Definition, etiopathogenesis, clinical manifestations, nonpharmacological and pharmacological management of the diseases associated with Respiratory System

Asthma

Definition:

- Asthma is a chronic inflammatory disorder of the airways characterized by reversible airflow obstruction, bronchial hyperresponsiveness, and airway inflammation, leading to episodes of wheezing, breathlessness, chest tightness, and coughing.

Etiopathogenesis:

- Asthma results from a complex interaction of **genetic** and **environmental** factors that cause:
    - Airway inflammation
    - Bronchial hyperresponsiveness
    - Mucus hypersecretion
    - Airflow obstruction (reversible)

Triggering factors:

1. **Allergens** (dust mites, pollen, pet dander)
2. **Respiratory infections**
3. **Cold air, exercise**
4. **Air pollutants and smoke**
5. **Drugs** (NSAIDs, β-blockers)
6. **Occupational irritants**
7. **Genetic predisposition** (e.g., family history of atopy or asthma)

Immunological Mechanisms:

- Activation of **TH2 helper cells** → production of **IL-4, IL-5, IL-13**
- **Eosinophilic inflammation** of airways
- **Mast cell degranulation** → histamine release → bronchoconstriction

Clinical Manifestations:

- Wheezing (especially during expiration)
- Shortness of breath

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- Chest tightness
- Cough (often worse at night or early morning)
- Prolonged expiration
- Use of accessory muscles during breathing
- Tachypnea, tachycardia

Severe or life-threatening asthma:

- Inability to speak in full sentences
- Silent chest (no wheeze due to no airflow)
- Cyanosis
- Decreased oxygen saturation

Nonpharmacological Management:

- Allergen avoidance (dust, smoke, pollen, pets)
- Avoidance of cold air or irritants
- Proper inhaler technique education
- Smoking cessation
- Vaccinations (Influenza, Pneumococcal)
- Pulmonary rehabilitation
- Weight loss and exercise (if obesity is a factor)

Pharmacological Management:

1. Reliever Medications (for acute symptoms):

- **Short-acting β2-agonists (SABA)**: Salbutamol (albuterol)
- **Anticholinergics**: Ipratropium (less common in asthma)

2. Controller Medications (for long-term control):

- **Inhaled corticosteroids (ICS)**: Beclomethasone, Budesonide, Fluticasone (mainstay)
- **Long-acting β2-agonists (LABA)**: Salmeterol, Formoterol (always combined with ICS)
- **Leukotriene receptor antagonists (LTRA)**: Montelukast, Zafirlukast
- **Theophylline** (used less commonly due to narrow therapeutic index)
- **Biologics** (for severe asthma):
  - **Omalizumab** (anti-IgE)

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- **Mepolizumab**, **Benralizumab** (anti-IL-5)

Chronic Obstructive Pulmonary Disease (COPD)

Definition:

- COPD is a progressive, irreversible, obstructive lung disease characterized by persistent airflow limitation, typically caused by chronic bronchitis and/or emphysema, associated with an abnormal inflammatory response to noxious particles or gases, especially cigarette smoke.

Etiopathogenesis:

- Cigarette smoking is the most important cause
- Air pollutants, occupational dust/fumes
- Genetic factors (e.g., α-1 antitrypsin deficiency)
- Frequent respiratory infections
- Aging

Pathophysiology:

- Chronic exposure to irritants → **inflammation** of airways → **mucus hypersecretion**
- **Loss of alveolar walls** (emphysema) → decreased gas exchange
- Airway narrowing and fibrosis
- Air trapping and hyperinflation
- Increased breathing work

Clinical Manifestations:

Chronic bronchitis phenotype:

- Productive cough for at least 3 months in 2 consecutive years
- Dyspnea on exertion
- Cyanosis ("blue bloaters")

Emphysema phenotype:

- Dyspnea, minimal cough
- Hyperinflated chest ("barrel chest")
- Pursed-lip breathing
- Weight loss

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- "Pink puffers"

Exacerbations are common and may be triggered by infections.

Nonpharmacological Management:

- **Smoking cessation** – most important intervention
- **Pulmonary rehabilitation**
- **Vaccination**: Influenza, Pneumococcal
- **Nutritional support**
- **Oxygen therapy** (for PaO_2 <55 mmHg or SaO_2 <88%)
- **Breathing techniques**: Pursed-lip breathing, diaphragmatic breathing

Pharmacological Management:

Bronchodilators:

- **Short-acting β2-agonists (SABA)**: Salbutamol
- **Long-acting β2-agonists (LABA)**: Salmeterol, Formoterol
- **Anticholinergics**:
  - **Short-acting (SAMA)**: Ipratropium
  - **Long-acting (LAMA)**: Tiotropium

Inhaled corticosteroids (ICS):

- Less effective than in asthma
- Used in combination with LABA or LAMA in moderate-to-severe cases

Other agents:

- **PDE-4 inhibitors**: Roflumilast (reduces exacerbations)
- **Theophylline**
- **Antibiotics**: Used during exacerbations (e.g., azithromycin)

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