

Diseases of the Respiratory System

Chronic Obstructive Pulmonary Diseases (COPD)



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Respiratory block
2019
Pathology
Lecture 2

Objectives:

- Give introduction for diffuse lung disease
- Compare and contrast the major clinical and functional differences between predominant **chronic bronchitis** versus predominant **emphysema** in patients with COPD
- Define **Bronchiectasis**, its causes, presentation, morphology and significant.

Obstructive Lung Diseases

(diffuse)

- 1) **Bronchial Asthma**
- 2) **Chronic obstructive pulmonary disease (COPD)**

Cigarette smoking is the principle cause

10% of population above 45 year has airflow obstruction

They are of two types:

- a) **Chronic bronchitis**
- b) **Emphysema**

- 3) **Bronchiectasis**

Common symptoms in lung disease

- **Dyspnea: difficulty with breathing**
- **Cough**
- **Hemoptysis**

Chronic injury (e.g., smoking)

Small airway disease

EMPHYSEMA

Alveolar wall destruction
Overinflation

CHRONIC BRONCHITIS

Productive cough
Airway inflammation

ASTHMA

Reversible obstruction

**Bronchial hyperresponsiveness
triggered by allergens, infection, etc.**

Diseases of the Respiratory System

Emphysema

Objectives:

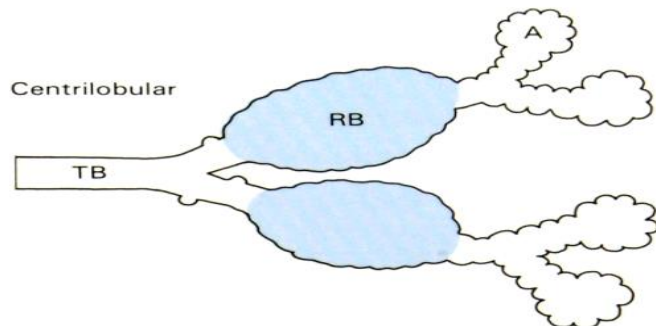
- a. Define emphysema.
- b. Describe the gross and microscopic changes in emphysema.
- c. Discuss the typical clinical presentation and causes of death.
- d. Describe the most likely mechanism of emphysema (the protease-antiprotease mechanism).
- e. Describe the pathophysiologic mechanisms of emphysema

Emphysema

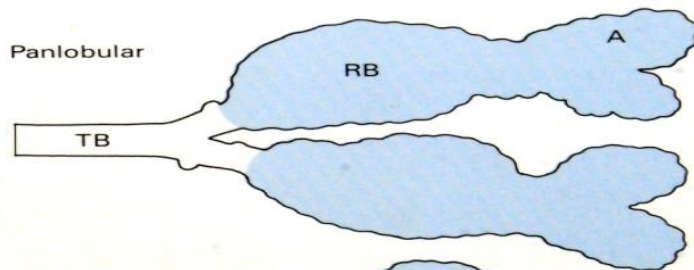
abnormal **permanent enlargement of all or part of the respiratory unit accompanied by destruction of their walls**

Associated with loss of elastic recoil and support of small airways leading to tendency to collapse with obstruction

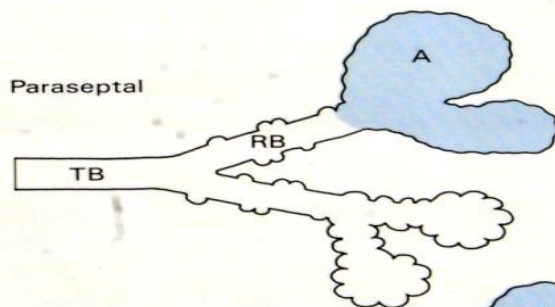
Diseases of Lung



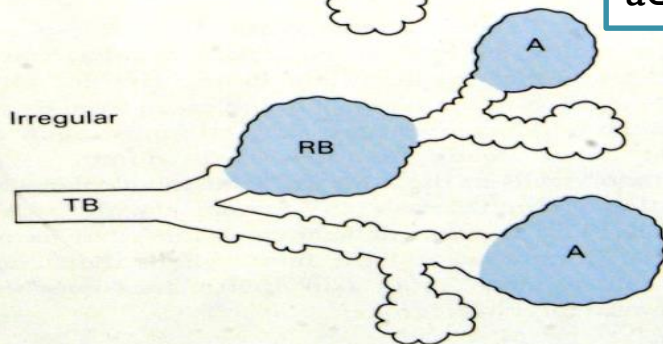
1. Centriacinar:
in heavy smoker, severe in upper lobes



2. Alpha 1 antitrypsin deficiency:
Commonly affect both lower lobes at lower zones



3. Distal acinar / paraseptal:
adjacent to areas of fibrosis or atelectasis
More severe in the upper half of the lungs, young adult, unknown cause, spontaneous pneumothorax

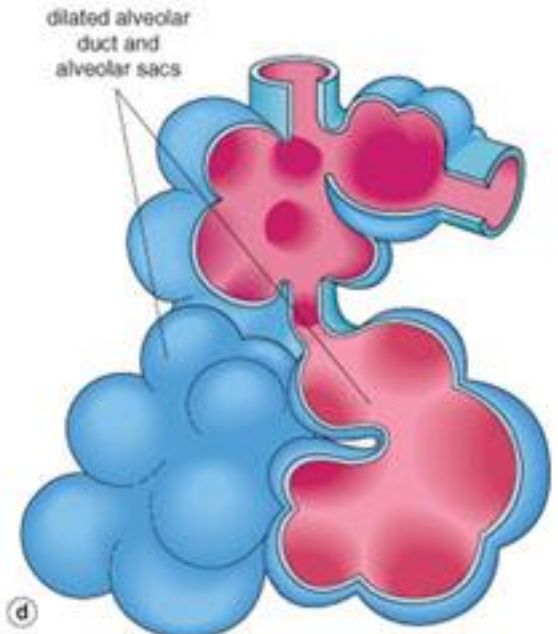
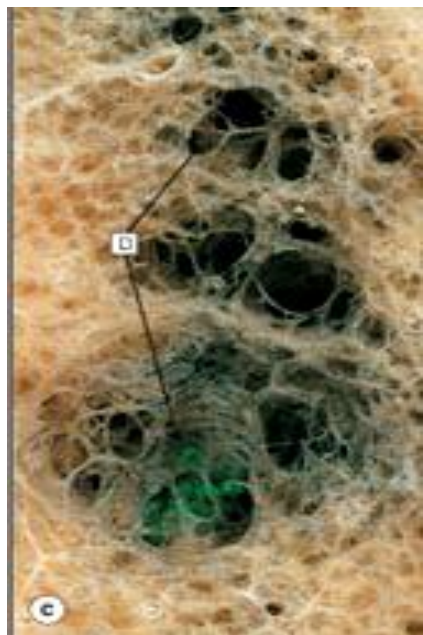
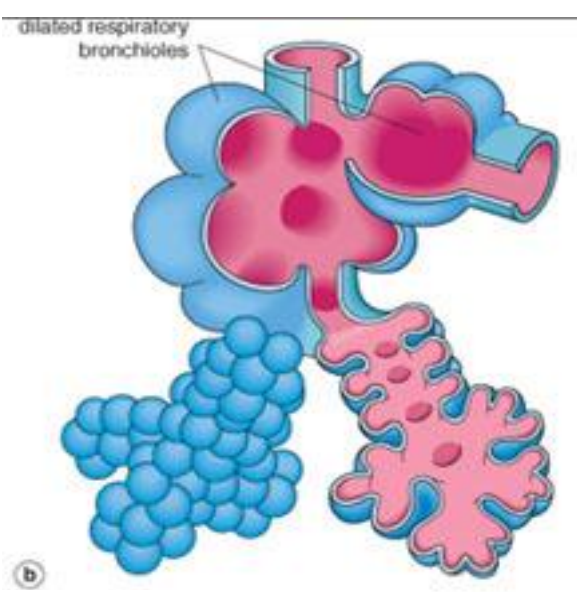
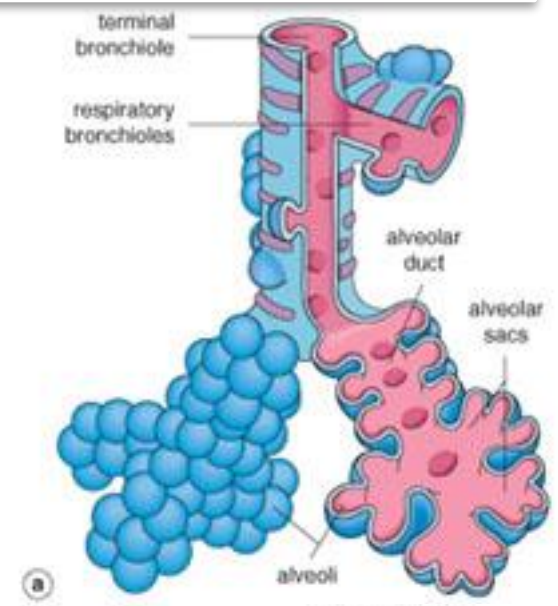


4. Irregular
Associated with scarring, e.g. in TB
Asymptomatic

Classification of emphysema

Emphysema: morphology

Diseases of Lung

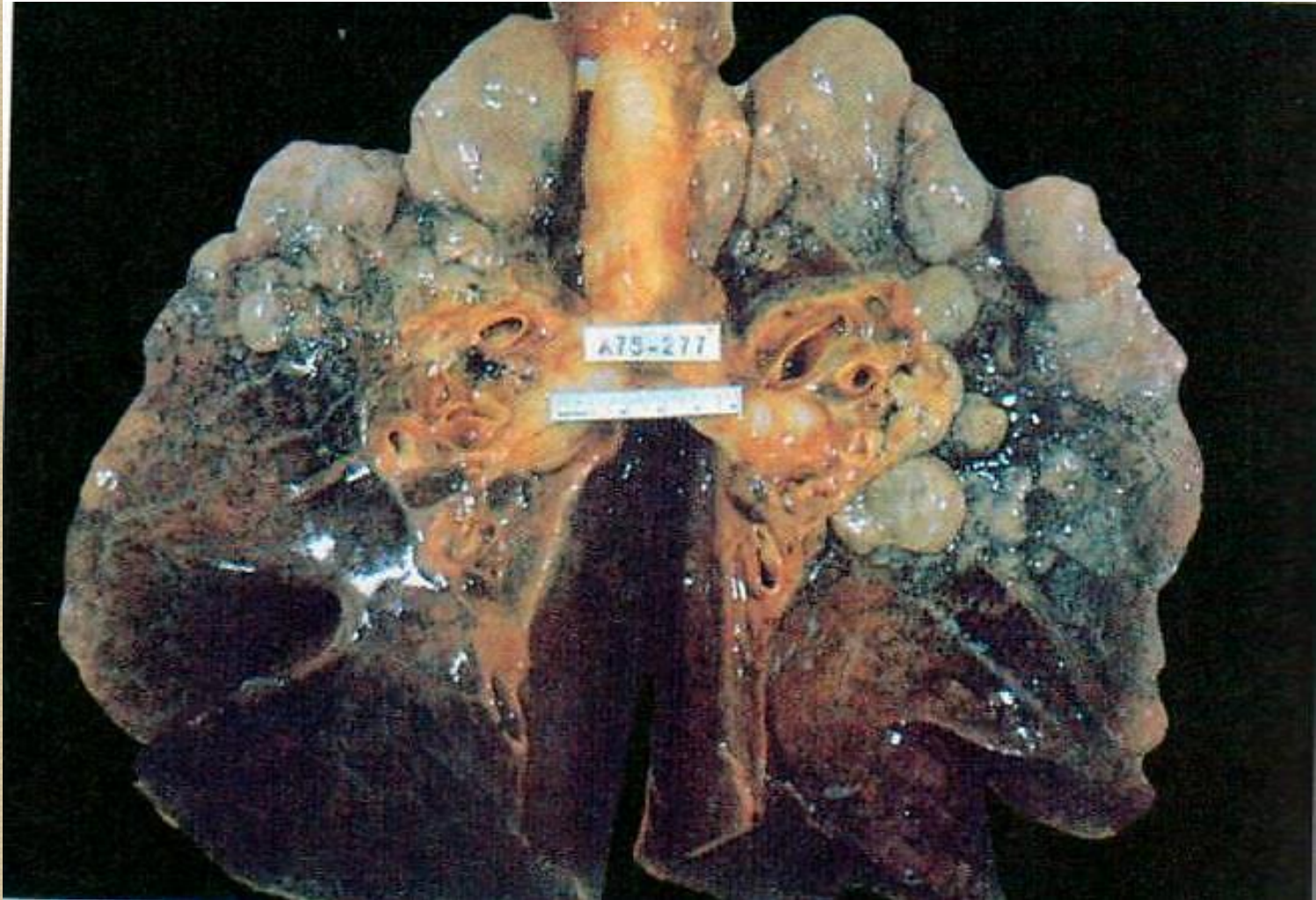


Generalized emphysema. (a) Normal distal lung acinus. (b) Centriacinar emphysema. (c) Centriacinar emphysema. (d) Panacinar emphysema. (e) Panacinar emphysema (Gough-Wentworth section).

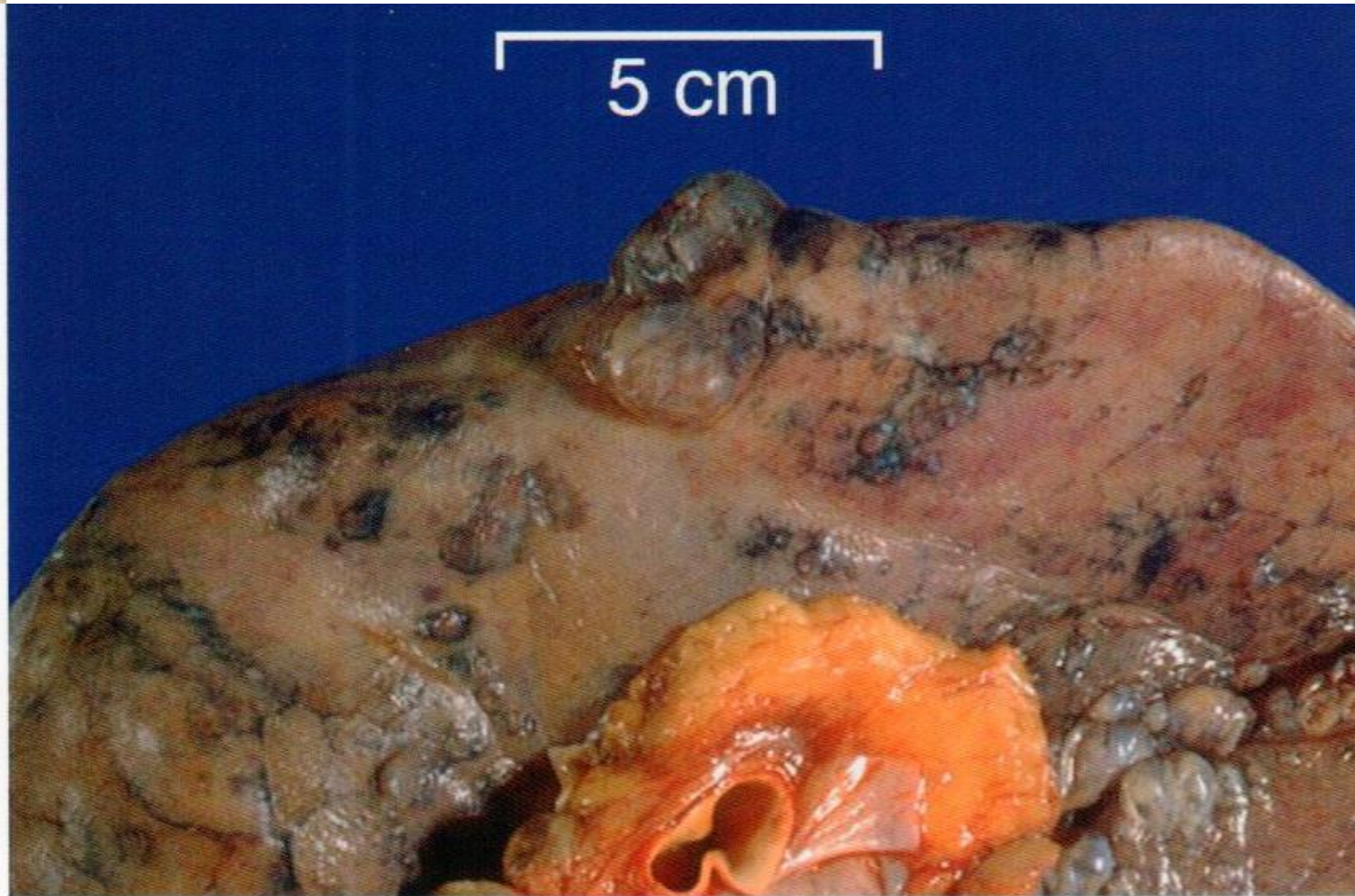
Diseases of Lung



Emphysema

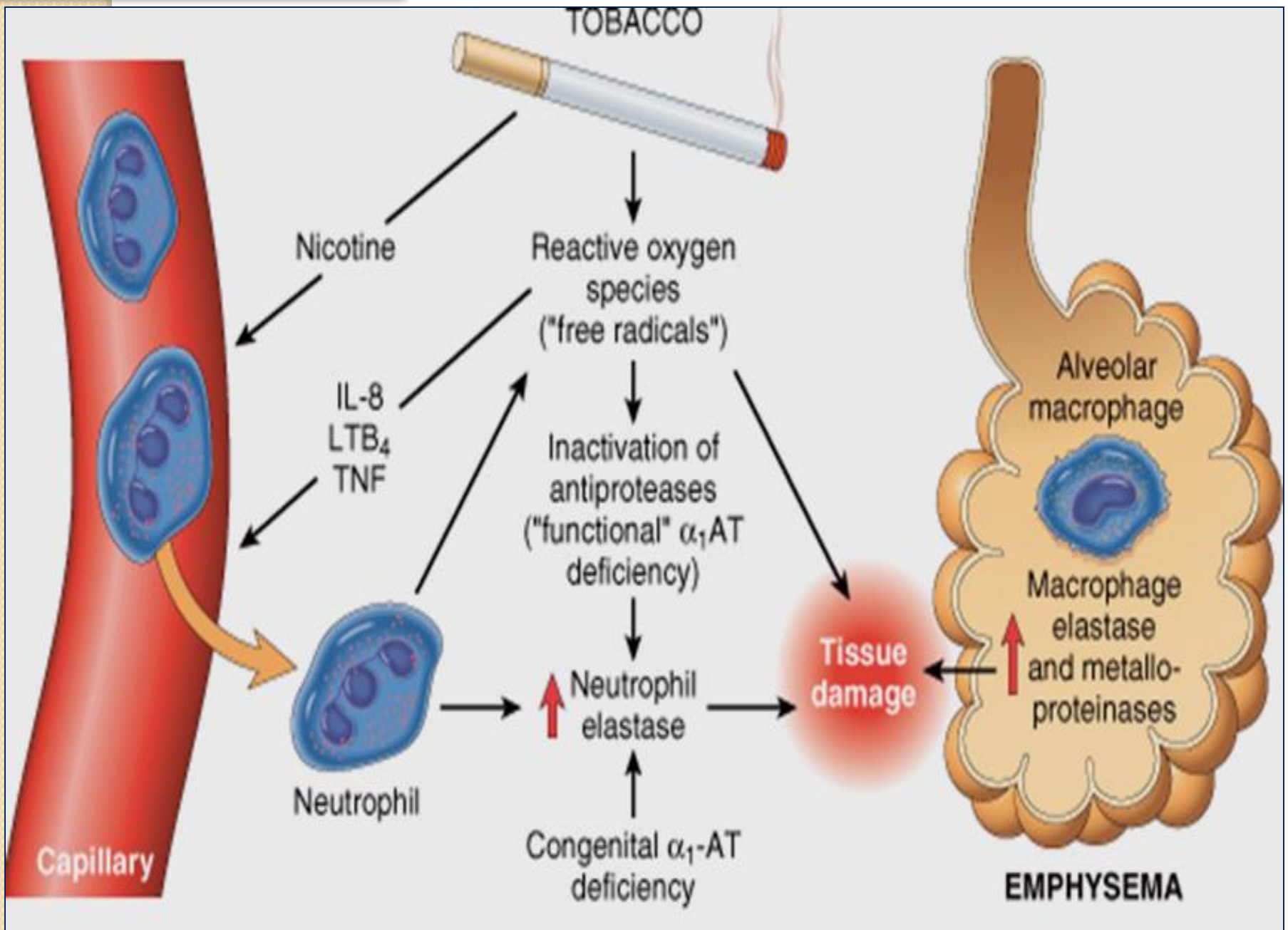


Bullous emphysema with large apical and subpleural bullae

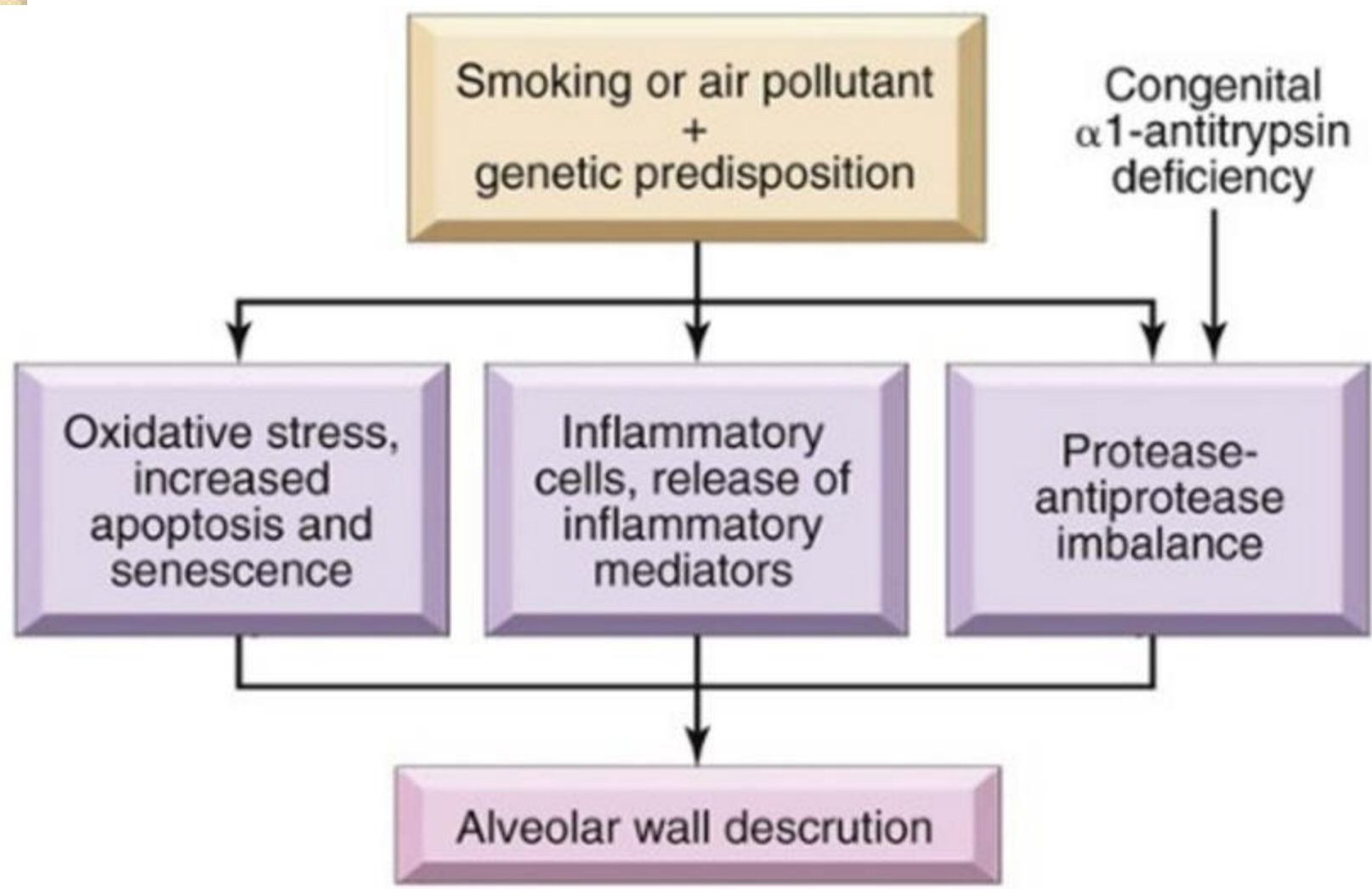


Distal acinar /paraseptal:
forming multiple cyst-like structures with
spontaneous pneumothorax.

Emphysema: Pathogenesis



Pathogenesis of Emphysema



Emphysema: morphology

Destruction of some alveolar septi

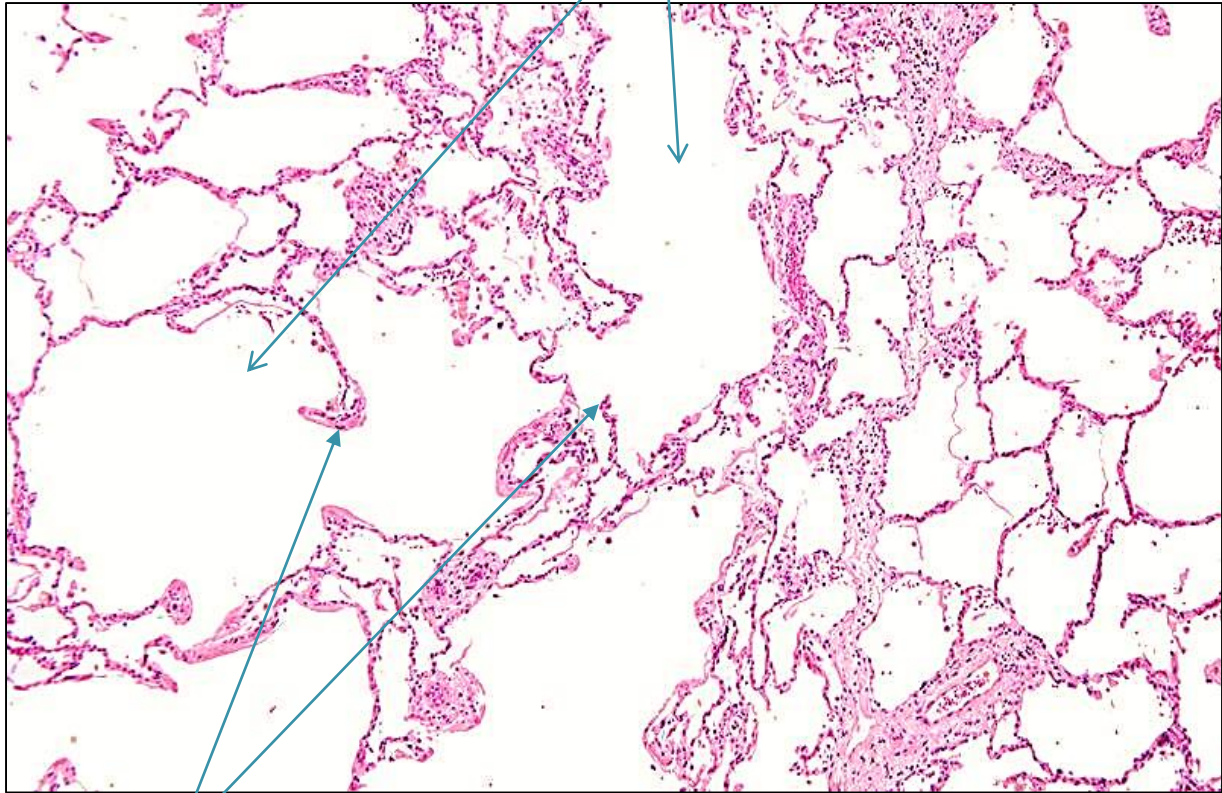


Enlarged air spaces/alveolar spaces.

**Paraseptal emphysema, microscopic
destruction of alveolar walls**

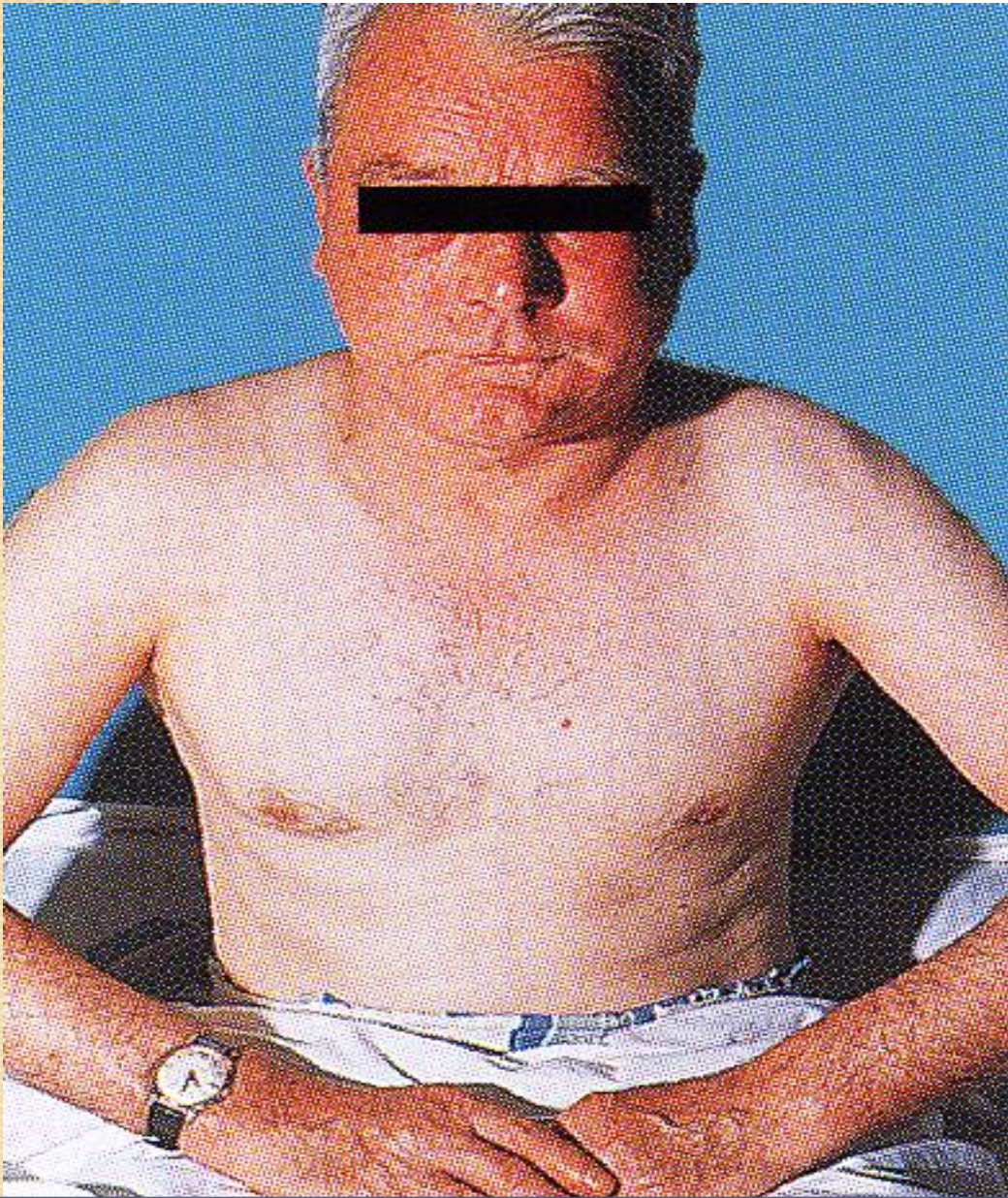
Emphysema: morphology

Enlarged air spaces



Destruction of some alveolar septi

Emphysema:- Clinical features: Dyspnea



Patient is sitting forward in a hunched- over position

Pursed lip expiration is a common maneuver adopted by patients with severe chronic obstructive pulmonary disease including emphysema.

The patient starts to breathe out closed or nearly closed lips to keep the intrabronchial pressure high and prevent collapse of the bronchial wall and expiratory obstruction. Later in expiration the lips are blown forwards and open, often with a grunt (“fish-mouth breathing”).



Barrel-shaped chest in a patient with emphysema.

The hyperinflation result from

1. air-trapping with inflammatory changes
2. hypersecretion of viscid contraction in the small airways.

Note the associated indrawing of the intercostal muscles. Similar changes are seen in patients with chronic bronchitis and asthma.

Emphysema: Complications

- **Pneumothorax**
- **Pulmonary hypertension (due to destruction of small capillaries in alveolar wall and hypoxia lead to pulmonary vascular spasm)**
- **Right-sided heart failure (Cor pulmonale)**
- **Death from emphysema is related to:**
 - **Pulmonary failure with respiratory acidosis, hypoxia and coma or due to pulmonary hypertension.**

Emphysema:

Dilated air spaces beyond respiratory bronchioles due to destruction of alveolar septa

Types

- **Centriacinar: Smoking**
- **Panacinar: deficiency of α 1 AT**
- **Paraseptal: Occurs adjacent to areas of fibrosis or atelectasis.**
- **Irregular: scar**

Clinical features

- **Cough and wheezing. Dyspnea**
- **Weight loss**
- **Pulmonary function tests reveal low FEV1**
- **Pink puffers. Respiratory acidosis**

Complications

- **Pneumothorax**
- **Pulmonary hypertension.**
- **Right-sided heart failure (Cor pulmonale)**
- **Pulmonary failure with respiratory acidosis, hypoxia and coma.**

Diseases of the Respiratory System

Chronic Bronchitis

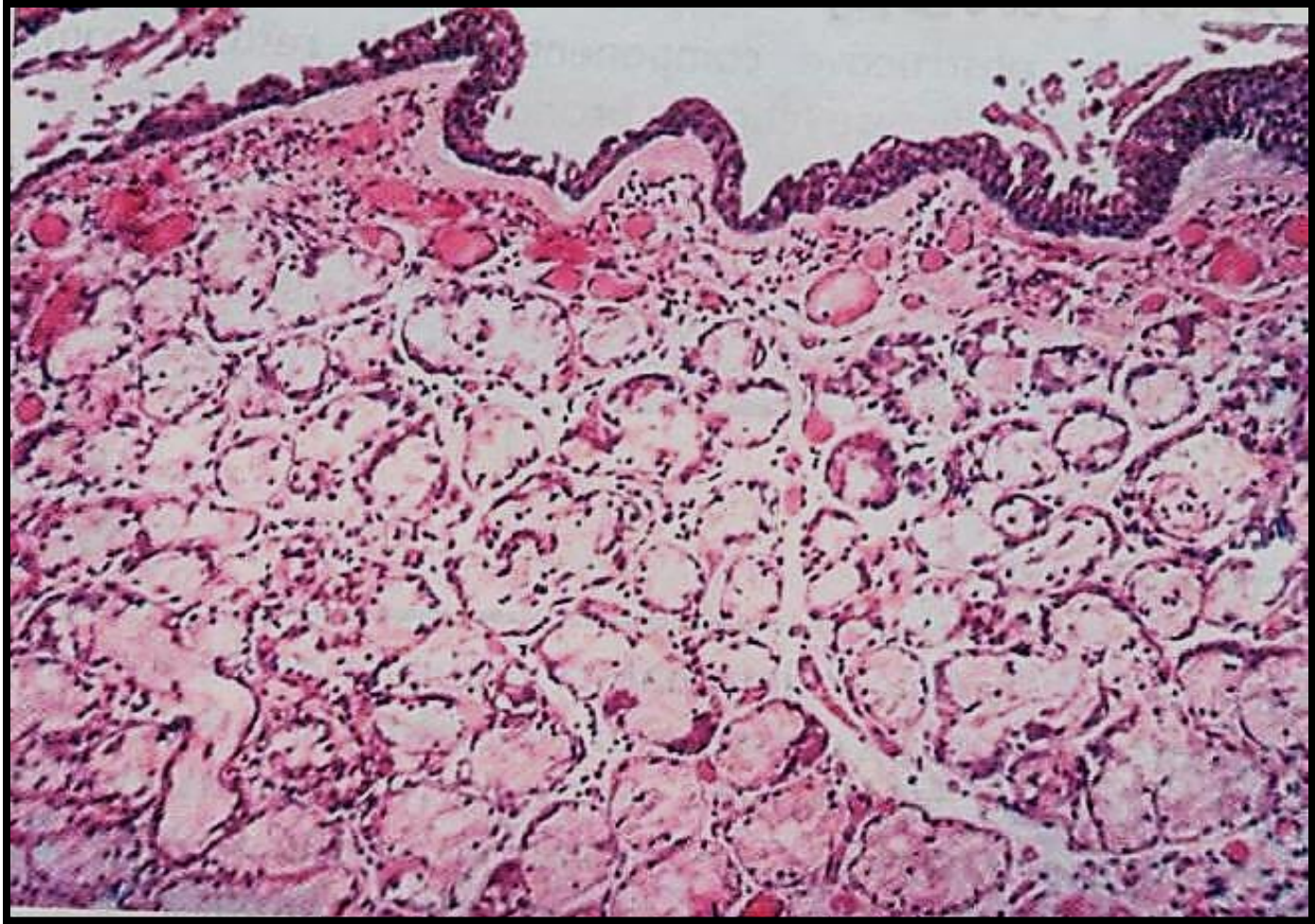
Objectives:

- a. Define chronic bronchitis.
- b. Describe the causes, pathogenesis and the morphology of chronic bronchitis.
- c. Describe the mechanism of airway obstruction in a patient with chronic bronchitis.
- d. Understand that when severe obstruction is present in chronic bronchitis, significant emphysema is nearly always present

Chronic Bronchitis: defined as persistent productive cough for at least 3 consecutive months in at least 2 consecutive years

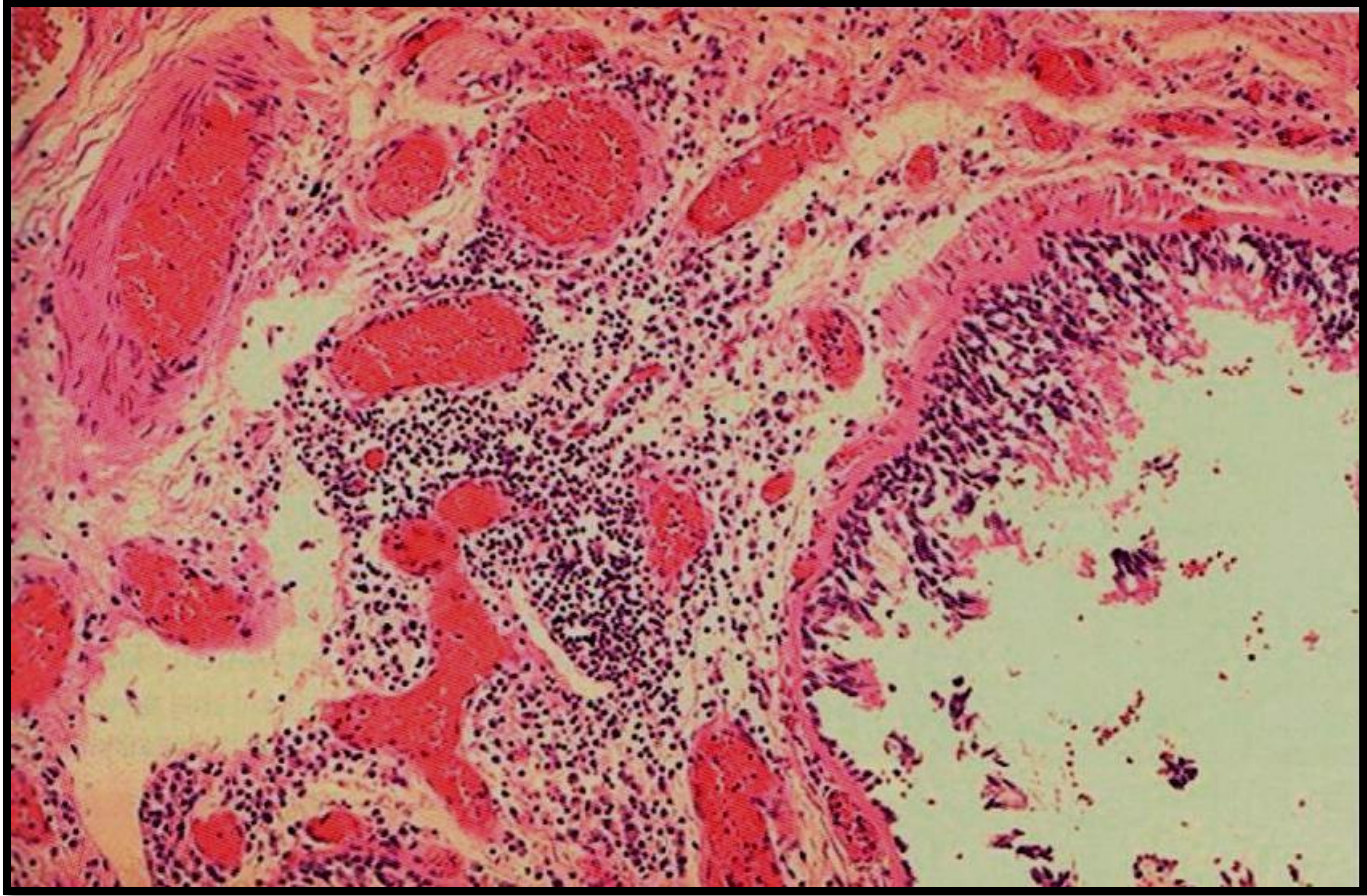
- **Causes**
 - Cigarette smoking is the most important risk factor
 - Air pollutants
 - Cystic fibrosis

Chronic Bronchitis: morphology



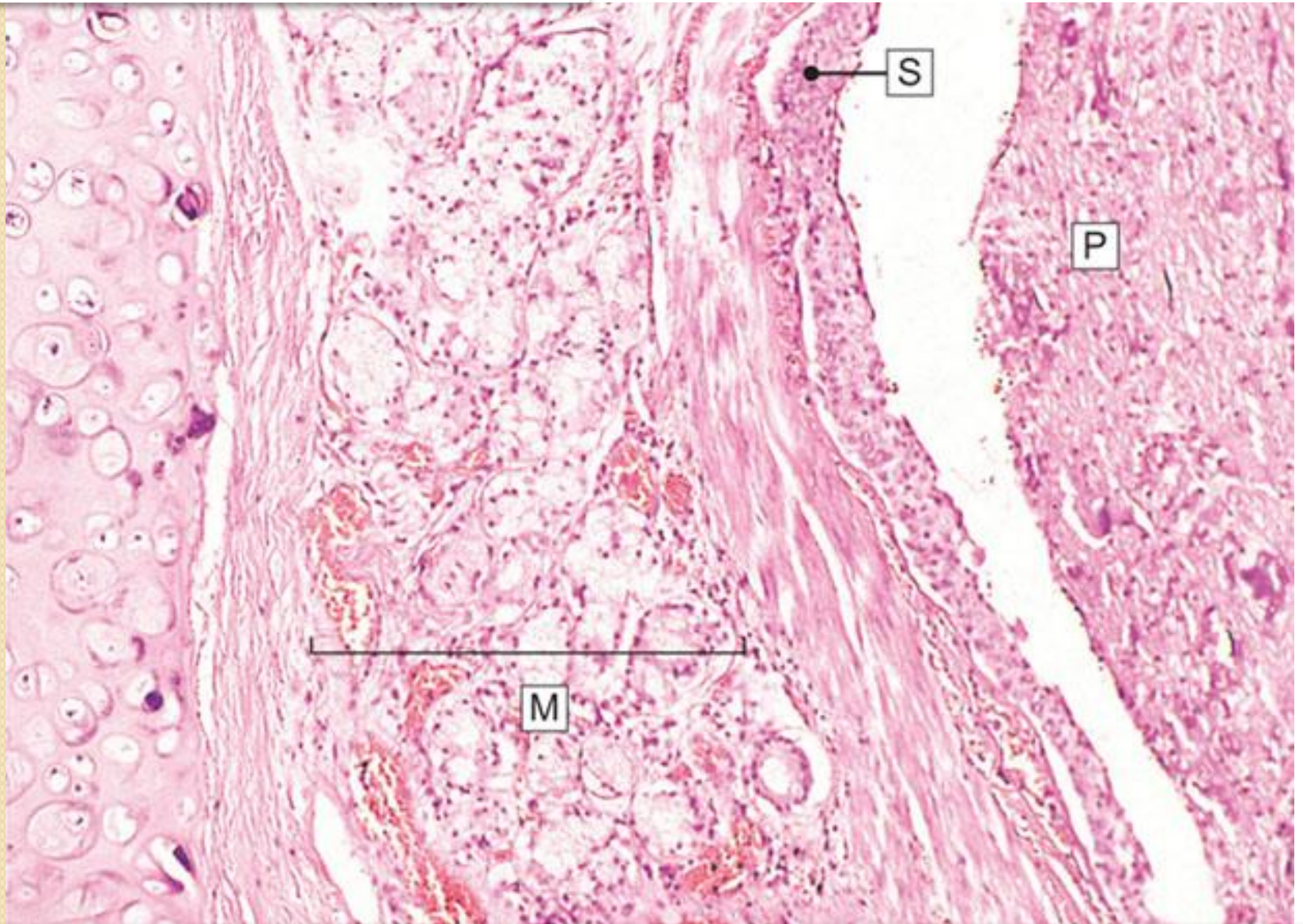
Chronic bronchitis

Chronic Bronchitis: morphology



Chronic bronchitis

Chronic Bronchitis: morphology



Chronic bronchitis. In chronic bronchitis the main abnormality is secretion of abnormal amounts of mucus, causing plugging of the airway lumen (P)

Clinical features and complications

- Persistent reproductive cough
- Dyspnea on exertion
- Hypercapnia, hypoxemia, cyanosis (blue bloaters)
- Emphysema
- Cor pulmonale

- Death due to further impairment of respiratory functions after superimposed acute bacterial infections.

Chronic Bronchitis

Definition: Persistent productive cough (with sputum) for at least 3 months in at least 2 consecutive years

Causes

- Cigarette smoking is the most important risk factor; air pollutants also contribute

Features

- enlargement of mucous-secreting glands, goblet cell hyperplasia, chronic inflammation, and bronchiolar wall inflammation and fibrosis.

Complications

- Persistent reproductive cough, dyspnea on exertion, hypercapnia, hypoxemia, cyanosis, cor pulmonale with edema (blue bloater)
- Death may result from further impairment of respiratory function due to superimposed acute infections.

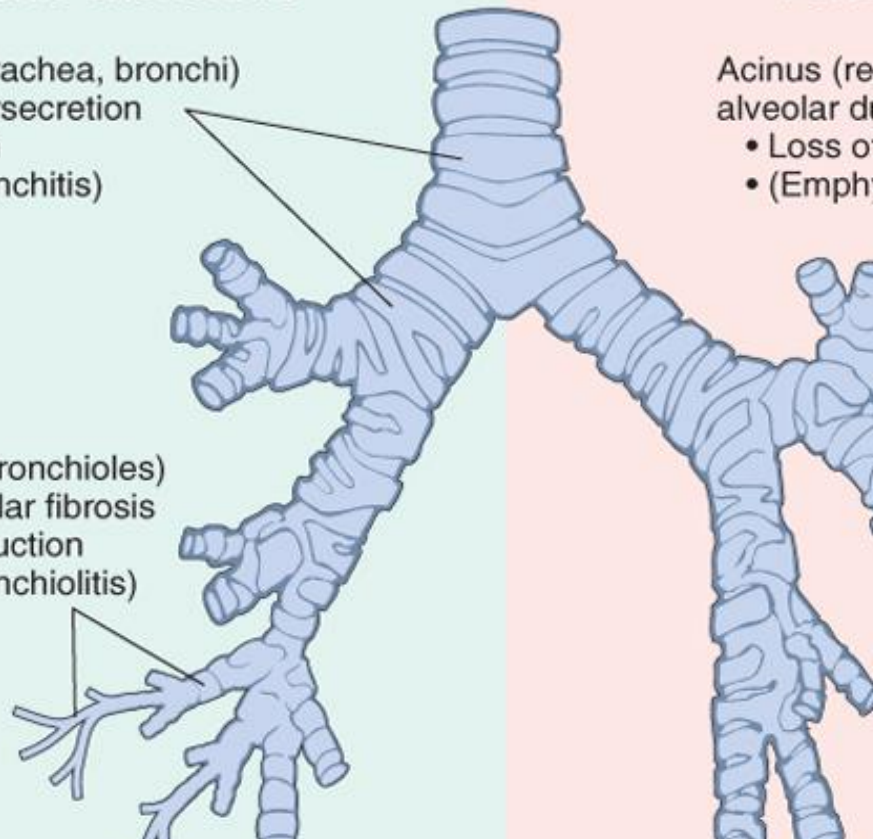
PURE CHRONIC BRONCHITIS

Large airways (trachea, bronchi)

- Mucus hypersecretion
- Inflammation
- (Chronic bronchitis)

Small airways (bronchioles)

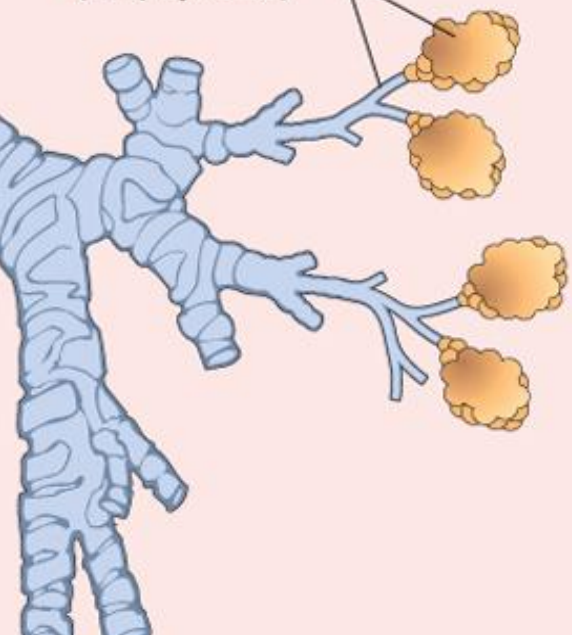
- Peribronchiolar fibrosis
- Airway obstruction
- (Chronic bronchiolitis)



PURE EMPHYSEMA

Acinus (respiratory bronchiole, alveolar ducts, and alveoli)

- Loss of elastic recoil
- (Emphysema)

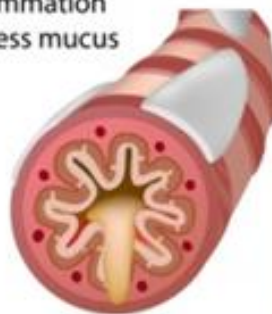


Chronic Bronchitis

Healthy



Inflammation
& excess mucus



Emphysema

Healthy



Alveolar membranes
break down



Bronchiectasis

Objectives:

Definition

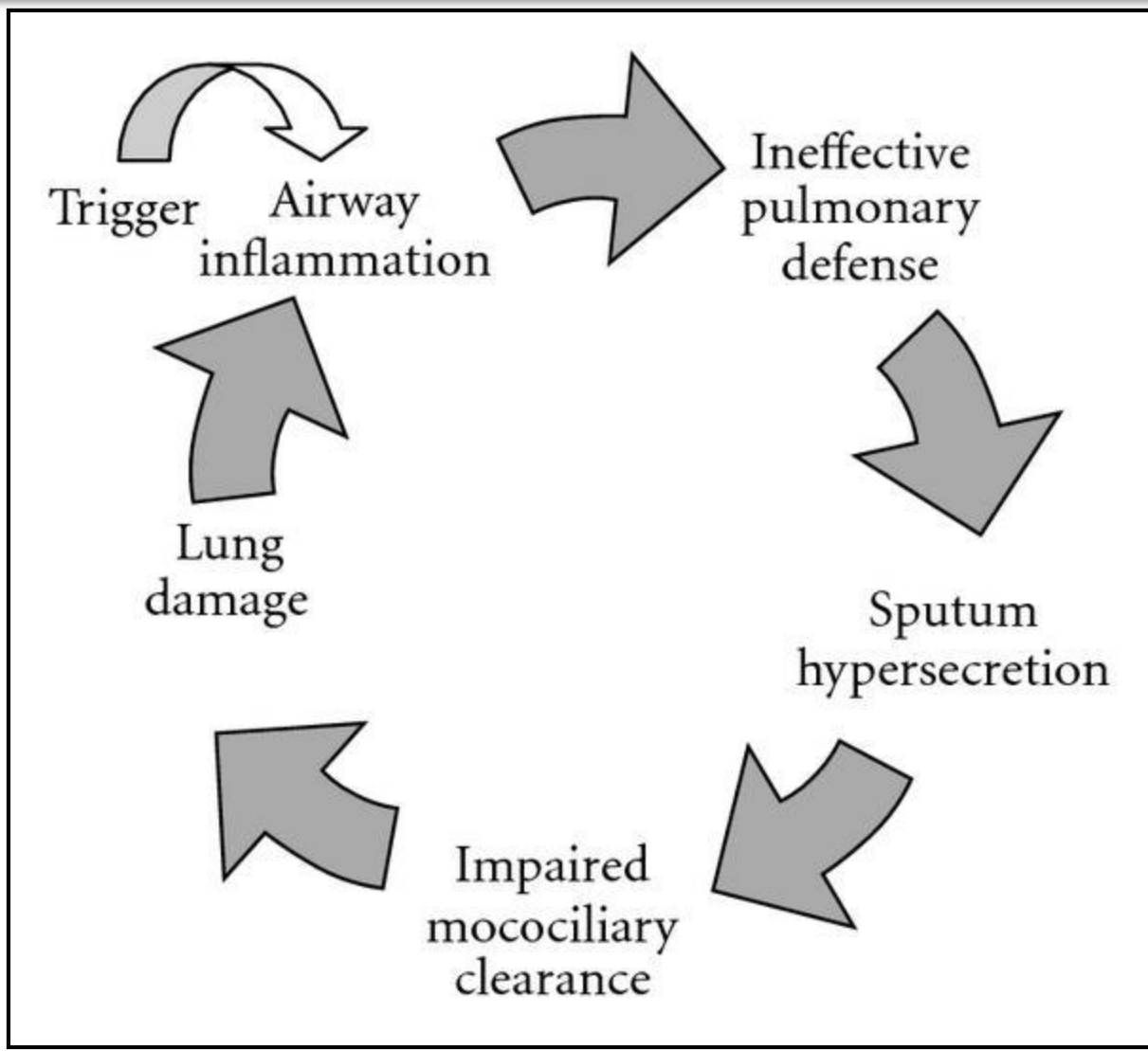
Causes

Presentation

morphology and significant

Bronchiectasis

Bronchiectasis is permanent dilatation of bronchi with destruction of their walls.
It is a result of chronic inflammation associated with an inability to clear mucoid secretions.



Causes of bronchiectasis

1. Bronchial obstruction

Localized:

- tumor, foreign bodies or mucous impaction

Generalized:

- bronchial asthma
- chronic bronchitis

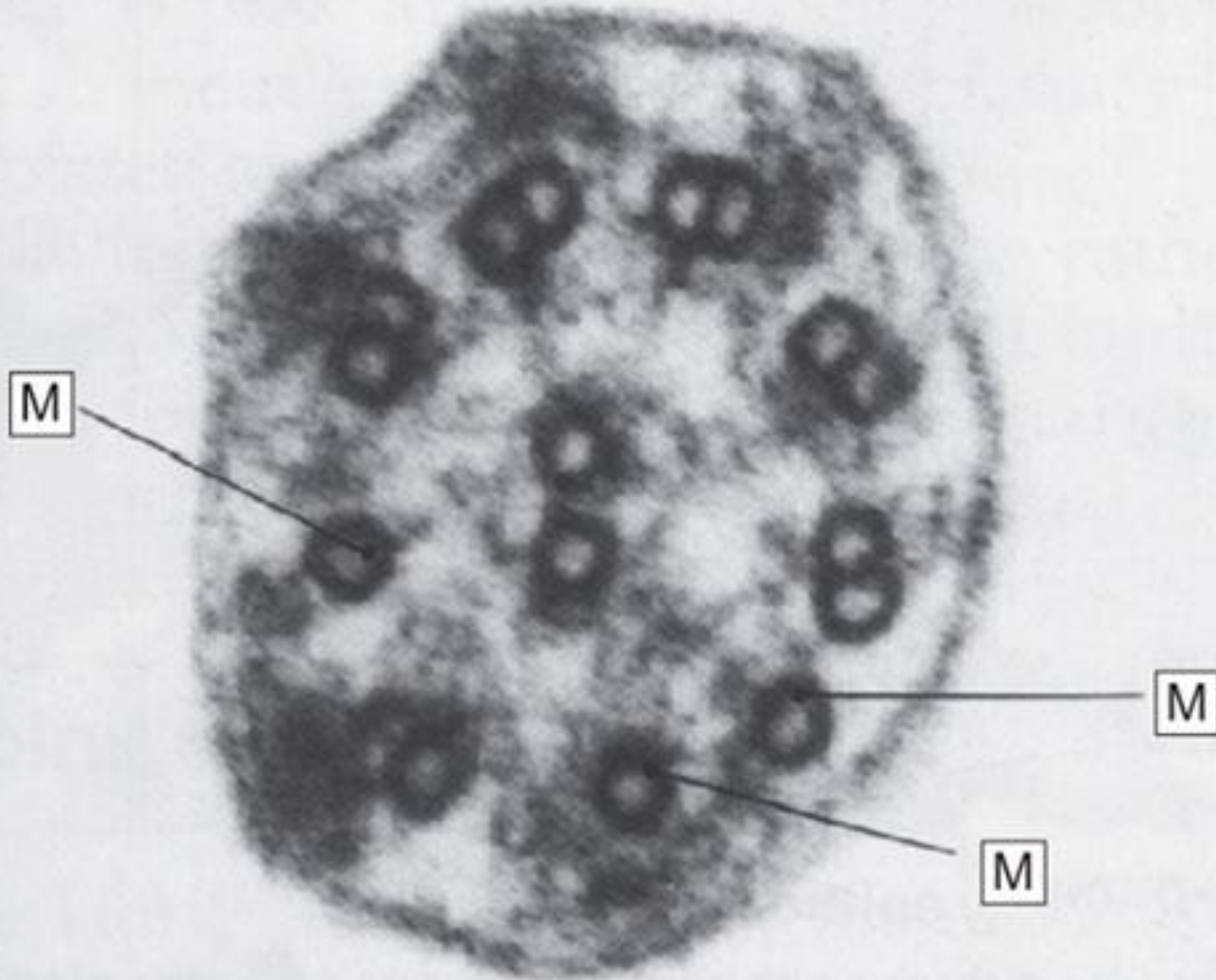
2. Congenital or hereditary conditions

- Congenital bronchiectasis
- Cystic fibrosis.
- Intralobar sequestration of the lung.
- Immunodeficiency status.
- Immotile cilia and kartagner syndrome

3. Chronic or severe infection / necrotizing pneumonia

Caused by TB, staphylococci or mixed infection

Diseases of Lung



Ciliary dyskinesia syndrome. Electron micrograph of cilia from a person with recurrent chest infections since childhood. The outer dynein arms are absent and there are abnormal single microtubules (M), which prevent normal motility.

Presentation of Bronchiectasis

Severe, persistent cough associated with expectoration of mucopurulent, sometimes bad smell sputum.

Other common symptoms include dyspnea, rhinosinusitis, and hemoptysis.



Bronchiectasis, chest radiograph

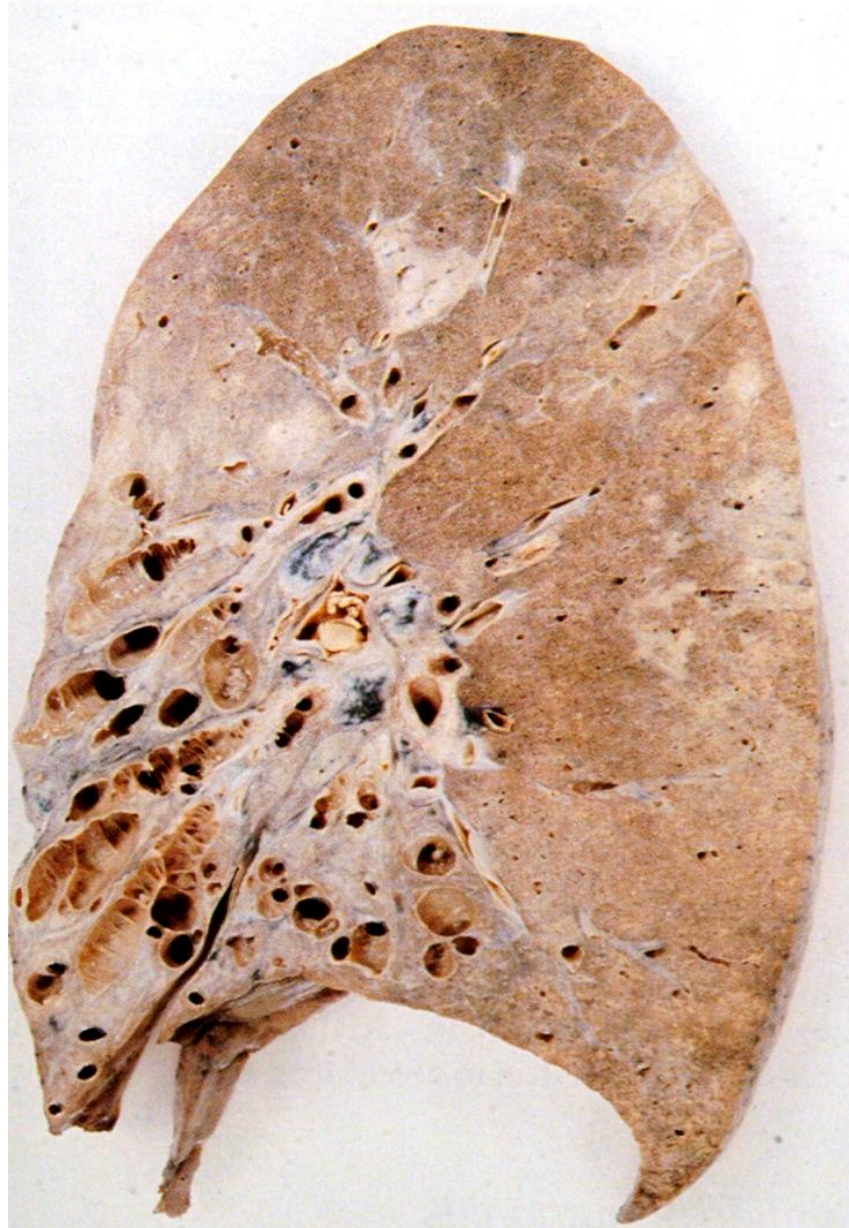


Bronchiectasis, gross

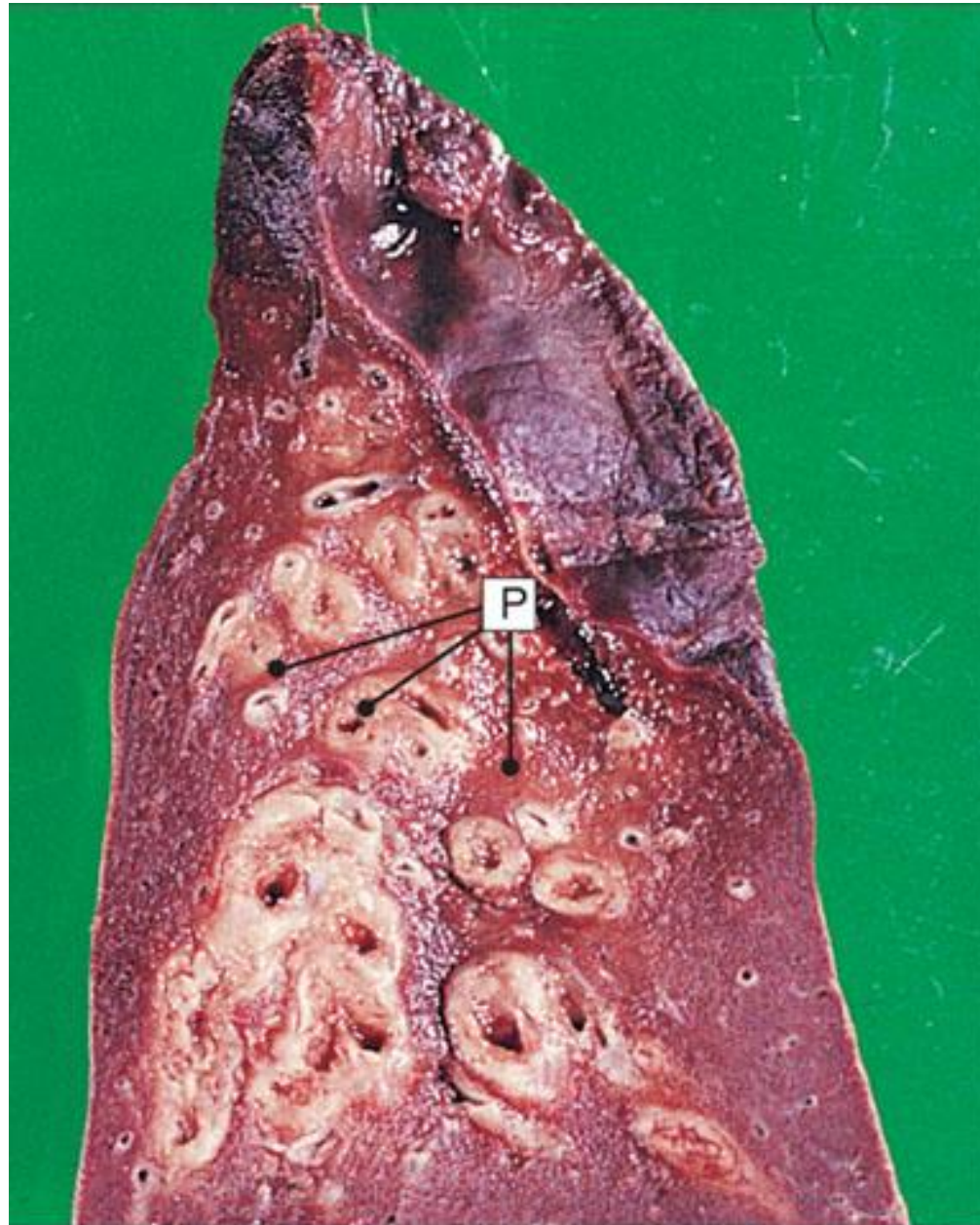
Diseases of Lung

Bronchiectasis

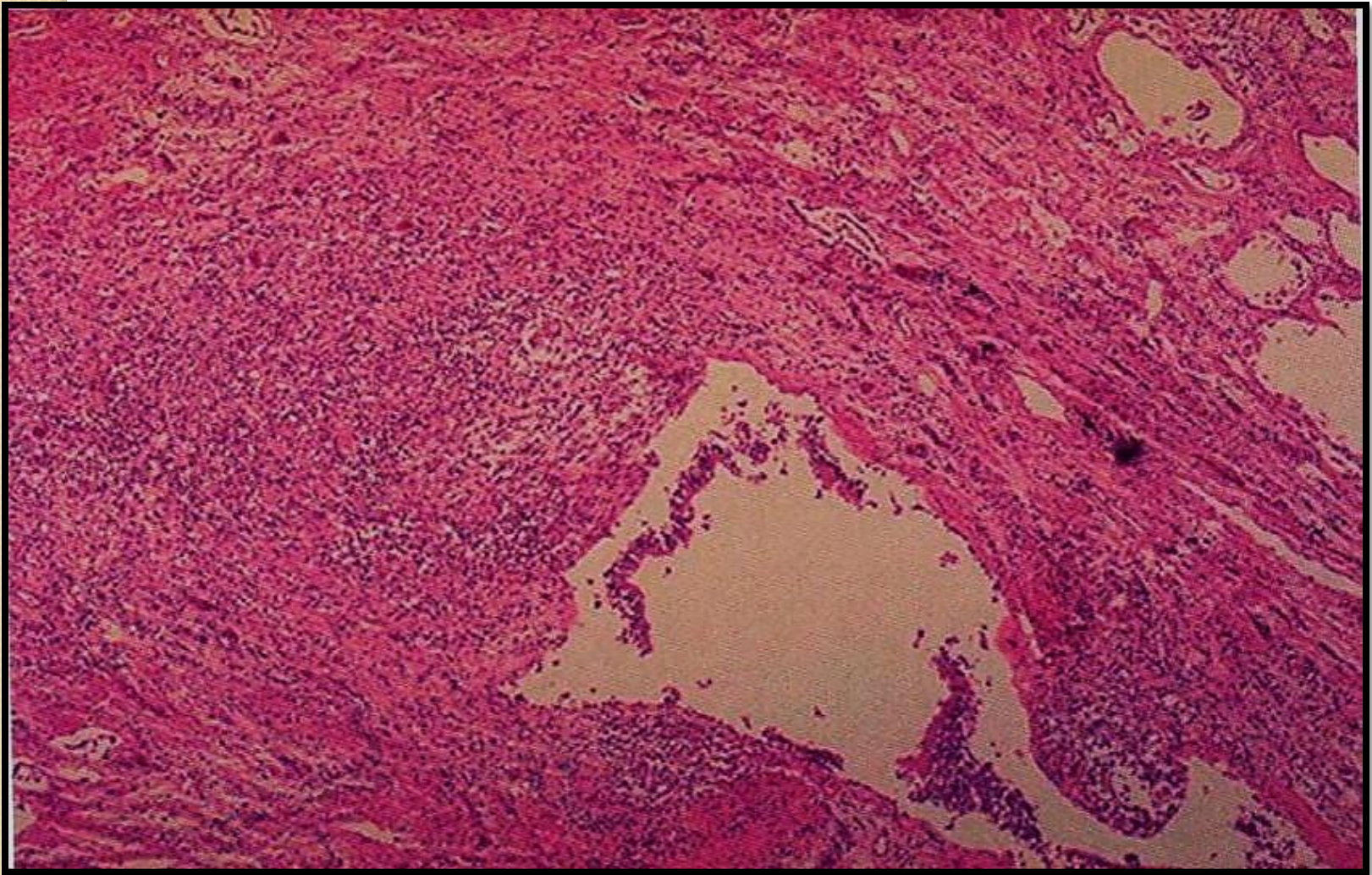
- Dilatation of bronchi with destruction of bronchial walls



Diseases of Lung



Bronchiectasis. This is a lower lobe of lung surgically resected for bronchiectasis.



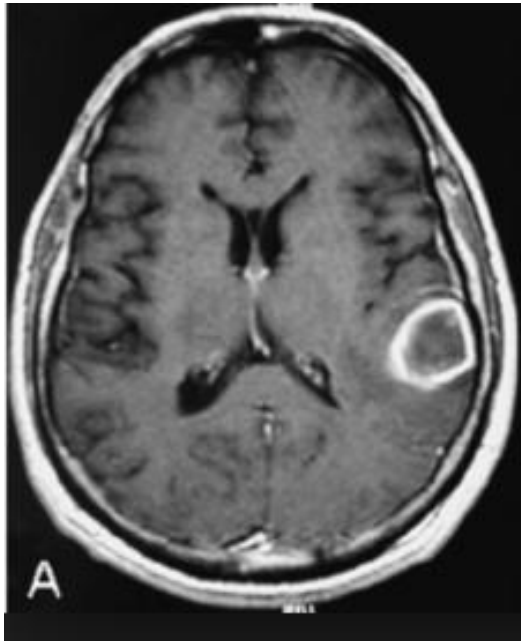
Bronchiectasis, microscopic

Bronchiectasis Complications

1. Obstructive pulmonary function (hypoxemia, hypercapnia, pulmonary hypertension, and cor pulmonale)
2. Lung Abscess

Rare complications: include

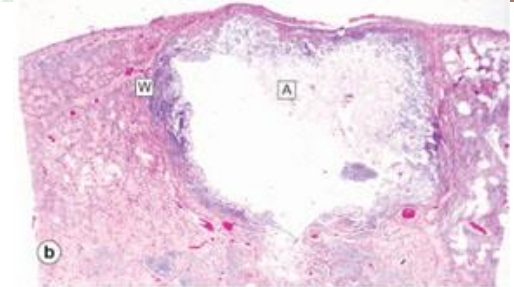
- I. Metastatic brain (**cerebral**) abscess
- II. Amyloidosis.



Brain (**cerebral**) abscess



Lung Abscess



Bronchiectasis:

Dilatation and destruction of bronchi and bronchioles secondary to chronic inflammation and obstruction

Causes

- Infection/ Necrotizing pneumonia
- Obstruction
- Congenital (Cystic fibrosis, Kartagener's Syndrome)

Clinical features

- Severe persistent cough with sputum (mucopurulent sputum) sometime with blood.
- Clubbing of fingers.

Complications

- If severe, obstructive pulmonary function
- Lung Abscess
- Rare complications: metastatic brain(**cerebral**) **abscess** and amyloidosis.

Diseases of Lung

Key Facts Chronic obstructive pulmonary disease



. Definition: a disease state characterized by airflow limitations that are not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases.

. Cigarette smoking remains the most important cause of COPD. Other risks are recurrent chest viral infections in childhood, atopy, asthma, and occupational exposure to dusts (especially mining).

. Respiratory bronchiolitis is one of the earliest lesions seen in smokers.

. Chronic bronchitic airways show mucous hypersecretion with mucous gland hyperplasia.

. Chronic bronchitis and bronchiolitis cause airway narrowing.

. Emphysema causes loss of elastic recoil in lungs and contributes to functional airways obstruction.

. Generalized emphysema is defined as permanent dilatation of any part of the respiratory acinus, with destruction of tissue in the absence of scarring.

. There are two patterns of generalized emphysema: centrilobular and panacinar.

. Many patients with COPD have a reversible component to functional airways obstruction.

. Pulmonary hypertension and right-sided heart failure are common in long-standing chronic obstructive pulmonary disease.

. Acute deterioration in COPD is usually caused by viral or bacterial infection.

