that cause the development of asthma and those that trigger asthma symptoms:

- The recognized factors that are associated with asthma are a genetic predisposition, specifically a personal or family history of atopy (propensity to allergy, usually seen as eczema, hay fever, and asthma).
- Asthma also is associated with exposure to tobacco smoke and other inflammatory gases or particulate matter. The overall etiology is complex and still not fully understood, but it is agreed that it is a multifactorial pathology, influenced by both genetics and environmental exposure.

Triggers for asthma include:

- Viral respiratory tract infections
- Exercise
- Gastroesophageal reflux disease
- Chronic sinusitis
- Environmental allergens
- Use of aspirin, beta-blockers
- Tobacco smoke
- Insects, plants, chemical fumes
- Emotional factors or stress

Factors influencing the development and expression of asthma:

- Genetic, like genes pre-disposing to atopy or genes pre-disposing to airway hyperresponsiveness
- Obesity, sex
- Environmental factors: allergens, such as furred animals (dogs, cats, mice), pollens, fungi.
- Infections (predominantly viral)
- Occupational sensitizes
- Tobacco smoke (active smoking, passive smoking)
- Air pollution

4 Pathophysiology

Asthma is a condition of acute, **fully reversible airway inflammation**, often following exposure to an environmental trigger. The pathological process begins with the inhalation of an irritant (e.g., cold air) or an allergen (e.g., pollen), which then, due to bronchial hypersensitivity, leads to airway inflammation and an increase in mucus production. This leads to a significant increase in airway resistance, which is most pronounced on expiration.

Airway obstruction occurs due to the combination of:

- Inflammatory cell infiltration.
- Mucus hypersecretion with mucus plug formation.
- Smooth muscle contraction.

The airway inflammation in asthma affects all airways, but its physiological effects are most pronounced in medium sized bronchi. The pattern of inflammation in the airways appears to be similar in all clinical forms of asthma, whether allergic, non-allergic, or aspirin-induced and at all ages. This inflammation is **based on a pro-inflammatory hyper-response**: inflammatory cells in airways (mucosal mast cells releasing bronchoconstrictor mediators, eosinophils that may damage epithelial cells, T lymphocytes releasing specific cytokines), and chemokines, cytokines, IgE and histamine involved.

These reversible changes may become irreversible over time (over years) due to

- Basement membrane thickening, collagen deposition, and epithelial desquamation.
- Airway remodeling occurs in chronic disease with smooth muscle hypertrophy and hyperplasia.

If not corrected rapidly, asthma may become more difficult to treat, as the mucus production prevents the inhaled medication from reaching the mucosa. The inflammation also becomes more edematous. This process is resolved with **beta-2 agonists** (e.g., salbutamol, salmeterol) and can be aided by **muscarinic receptor antagonists** (e.g., ipratropium bromide), which act to reduce the inflammation and relax the bronchial musculature, as well as reducing mucus production

We can identify two types of asthma, depending on the triggers:

1. **extrinsic asthma**: triggered by factor such as pollen, fungi, animal epithelium
2. **intrinsic**: no triggering factor identified

5 Clinical manifestations

Clinical manifestations of asthma can be controlled with appropriate treatment. When asthma is controlled severe exacerbations should be rare. The clinical spectrum of asthma is highly variable, but the airway inflammation remains a consistent feature.

Patients will usually give a history of a wheeze or a cough, exacerbated by allergies, exercise, and cold. There is often diurnal variation, with symptoms being worse at night. Patients may give a history of other forms of atopy, such as eczema and hay fever. There may be some mild chest pain associated with acute exacerbations. Many asthmatics have nocturnal coughing spells but appear normal in the day time

Physical exam findings will depend on whether the patient is currently experiencing an acute exacerbation.

During an acute exacerbation, there may be a fine tremor in the hands due to salbutamol use, and mild tachycardia. Patients will show some respiratory distress, often sitting forward to splint open their airways. On auscultation, a bilateral, expiratory wheeze will be heard.

6 Evaluation and diagnosis

Physicians should have a suspicion of having asthma:

- The diagnosis of asthma should be considered in patients with symptoms and characteristic clinical signs such as dyspnea, coughing, wheezing and chest tightness.
- Usually variable, predominantly nocturnal
- Caused by different triggers (viral infections, allergens, smoke snuff, exercise ...).
- Seasonal variations and background family and personal history of atopy are important aspects
- None of these symptoms and signs are specific to asthma respiratory function tests.

6.1 Diagnostic tests

Peak flow measures also can be used to assess asthma and should always be checked against a nomogram as well as the individual patient's normal baseline function. The different severities of acute asthma attacks have an associated peak flow measurement, recorded as a certain percentage of expected peak flow. Peak expiratory flow measurement is common today and allows to document response to therapy.

Spirometry is the diagnostic method of choice and will show an obstructive pattern that is partially or completely resolved by salbutamol. Spirometry should be done before treatment to determine the severity of the disorder. A reduced ratio of FEV1 to FVC is indicative of airway obstruction, which is reversible with treatment.

In some patients, a **methacholine/histamine test** may be required to determine if airway hyper-reactivity is present. This test should only be done by trained individuals.

Exercise spirometry may help identify patients with exercise-induced bronchoconstriction.

7 Treatment / Management

Medical management includes bronchodilators like beta-2 agonists and muscarinic antagonists (salbutamol and ipratropium bromide respectively) and anti-inflammatories such as inhaled steroids (usually beclometasone but steroids via any route will be helpful).