PATHOPHYSIOLOGY OF RESPIRATORY SYSTEM ASTHMA

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Subject- Pathophysiology (BP204T)

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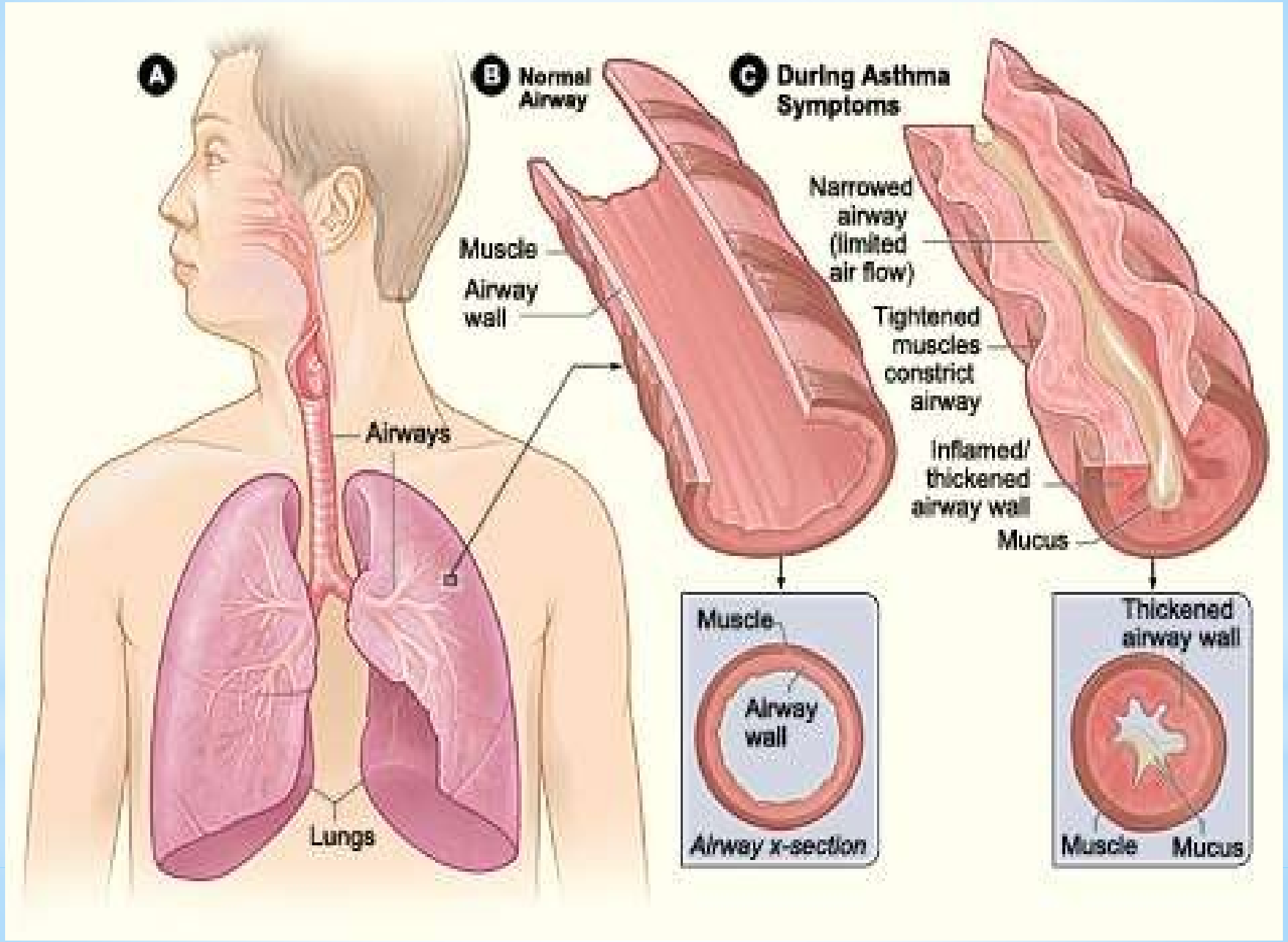
INTRODUCTION

- **Asthma is a chronic inflammatory disease of the airways that causes airway hyper-responsiveness, mucosal edema, and mucus production**

Asthma is characterized by chronic airway inflammation and increased airway hyper-responsiveness leading to symptoms of wheeze, cough, chest tightness and dyspnoea.

- Asthma differs from the other obstructive lung diseases in that it is **largely reversible**, either spontaneously or with treatment.

- Patients with asthma may experience **symptom-free periods** alternating with **acute exacerbations**, which last from minutes to hours or days.


A
B Normal Airway
C During Asthma Symptoms
Muscle
Airway wall
Airways
Lungs
Narrowed airway (limited air flow)
Tightened muscles constrict airway
Inflamed/ thickened airway wall
Mucus
Muscle
Airway wall
Airway x-section
Thickened airway wall
Muscle
Mucus

EPIDEMIOLOGY

- In many countries the **prevalence** of asthma is **increasing.**

- This increase, with its accompanying allergy, is particularly in **children** and **young adults** where this disease may affect up to **15% of the population**.

- Asthma being commoner in more developed countries.

ETIOLOGY AND RISK FACTOR

- Asthma occurs in families which suggest that it is **an inherited** disorder.
  - **Allergy** is the strongest predisposing factor for asthma.
  - **Chronic exposure to airway** irritants or allergens also increases the risk for developing asthma.
  - Common allergens can be seasonal (eg, grass, tree, and weed pollens, mold, dust, or animal dander).

- **Excitatory state** (stress ,cry)
- Occupational environment
- factor such as cold air, air pollution, drug infection,
- Occupational environment
- Other factor such as cold air ,air pollution, infection, diet

Triggers

- Allergens
- Upper respiratory tract viral infections
- Exercise
- Cold air
- Sulfur dioxide Drugs (BETA blockers, aspirin)
- Stress
- Irritants (household sprays, paint fumes)

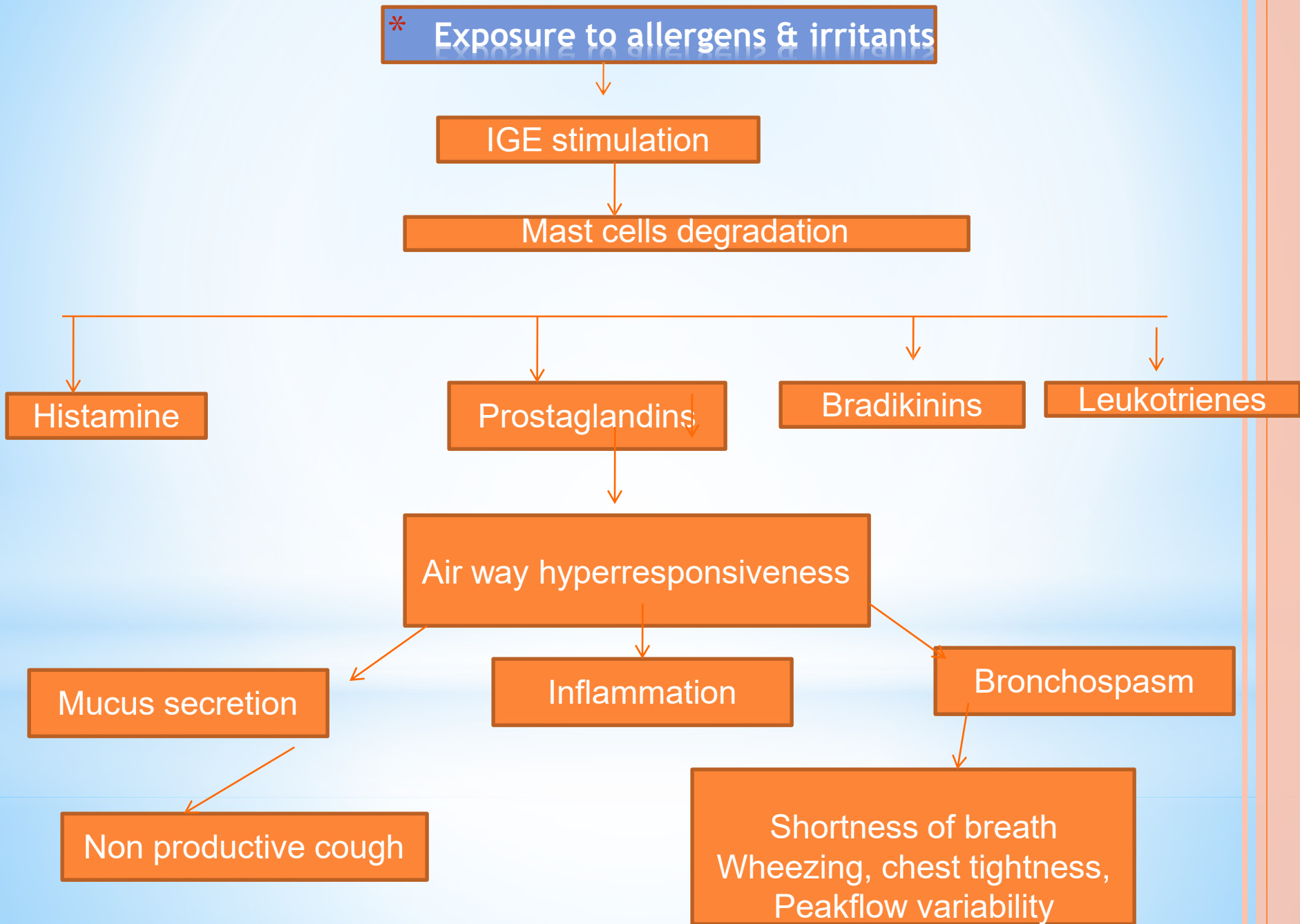
CLASSIFICATION

Asthma is a complex disorder of the conducting airways that most simply can be classified as:

- Extrinsic – implying a definite external cause
- Intrinsic – when no causative agent can be identified.

PATHOPHYSIOLOGY

- Asthma is a complex condition where interaction of genetics and environment occurs involving many inflammatory cells which release a wide range of variety of mediators.
- These mediators act on the cells of the airway leading to smooth muscle contraction, mucus hyper secretion, plasma leakage, edema, activation of cholinergic reflexes and activation of sensory nerves, which lead to amplification of the continuing inflammatory response.
- The chronic inflammation leads to structural changes, including sub-epithelial fibrosis and smooth muscle hypertrophy and hyperplasia. This late process is less easily reversed than the acute changes and might end up with airway remodeling.


* Exposure to allergens & irritants
IGE stimulation
Mast cells degradation
Histamine
Prostaglandins
Bradikinins
Leukotrienes
Air way hyperresponsiveness
Mucus secretion
Inflammation
Bronchospasm
Non productive cough
Shortness of breath
Wheezing, chest tightness,
Peakflow variability

CLINICAL MANIFESTATIONS

- The principal symptoms of asthma are wheezing attacks and **episodic shortness of breath.**
- Typical symptoms include **recurrent episodes of wheezing, chest tightness**, **breathlessness** and **cough**.
- In some instances, **cough may be the only symptom**
- cough, with or without mucus production
- **Expiration requires effort** and becomes **prolonged.**

DIAGNOSIS

History taking

- A complete family, environmental, and occupational history is essential.
- Family history : History of asthma in family
- Environmental history : seasonal changes, high pollen counts, mold, climate changes (particularly cold air), and air pollution,

- Occupational history : occupation-related chemicals and compounds, including metal salts, wood and vegetable dust

- Medications (eg, aspirin)

- Industrial chemicals and plastics, biologic enzymes (eg, laundry detergents), animal and insect dusts, sera, and secretions.

INVESTIGATIONS

- *Lung function tests/ pulmonary function test :* *Shows* variable airflow limitation

- *Blood tests :shows* increase in the number of eosinophils in peripheral blood (> 0.4 × 109/L).

- *Sputum tests* The presence of large numbers of eosinophils in the sputum is a more useful diagnostic tool.

- *Chest X-ray* : There are no diagnostic features of asthma on the chest X-ray

- A chest X-ray may be helpful in excluding a pneumothorax, which can occur as a complication of asthma

- *Skin tests* Skin-prick tests (SPT) should be performed in all cases of asthma to help identify allergic causes.

ESSENTIALS OF DIAGNOSIS

- Episodic or chronic symptoms of airflow obstruction: breathlessness, cough, wheezing, and chest tightness.
- Symptoms frequently worse at night or in the early morning.
- Prolonged expiration and diffuse wheezes on physical examination.
- Limitation of airflow on pulmonary function testing.
- Complete or partial reversibility of airflow obstruction, either spontaneously or following bronchodilator therapy.

Diagnosis: Ineffective Breathing Pattern

Nursing diagnosis: Ineffective breathing pattern related to shortness of breath, mucus, bronchoconstriction, and airway irritants

Outcomes

- A decreasing respiratory rate to within normal limits.
- Decreased dyspnoea, less nasal flaring, and reduced use of accessory muscles.
- Decreased manifestations of anxiety.
- Oxygen saturation greater than 95%.

Diagnosis: Impaired Gas Exchange.

- **Nursing diagnosis**: Impaired Gas Exchange related to air trapping.

Outcomes

- Decreased inspiratory and expiratory wheezing.
- Oxygen saturation >90%.
- pH of 7.35 to 7.45.
- Usual skin color (no cyanosis).
- Decreasing dry, nonproductive cough.

MEDICAL MANAGEMENT

1. **Oxygen** : Give oxygen to keep oxygen saturation > 95% in all children with asthma who are cyanosed (oxygen saturation ≤ 90%) or whose difficulty in breathing interferes with talking, eating or breastfeeding.

2. Pharmacotherapy:

- **Quick relievers:** Used for acute attacks to relieve bronchospasm as and when needed.
- Salbutamol
- Terbutaline
- Adrenaline
- Aminophylline
- **Preventers:** Used for long-term to control the inflammation and to prevent further attacks.
- - Steroids (Oral and Inhaled) like prednisolone.
- - Theophylline

- **Long-term symptom relievers:** Used to relieve bronchospasm for longer hours.
- – Salmeterol
- – Formoterol
- – Bambuterol

Always use with inhaled Steroids

- If the methods of delivering salbutamol are not available, give a subcutaneous injection of adrenaline at 0.01 ml/kg of 1:1000 solution (up to a maximum of 0.3 ml), measured accurately with a 1-ml syringe. If there is no improvement after 15 min, repeat the dose once.

- **Magnesium sulfate :** Intravenous magnesium sulfate may provide additional benefit in children with severe asthma treated with bronchodilators and corticosteroids. Give 50% magnesium sulfate as a bolus of 0.1 ml/kg (50 mg/kg) IV over 20 min.

- **Oral bronchodilators** : Use of oral salbutamol (in syrup or tablets) is not recommended in the treatment of severe or persistent wheeze. It should be used only when inhaled salbutamol is not available for a child who has improved sufficiently to be discharged home. Dosage is Age 1month to 2 years: 100 µg/kg (maximum, 2 mg) up to four times daily – Age 2–6 years: 1–2 mg up to four times daily.

NURSING MANAGEMENT

The management of asthma includes:

- Education
- Environment control
- Evaluation
- Emotional support
- Regular follow-up.

1. **Education:** The nurse must spend time to clear the misconceptions about the disease, sexual bias, non-communicability of the disease, fear of inhalers, steroids, etc.

2. **Environment Control**

It is the most important factor in the control of asthma. The aim should be to avoid allergens and irritants:

- **Dust mites:** Avoid carpets, use plastic covers to pillows and mattresses; and expose to sunlight once a week; wash soft toys periodically; and wet mop the floorings.
- **Cockroach:** Cover garbage and unused food containers.
- **Fungus:** Attend to damp walls, have good ventilation and clean the shower curtains weekly.
- **Pets:** Keep them away from sleeping area, if possible outside the house
- Avoid strong odors, smoke, mosquito coil burning, and especially tobacco smoke.

3. Evaluating respiratory status and patients general condition

- Frequent assessment of respiratory pattern.
- Cyanosis
- Breath sounds
- Vital signs
- Cerebral functions

4. Providing emotional support:-

- Calm and quiet approach
- Trusting relationship
- Reassurance
- Play and recreation
- Parental participations

5. Positioning:-

- Comfortable sitting position and supporting with pillow.
- Leaning forward with support may be allowed
- Administering oxygen

6. Administering fluid therapy:-

- During asthma they take less fluid.
- Vomiting and insensible loss due to hyperventilation.
- Maintain input output chart

7. Maintaining adequate dietary intake:-

- Clear liquids in small amounts.
- Allergic foods to be avoided.
- Spicy and gas forming foods to be avoided.
- Balanced diet.

7. Maintenance of hygienic measures:-

- Routine hygiene care.
- Dust and allergen free environment.
- Aseptic technique.

8. Supporting parents and family

- Emotional support
- Parent participation in care
- Discuss treatment plan.
- Health education.