Respiratory Block

Bronchial Asthma

Dr. Wajd Althakfi, MD
Assistant Professor
KSU-KKUH

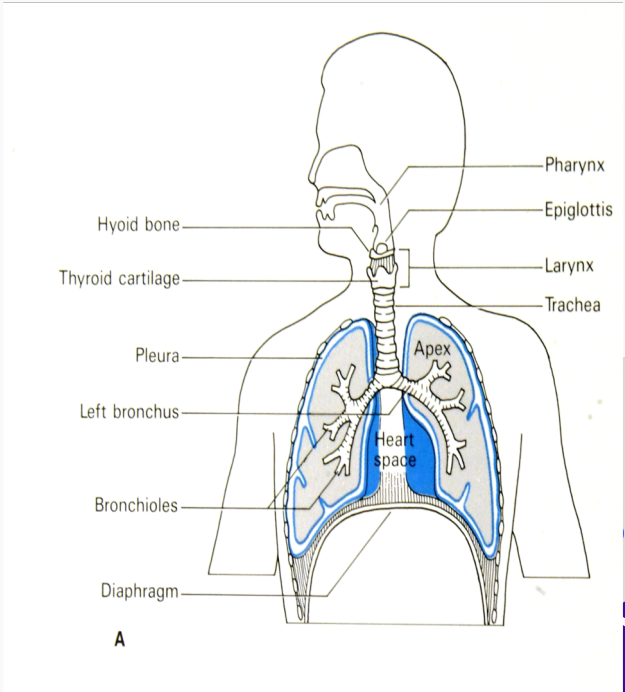
Oobjectives of lecture

1. Understand asthma as an episodic, reversible bronchoconstriction caused by increased responsiveness of the tracheobronchial tree to various stimuli
2. Know that asthma is divided into two basic types: extrinsic or atopic allergic and intrinsic asthma
3. Understanding the morphological changes (gross and microscopic) seen in the lungs in cases of severe asthma

TABLE OF CONTENTS

INTRODUCTION

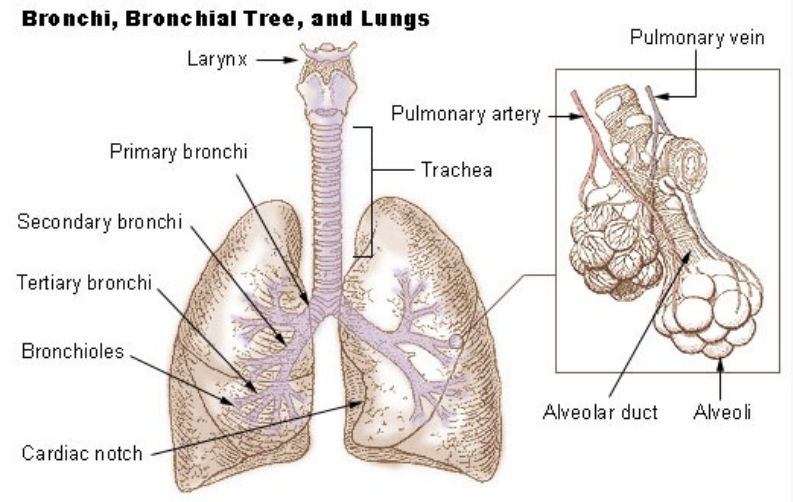
- Right lung divided into upper middle and lower lobes supplied by 3 bronchi
- Left lung divided into upper and lower lobes, supplied by 2 bronchi
- Bronchi branch⟶ termed bronchioles (distinguished from bronchi by the lack of cartilage and submucosal glands within their walls)
- Terminal bronchioles ⟶acini; are the functional units of the lungs and they form the site of gaseous exchange and lined by pneumocytes

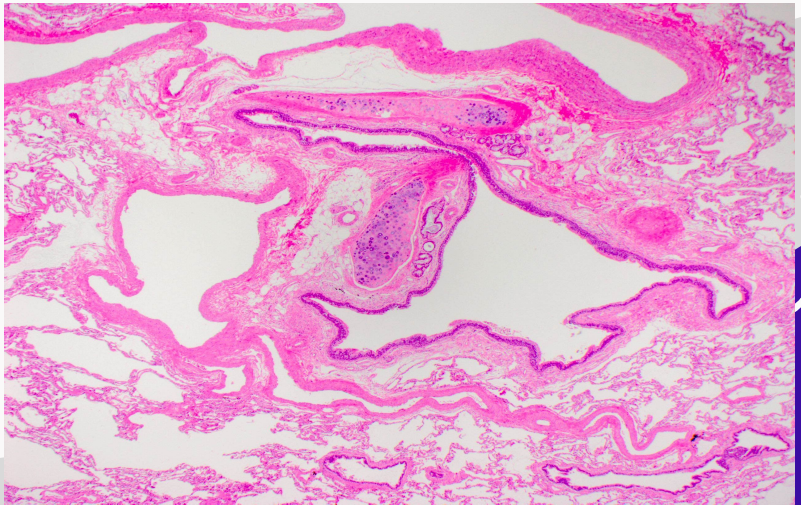


INTRODUCTION

- Pulmonary acini are composed of respiratory bronchioles that proceed into alveolar ducts
- Immediately branch into alveolar sacs, the blind ends of the respiratory passages

➢ Bronchovascular bundle: bronchiole + blood vessels

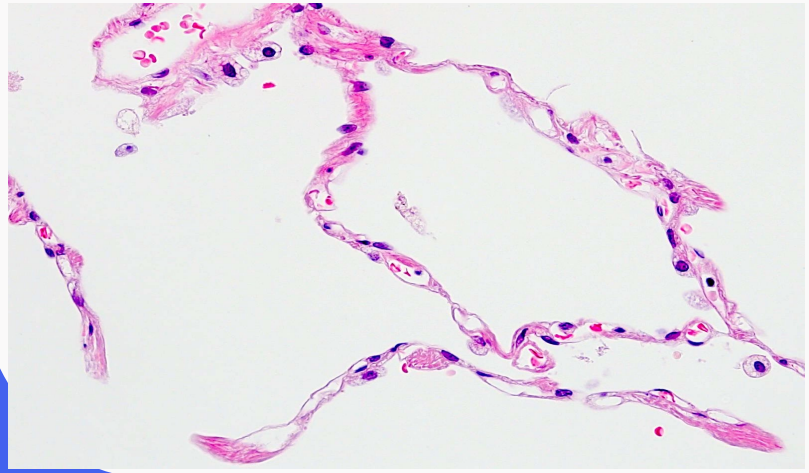


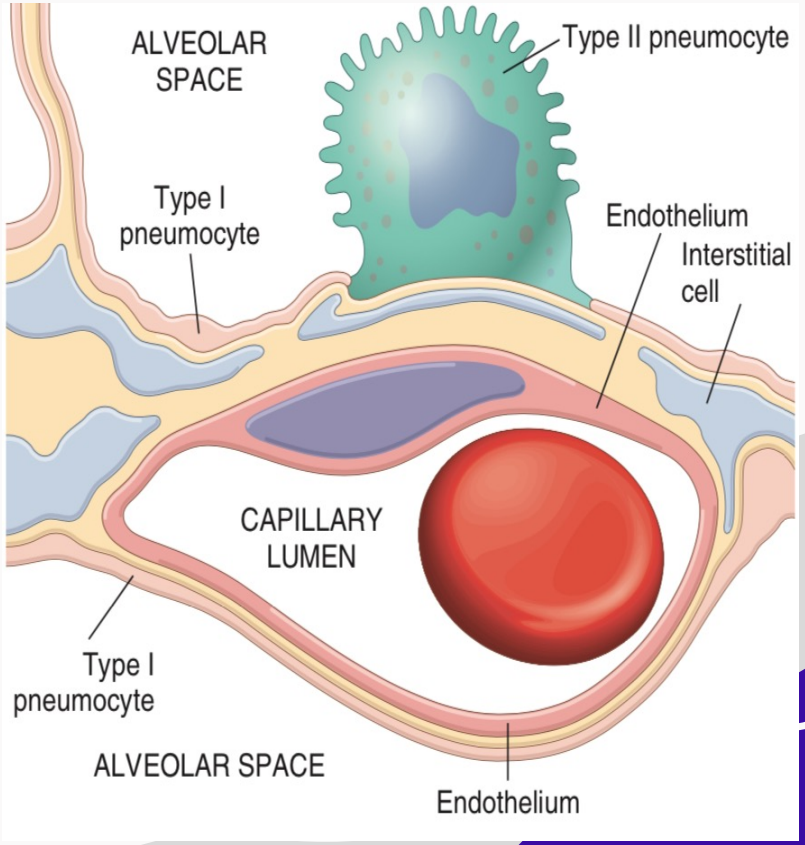


INTRODUCTION

The alveolar walls (or alveolar septa) consist of the following components:

1. The capillary endothelium and basement membrane.
2. The pulmonary interstium
3. Alveolar epithelium

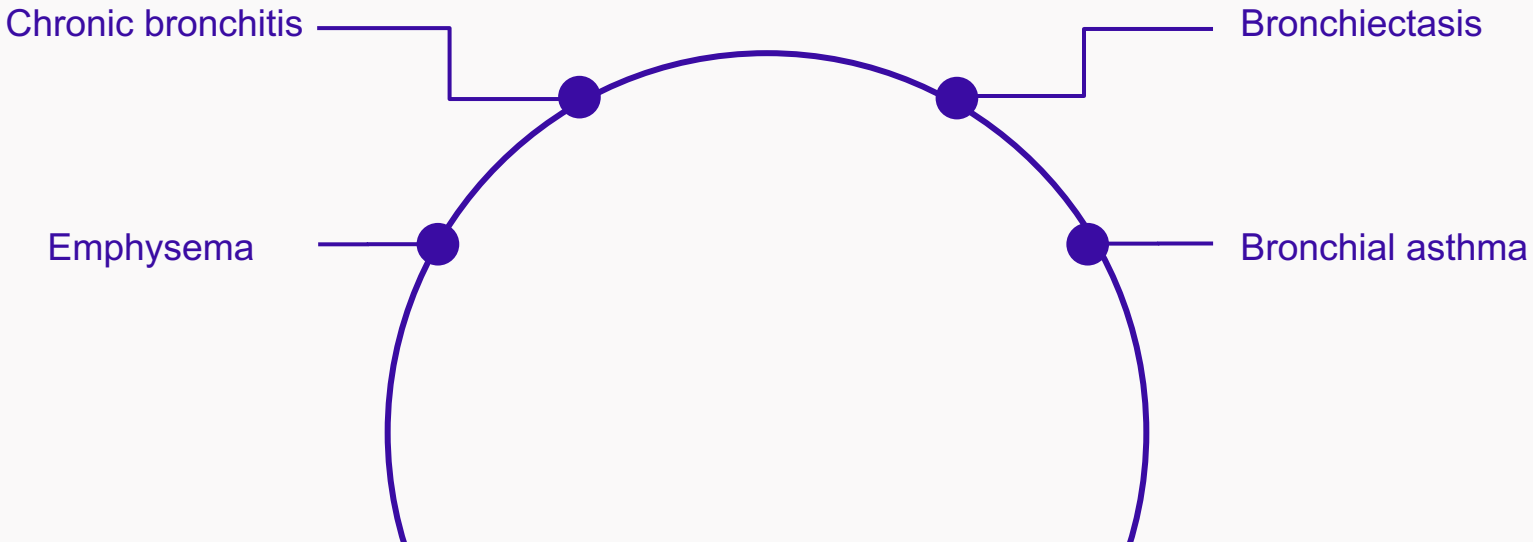




OBSTRUCTIVE LUNG DISEASES

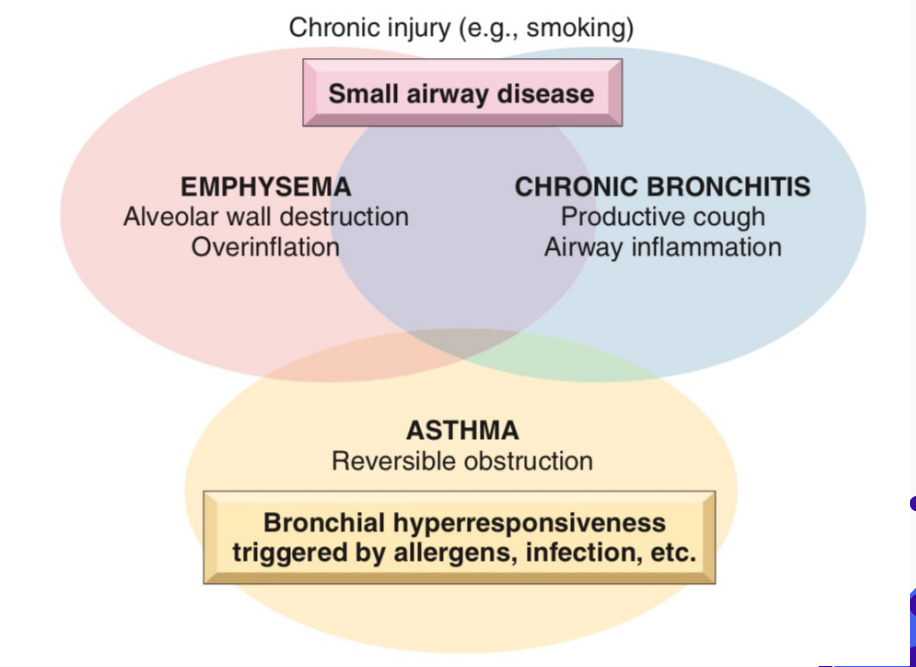
Classified into

Characterized by limitation of airflow, usually resulting from an increase in resistance caused by partial or complete obstruction at any level



- It should be noted that emphysema is defined on the basis of morphologic and radiologic features, whereas chronic bronchitis is defined on the basis of clinical features

- emphysema and chronic bronchitis often are grouped together under the rubric of chronic obstructive pulmonary disease (COPD)



BRONCHIAL ASTHMA

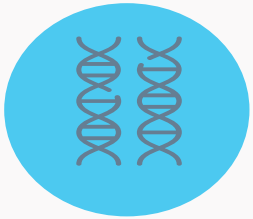
Definition

- Asthma is a chronic inflammatory disorder of the airways that causes recurrent episodes of wheezing, breathlessness, chest tightness, and cough, particularly at night and/or early in the morning

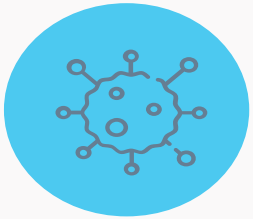
- The hallmarks of asthma are:
  1. Intermittent, reversible airway obstruction
  2. Chronic bronchial inflammation with eosinophils
  3. Bronchial smooth muscle cell hypertrophy and hyperreactivity
  4. Increased mucus secretion

ETIOLOGY AND PATHOGENESIS

Asthma is a complex disease with contribution of



Genetic predisposition to type I hypersensitivity
(atopy)



Acute and chronic airway inflammation
(especially viral)

bronchial hyperresponsiveness to a variety of stimuli
(smoke, fumes, cold air, stress, and exercise)

CLASSIFICATION

Atopic asthma

Triggered by immunologically-mediated hypersensitivity reaction TYPE I against foreign substances or allergens, in 70% of cases

Non-atopic asthma

Do not have evidence of allergen sensitization. Respiratory and inhaled air pollutants are common triggers

Drug-Induced Asthma

Attack of asthma related to intake of some drugs ex; aspirin

Occupational Asthma

Asthma related to long term exposure to certain occupational hazard ex: wood, cotton, platinum

1. Atopic asthma

- Atopic asthma is associated with excessive reaction of T-helper 2 cells to environmental antigens

- T-helper 2 cells secrete:
  1. IL-4 and IL-3 → stimulates the production of IgE by B lymphocytes
  2. IL-5 → activates eosinophils
  3. IL-13 → stimulates mucous production
- IgE is responsible for mast cell degranulation and the release of 1ry and secondary mediators leading to an early and late phase of the reaction
- Childhood
- Positive family Hx of allergy
- Attacks may be triggered by allergens in dust, pollen, animal dander, or food, or by infections
- The onset of asthmatic attacks is often preceded by allergic rhinitis, urticaria, or eczema
- A skin test with the offending antigen results in an immediate wheal-and-flare reaction

PATHOGENESIS

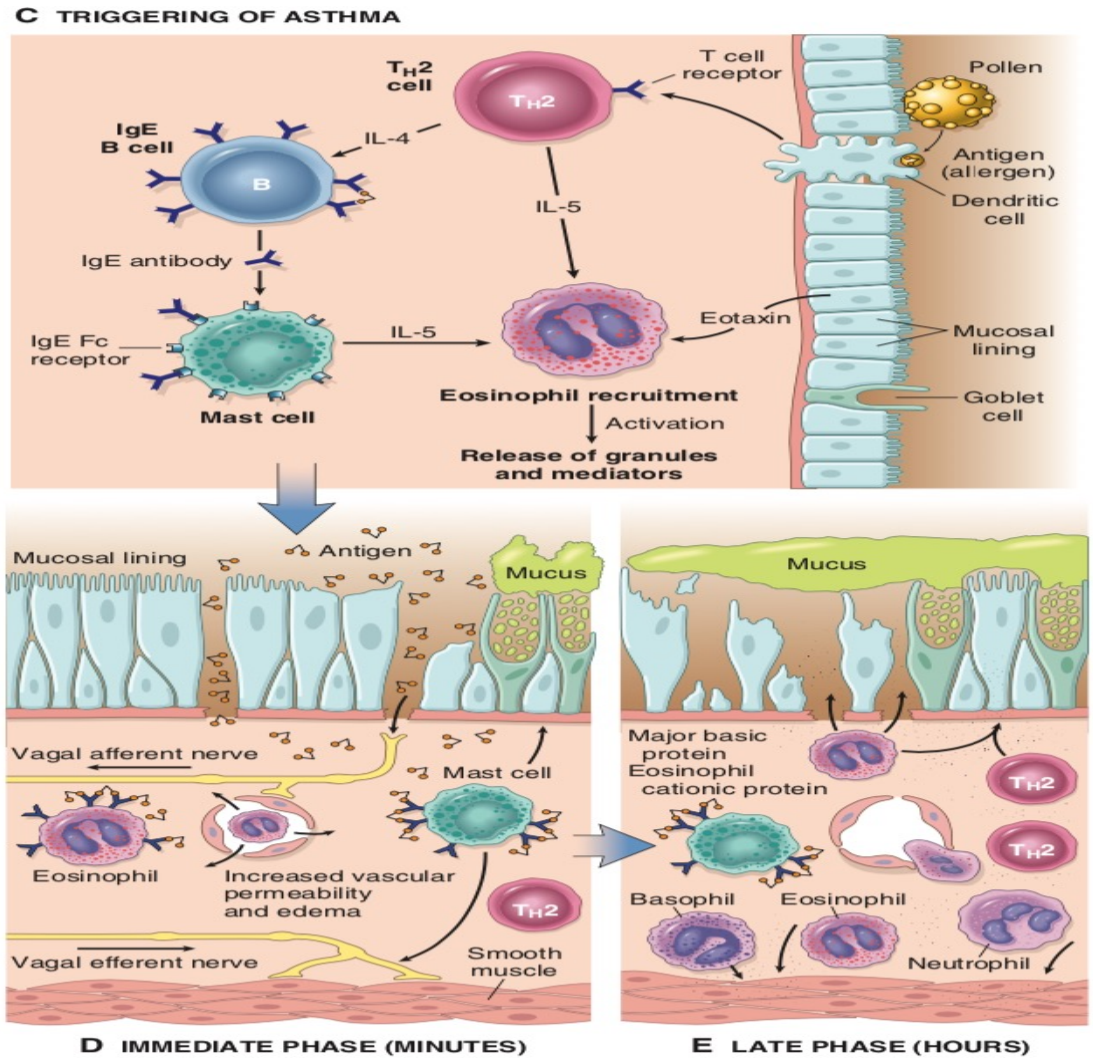
Atopic Asthma

Early phase:

- Dominated by bronchoconstriction, increased mucus production, and vasodilation.
- Bronchoconstriction is triggered by mediators released from mast cells
  - Histamine
  - Prostaglandin D2
  - Leukotrienes LTC4, D4, and E4

Late phase:

- Inflammatory in nature
- Inflammatory mediators stimulate epithelial cells to produce chemokines
  - Eotaxin ⟶ that promote the recruitment of T_H2 cells, eosinophils amplifying an inflammatory reaction that is initiated by resident immune cells


C TRIGGERING OF ASTHMA
T_H2 cell
T cell receptor
Pollen
IgE B cell
IL-4
B
Antigen (allergen)
Dendritic cell
IL-5
IgE antibody
IgE Fc receptor
IL-5
Eotaxin
Mucosal lining
Eosinophil recruitment
Activation
Goblet cell
Mast cell
Release of granules and mediators
Mucosal lining
Antigen
Mucus
Vagal afferent nerve
Mast cell
Eosinophil
Increased vascular permeability and edema
Vagal efferent nerve
Smooth muscle
Mucus
Major basic protein
Eosinophil cationic protein
Basophil
Eosinophil
Neutrophil
D IMMEDIATE PHASE (MINUTES)
E LATE PHASE (HOURS)

2. Non atopic Asthma

- No evidence of allergen sensitization and is triggered by non-immune stimuli such as psychological disturbance, stress
- Skin tests are negative
- In 30% of patients
- Positive family history is less common
- Precipitated by Viral infection and Inhaled air pollutants associated with chronic eosinophilic infiltrate (that lead to similar reaction to atopic one)

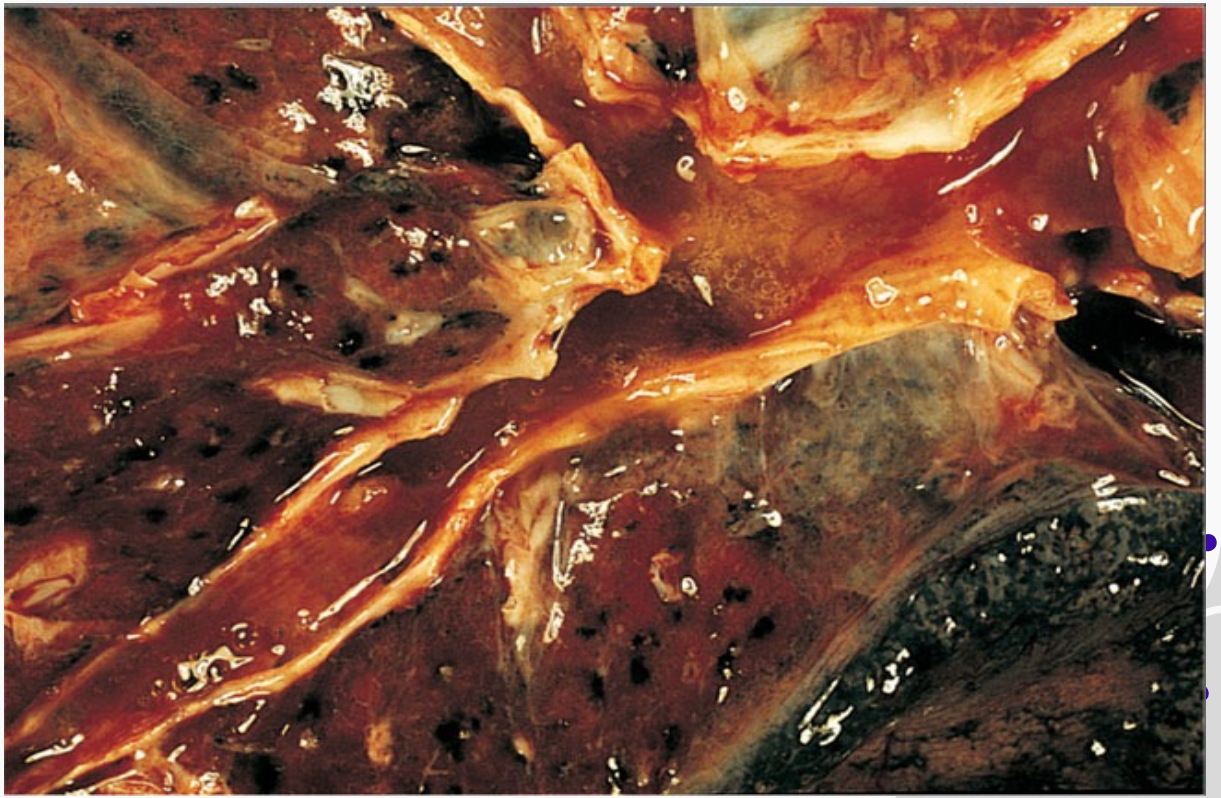
Humoral and cellular mediators of airway obstruction (e.g., eosinophils) are common to both atopic and nonatopic variants of asthma, so they are treated in a similar way

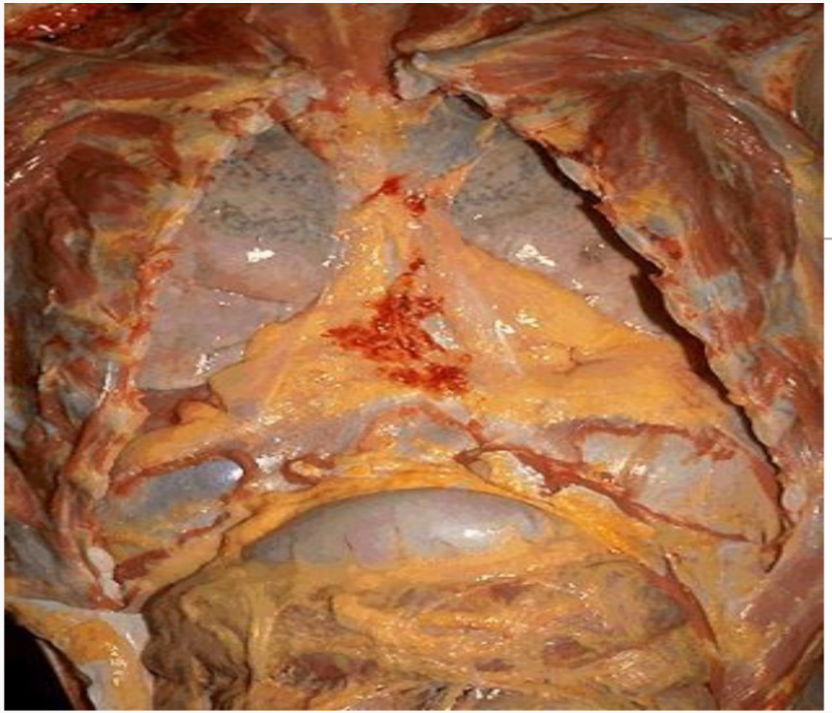
	Atopic Asthma	Non-atopic asthma
Underlying abnormality	Immune reaction (atopic)	Abnormal autonomic regulation of airway
Onset	Childhood	Adulthood
Allergens	Recognized	None identified
Family history	Present	Absent
Predisposition to form IgE antibodies	Present	Absent
Natural progression	Improves	Worsens
Eosinophilia	Sputum and blood	Sputum
Drug hypersensitivity	Absent	Present

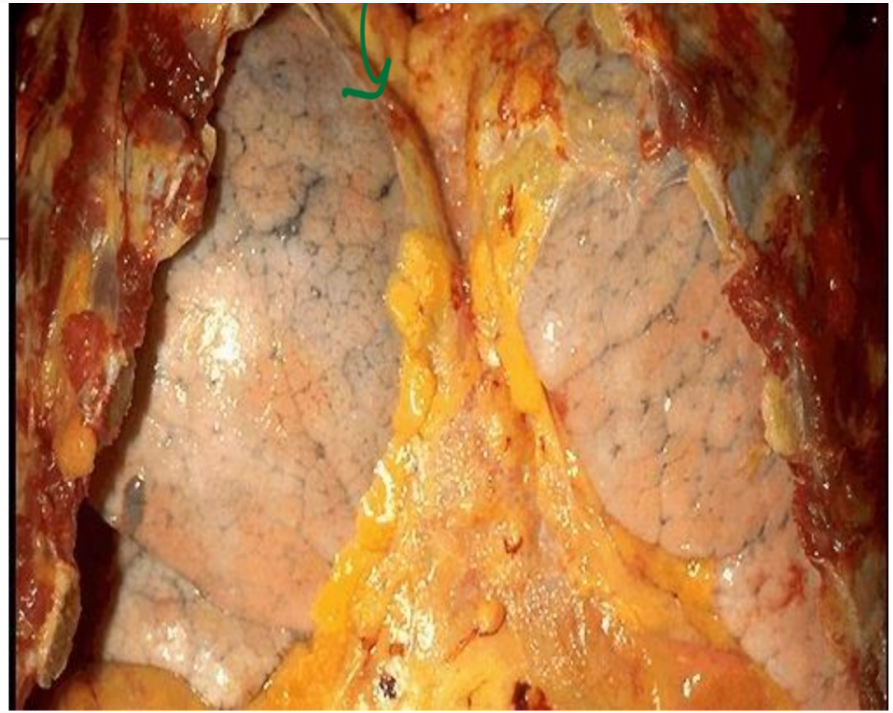
MORPHOLOGY

Gross morphology

- Presence of congested mucosa and mucoid secretions
- Occlusion of bronchi and bronchioles by thick tenacious mucous plugs

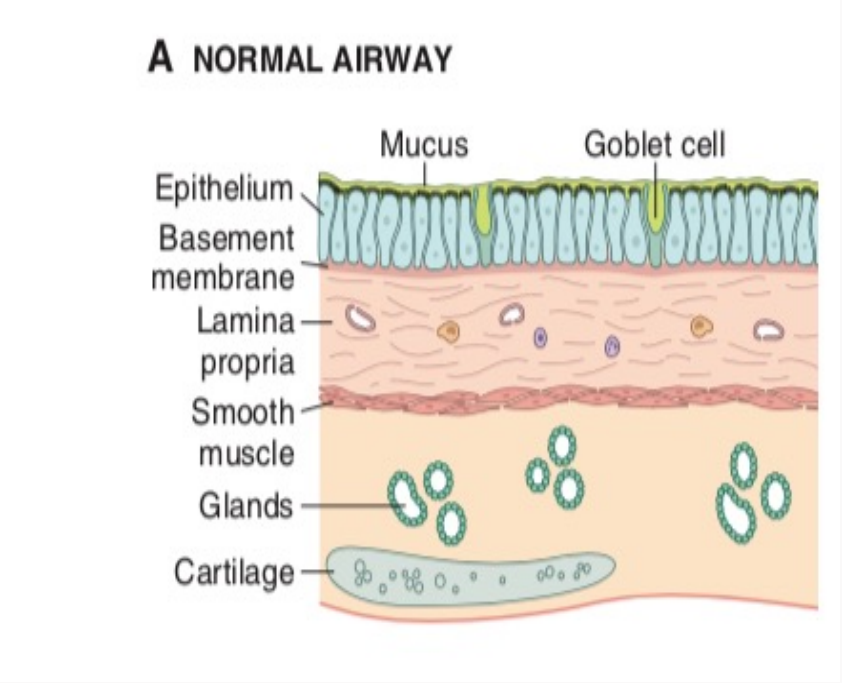


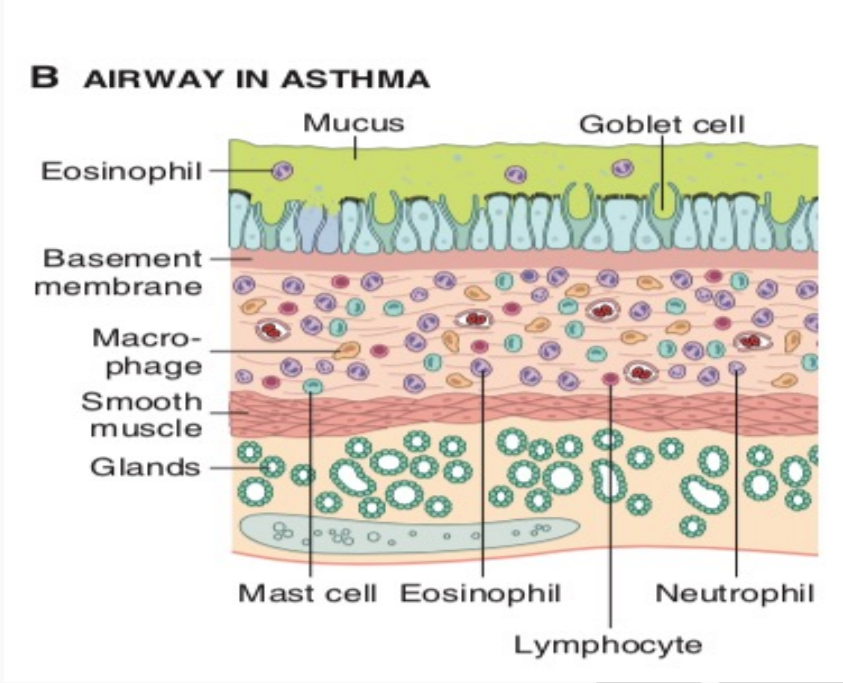




- **Over-distention of lungs due to over inflation**
- **Small areas of atelectasis**

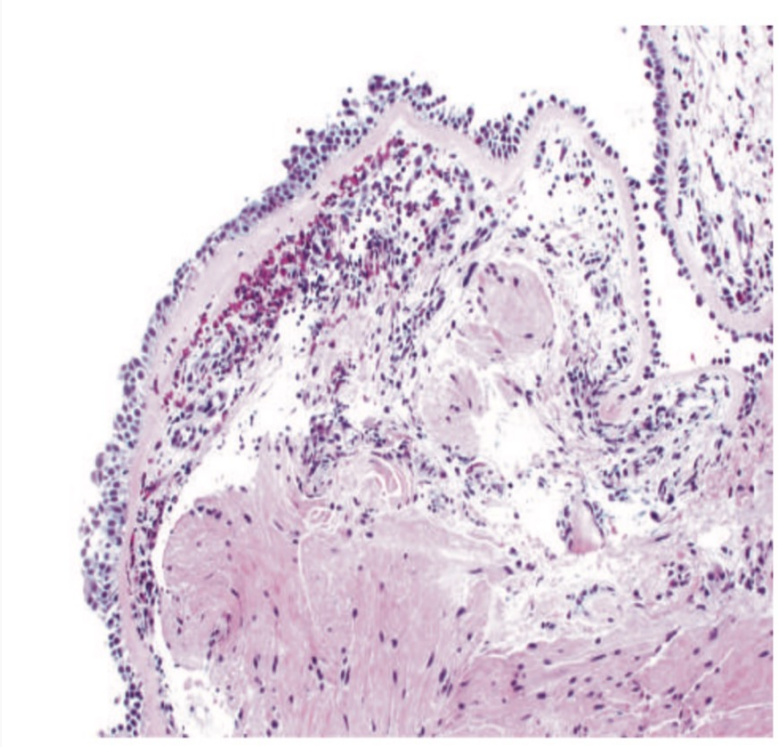
Microscopic morphology





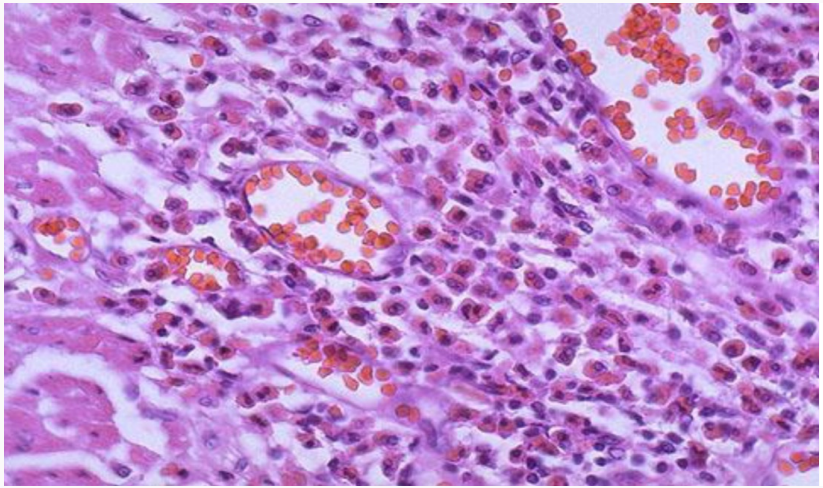
Microscopic morphology

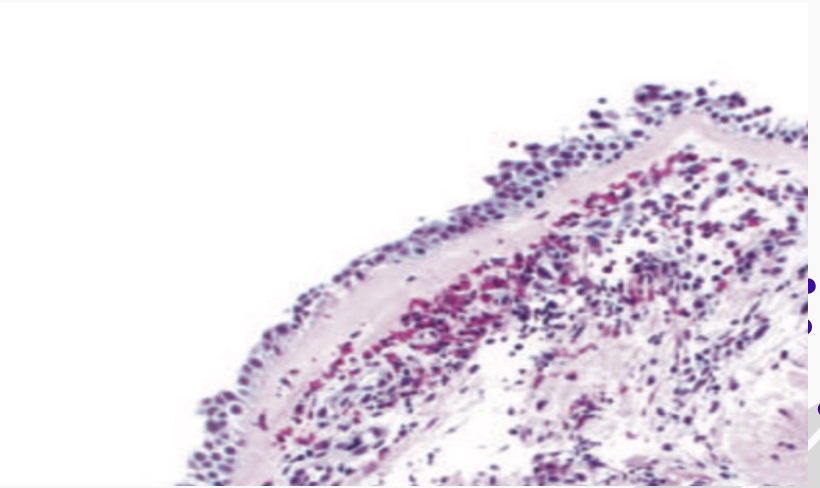
- **Eosinophils are key inflammatory cells found in almost all subtypes of asthma; eosinophil products (such as major basic protein) are responsible for airway damage**
- Airway remodeling:
  1. Thickening of airway wall
  2. Sub-basement membrane fibrosis
  3. Increased submucosal vascularity
  4. An increase in size of the submucosal glands and goblet cell
  5. Metaplasia of the airway epithelium
  6. Hypertrophy and/or hyperplasia of the bronchial muscle

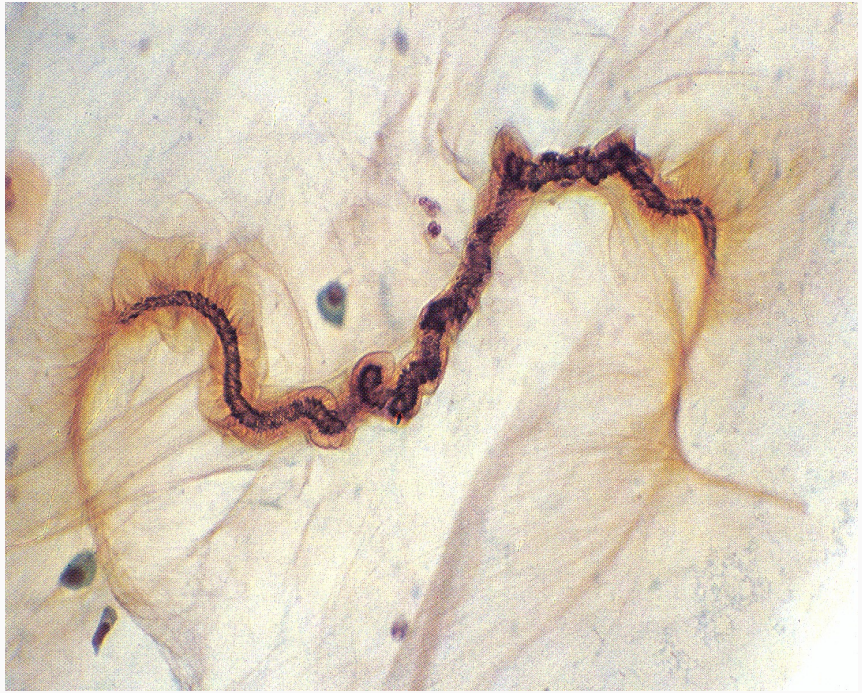


Microscopic morphology

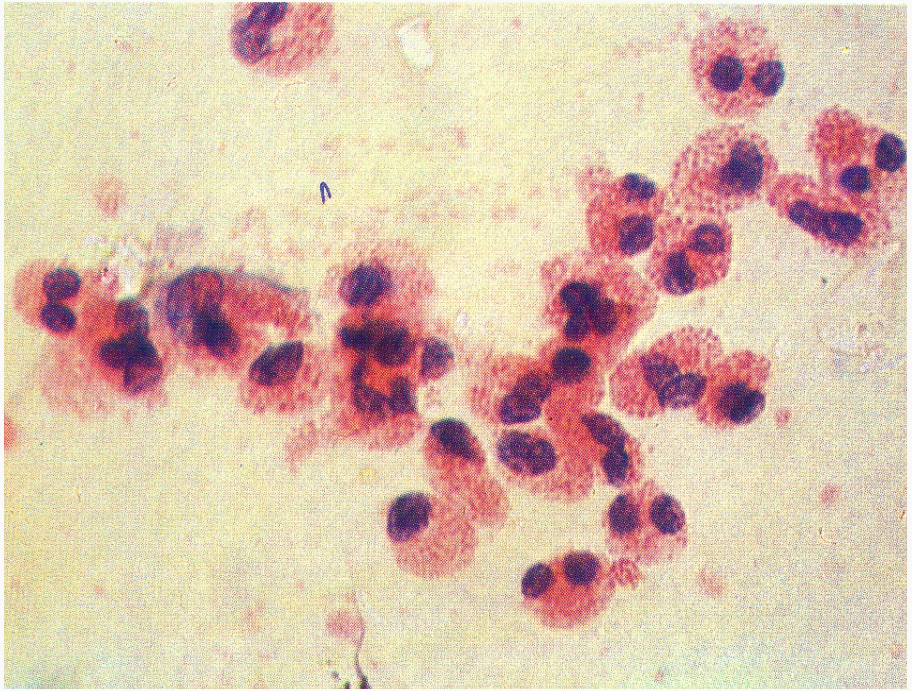
Inflammation of bronchial wall (eosinophils (5-50%), mast cells, lymphocytes, plasma cells)



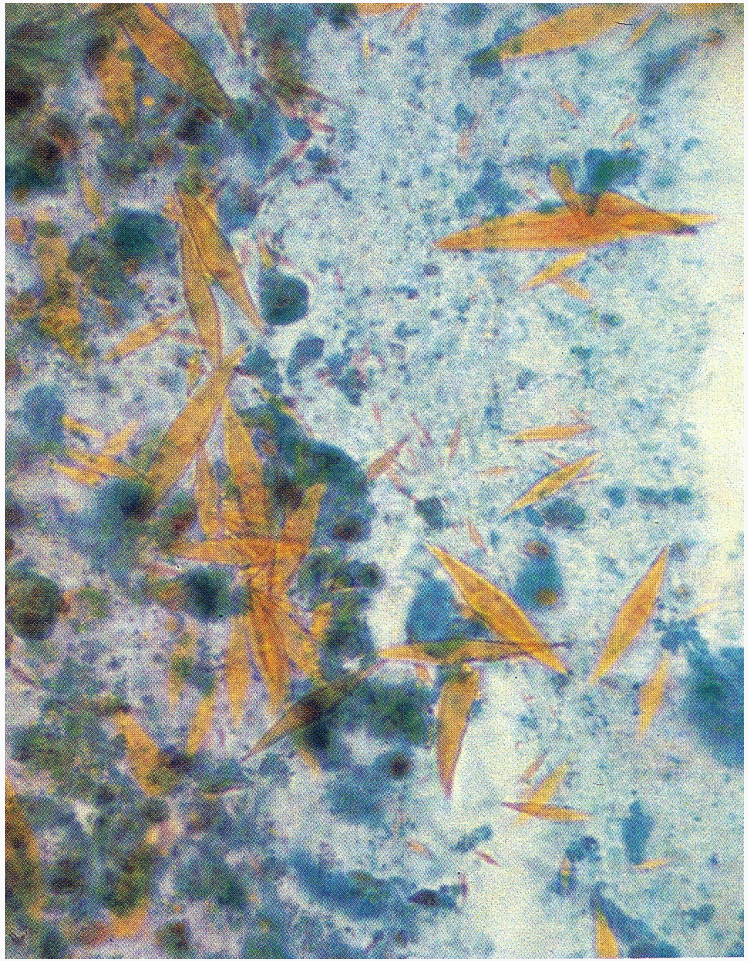


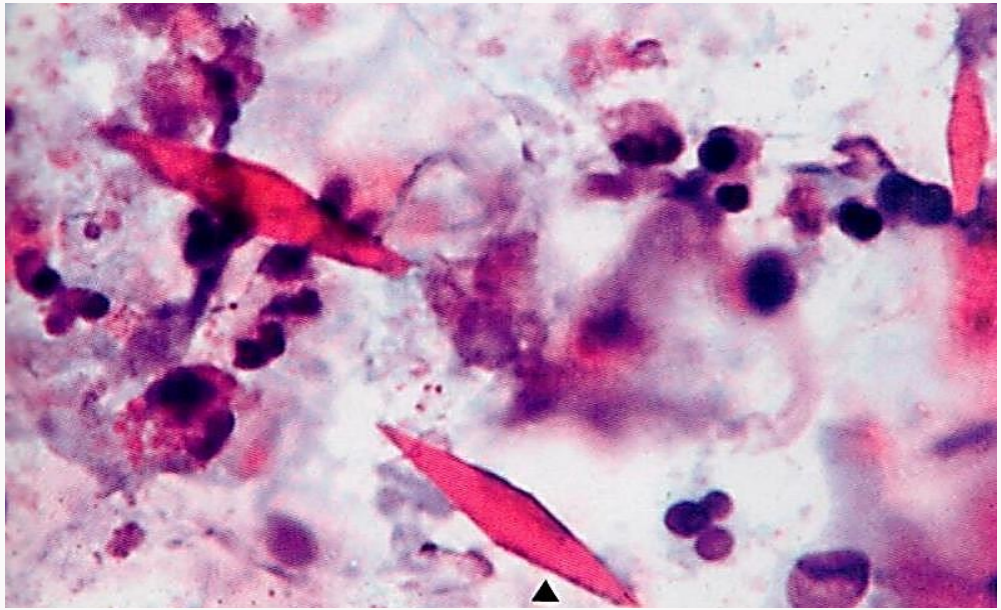


Mucous plugs containing whorls of shed epithelium **(Curschmann spirals)**



Eosinophils from a case of Bronchial Asthma





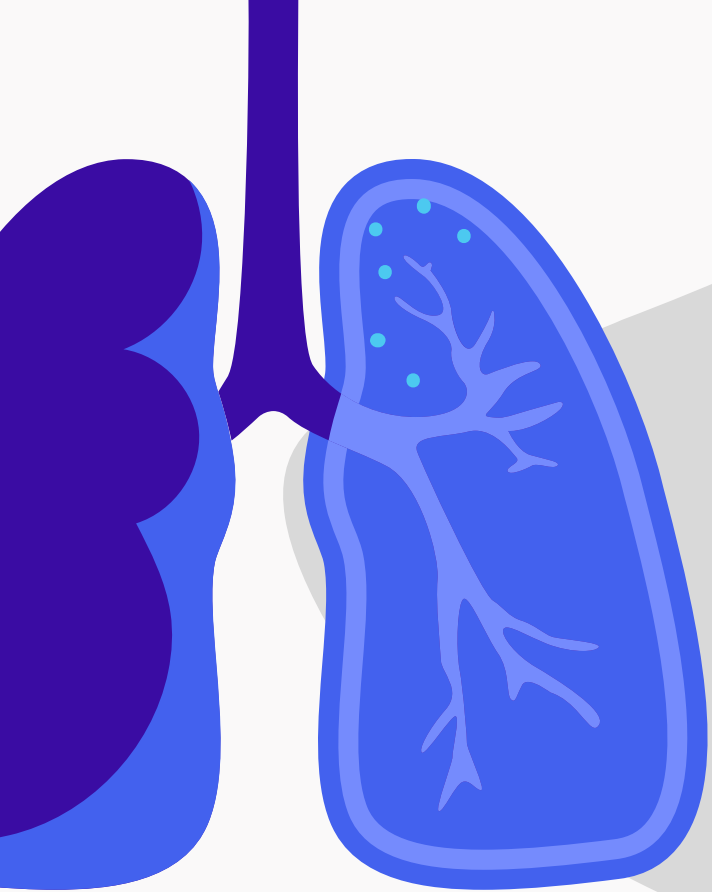
Numerous eosinophils and **Charcot-Leyden crystals** (crystalloids made up of the eosinophil protein galectin-10)

Clinical Features

Severe dyspnea and wheezing due to bronchoconstriction and mucus plugging, which leads to trapping of air in distal airspaces and progressive hyperinflation of the lung

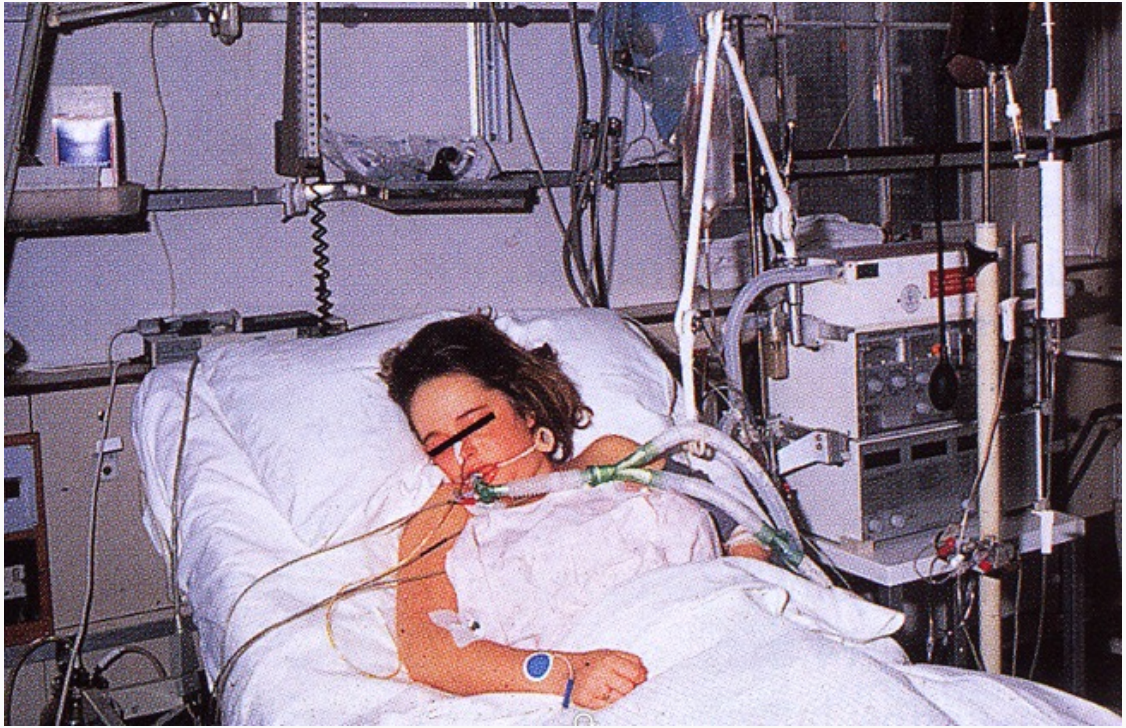
Attacks last from 1 to several hours and subside either spontaneously or with therapy

Intervals between attacks are characteristically free from overt respiratory difficulties



COMPLICATION

1. Superimposed infection i.e., pneumonia
2. Chronic bronchitis
3. Emphysema, pneumothorax and pneumomediastinum
4. Bronchiectasis
5. Status asthmaticus (Overinflated lungs with sever obstruction and air trapping)
6. Respiratory failure which requiring intubation
7. Hypercapnia, acidosis, and severe hypoxia In some cases, cor pulmonale and heart failure develop



This patient presented as a medical emergency with acute severe breathlessness and diagnosed as a case of status asthmaticus (Overinflated lungs because of sever obstruction and air trapping) which required immediate intensive care including intermittent positive-pressure ventilation

PROGNOSIS

- **Remission**

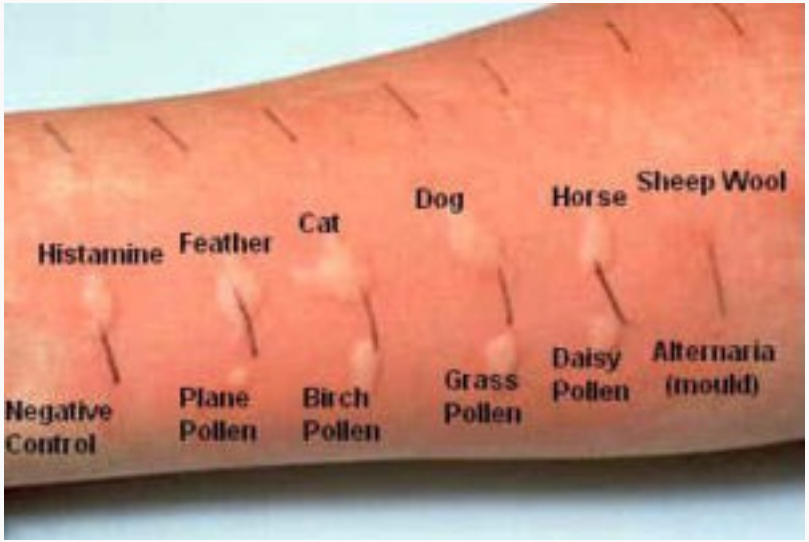
  Approximately 50% of cases of childhood asthma resolve spontaneously but may recur later in life; remission in adult-onset asthma is less likely

- **Mortality-death**

  Occurs in approximately 0.2% of asthmatics. Mortality is usually (but not always) preceded by an acute attack and about 50% are more than 65 years old

TREATMENT

- Control of factors contributing to asthma severity
- Medication:
  - Anti-inflammatory drugs, particularly glucocorticoids
  - Bronchodilators such as beta-adrenergic drugs
  - leukotriene inhibitors



ASTHMA
INFOGRAPHICS

NORMAL AIRWAY

DURING ASTHMA SYMPTOMS

LOREM IPSUM

lorem ipsum dolor sit amet, consectetur adipiscing elit, incididunt ut labore et back

RISK FACTORS

GENETIC

INFECTION

DUST

POLLUTION

ALCOHOL

CIGARETTE

PET

DUST

PERFUME AND COSMETICS

SYMPTOMS

DRY COUGH

NIGHT COUGH

DIFFICULTY BREATHING

SHORTNESS OF BREATH

CHEST PAIN OR TIGHTNESS

WHEEZING

TREATMENTS

EXERCISE

LOREM IPSUM

AVOID

Summery

- Asthma is characterized by reversible bronchoconstriction caused by airway hyper responsiveness to a variety of stimuli
- Atopic asthma most often is caused by a TH2 and IgE-mediated immunologic reaction to environmental allergens and is characterized by early-phase (immediate) and late-phase reactions
- The TH2 cytokines IL-4, IL-5, and IL-13 are important mediators
- Triggers for nonatopic asthma are less clear but include viral infections and inhaled air pollutants
- Eosinophils are key inflammatory cells found in almost all subtypes of asthma; eosinophil products (such as major basic protein) are responsible for airway damage
- Airway remodeling (sub-basement membrane thickening and hypertrophy of bronchial glands and smooth muscle)

Thanks for your attention