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A COMPREHENSIVE REVIEW ON ASTHMA: PATHOPHYSIOLOGY, DIAGNOSIS AND MANAGEMENT

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ABSTRACT

Asthma is a chronic inflammatory disorder of the airways characterized by reversible airflow obstruction, bronchial hyperresponsiveness, and airway inflammation. It affects individuals of all age groups and represents a significant global health burden. The disease involves complex interactions between genetic predisposition and environmental factors, leading to structural and functional changes in the airways. This review provides a comprehensive overview of asthma, focusing on its pathophysiology, diagnostic approaches, and current management strategies. Understanding these aspects is essential for effective disease control and improved patient outcomes.

KEYWORDS: Asthma, airway inflammation, bronchoconstriction, diagnosis, management, inhaled corticosteroids.

1. INTRODUCTION

Asthma is a common chronic respiratory disease affecting approximately 300 million people worldwide. It is characterized by recurrent episodes of wheezing, shortness of breath, chest tightness, and coughing, particularly at night or early morning. The prevalence of asthma has increased over the past decades due to environmental pollution, lifestyle changes, and genetic

susceptibility. Despite advances in treatment, uncontrolled asthma remains a major cause of morbidity and healthcare burden.

2. Pathophysiology of Asthma

Asthma involves chronic inflammation of the airways, leading to airway hyperresponsiveness and reversible obstruction. The major components of asthma pathophysiology include:

2.1 Airway Inflammation

Inflammation is the central feature of asthma. Various inflammatory cells participate, including:

Eosinophils

Mast cells

T lymphocytes (especially Th2 cells)

Macrophages

These cells release cytokines such as IL-4, IL-5, and IL-13, which promote IgE production and eosinophilic inflammation.

2.2 Bronchial Hyperresponsiveness

Patients with asthma exhibit exaggerated bronchoconstriction in response to stimuli such as allergens, cold air, exercise, or irritants. This results from increased sensitivity of airway smooth muscles.

2.3 Airway Remodeling

Chronic inflammation leads to structural changes:

Thickening of basement membrane

Smooth muscle hypertrophy

Goblet cell hyperplasia

Increased mucus secretion

These changes contribute to persistent airflow limitation.

2.4 Immunological Mechanisms

Asthma often involves IgE-mediated hypersensitivity reactions. Exposure to allergens leads to:

Allergen presentation by antigen-presenting cells

Activation of Th2 cells

IgE production by B cells

Mast cell degranulation

Release of histamine and leukotrienes

This results in bronchoconstriction and inflammation.

3. Diagnosis of Asthma

Asthma diagnosis is based on clinical evaluation, pulmonary function tests, and supportive investigations.

3.1 Clinical Features

Common symptoms include:

Wheezing

Shortness of breath

Chest tightness

Cough (especially nocturnal)

Symptoms are typically variable and reversible.

3.2 Pulmonary Function Tests

Spirometry is the gold standard for diagnosis. It shows:

Reduced FEV1

Reduced FEV1/FVC ratio

Improvement after bronchodilator (reversibility)

3.3 Peak Expiratory Flow Rate (PEFR)

Monitoring peak flow variability helps in assessing severity and control.

3.4 Bronchoprovocation Tests

Methacholine or exercise challenge tests may be used when diagnosis is uncertain.

3.5 Laboratory Investigations

Elevated eosinophil count

Increased serum IgE

Fractional exhaled nitric oxide (FeNO)

4. Classification of Asthma Severity

Asthma is classified based on symptom frequency and lung function:

Intermittent asthma

Mild persistent asthma

Moderate persistent asthma

Severe persistent asthma

This classification helps in selecting appropriate therapy.

5. Management of Asthma

The goal of asthma management is symptom control and prevention of exacerbations.

5.1 Non-Pharmacological Management

Avoid allergens and triggers

Smoking cessation

Regular physical activity

Patient education

Vaccination (influenza, pneumococcal)

5.2 Pharmacological Management

5.2.1 Reliever Medications

Used for immediate symptom relief:

Short-acting β2 agonists (Salbutamol)

Anticholinergics (Ipratropium)

5.2.2 Controller Medications

Used for long-term control:

Inhaled corticosteroids (ICS)

Long-acting β2 agonists (LABA)

Leukotriene receptor antagonists

Theophylline

5.2.3 Stepwise Approach

Management follows stepwise therapy:

Step 1: As-needed SABA

Step 2: Low-dose ICS

Step 3: ICS + LABA

Step 4: Medium/high-dose ICS + LABA

Step 5: Add biologics (e.g., omalizumab)

5.2.4 Biological Therapy

Used in severe asthma:

Anti-IgE (Omalizumab)

Anti-IL-5 (Mepolizumab)

Anti-IL-4 receptor (Dupilumab)

6. Acute Asthma Exacerbation Management

Treatment includes:

Oxygen therapy

Nebulized β2 agonists

Systemic corticosteroids

Anticholinergics

Magnesium sulfate (severe cases)

7. Prevention and Patient Education

Patient education plays a crucial role:

Proper inhaler technique

Adherence to medication

Self-monitoring with peak flow meter

Asthma action plan

8. CONCLUSION

Asthma is a chronic inflammatory airway disease requiring long-term management. Early diagnosis, appropriate pharmacological therapy, and patient education significantly improve outcomes. Advances in biological therapy have provided new treatment options for severe asthma. A comprehensive, individualized approach is essential for effective asthma control and prevention of complications.

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