

# RESPIRATORY SYSTEM BLOCK

## *Pathology Practical*

Prepared by:

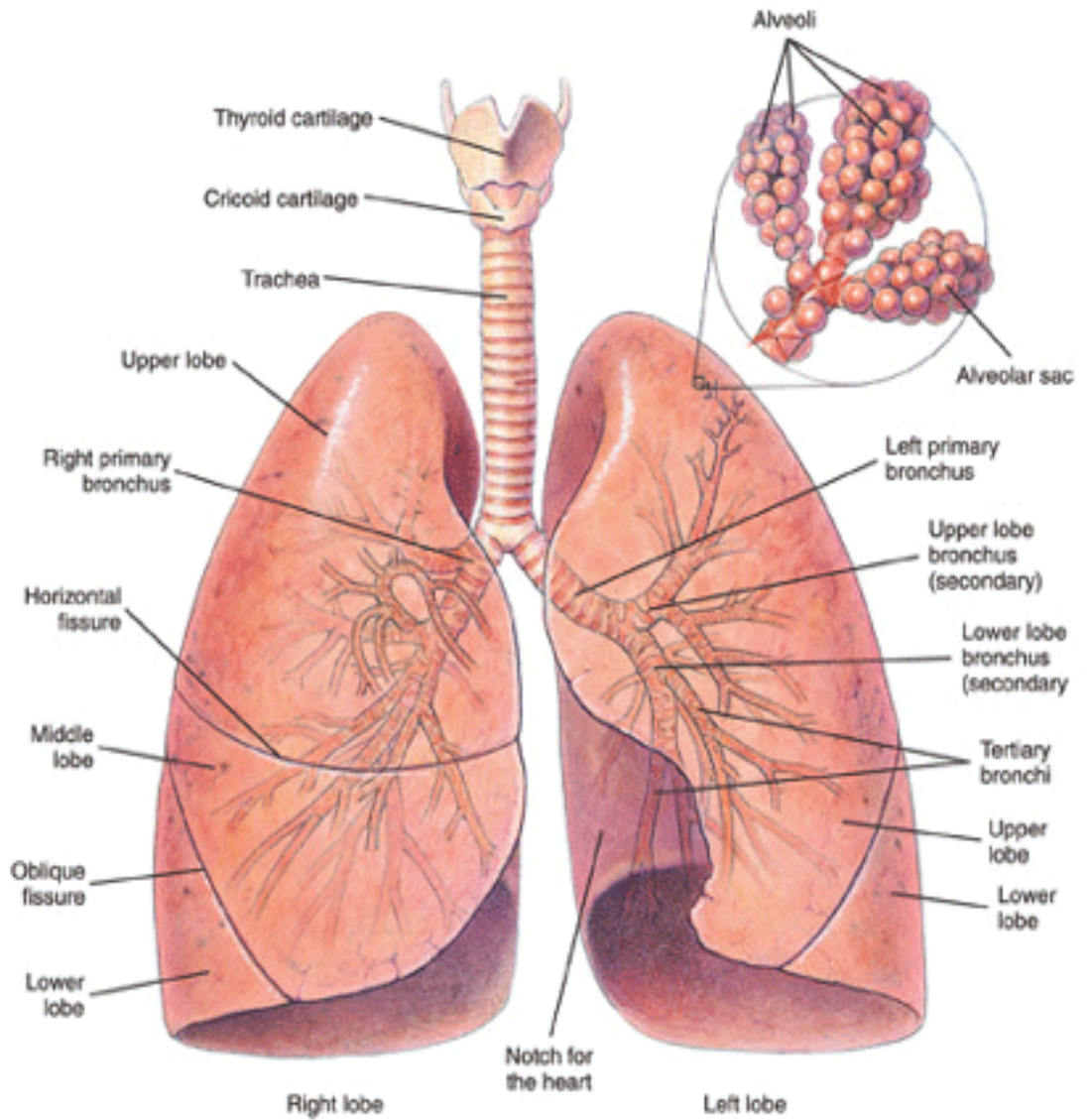
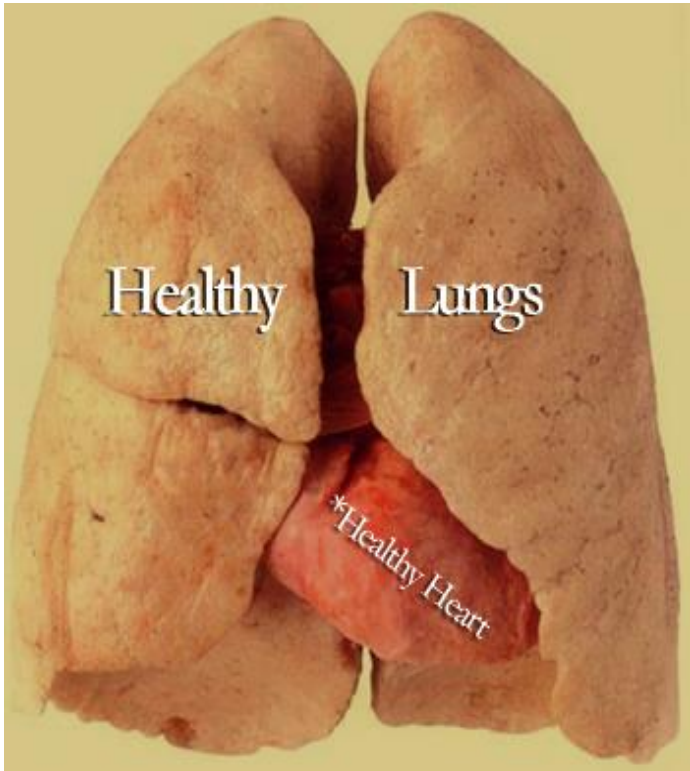
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# ***First Practical Session***

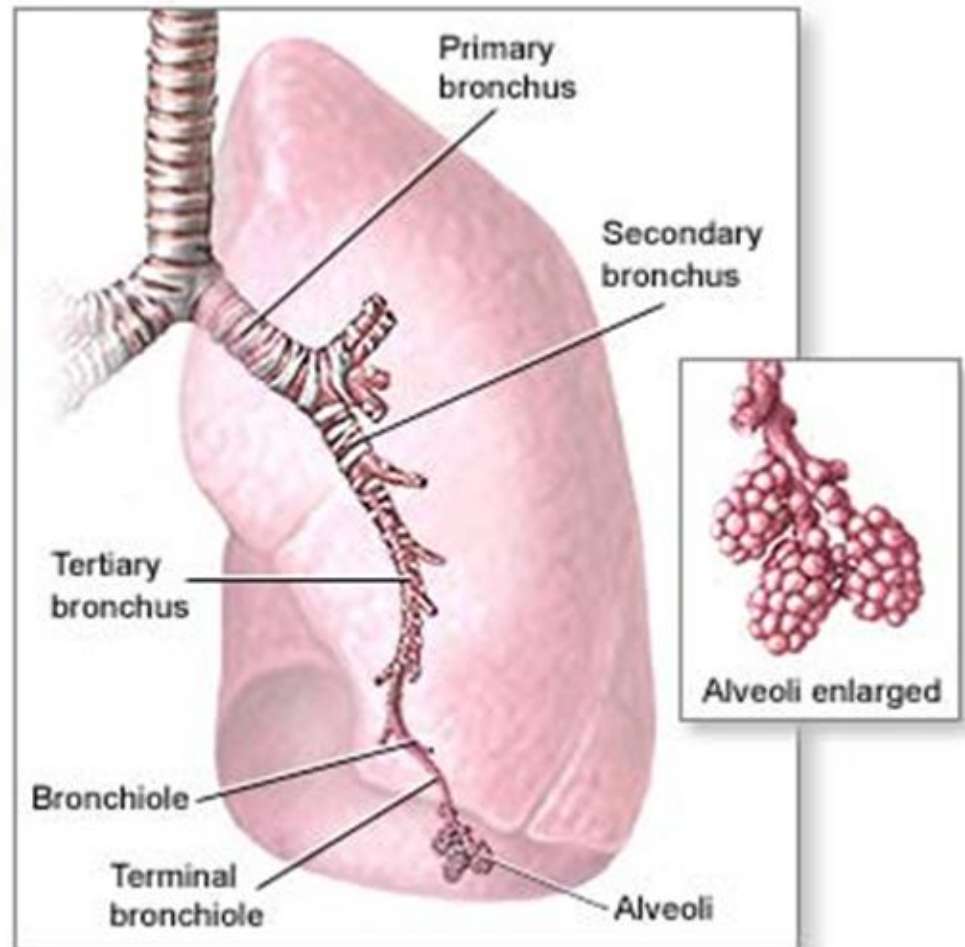
- **Allergic Alveolitis**
- **Bronchial asthma**
- **Bronchiectasis**
- **Chronic Bronchitis**
- **Emphysema**
- **Lobar Pneumonia**
- **Bronchopneumonia**
- **Pulmonary Embolus & Infarction**

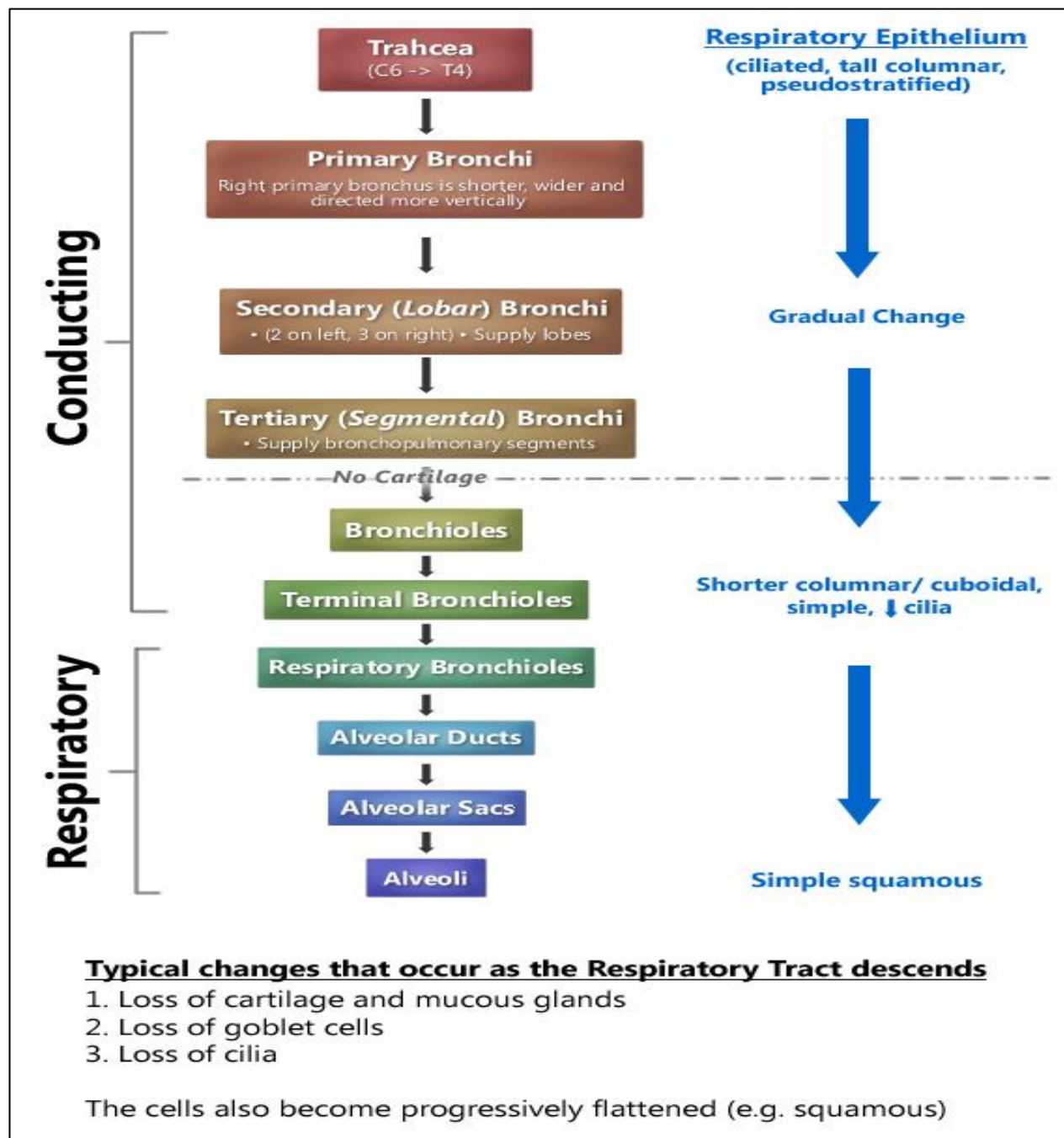
# Anatomy of the Respiratory System



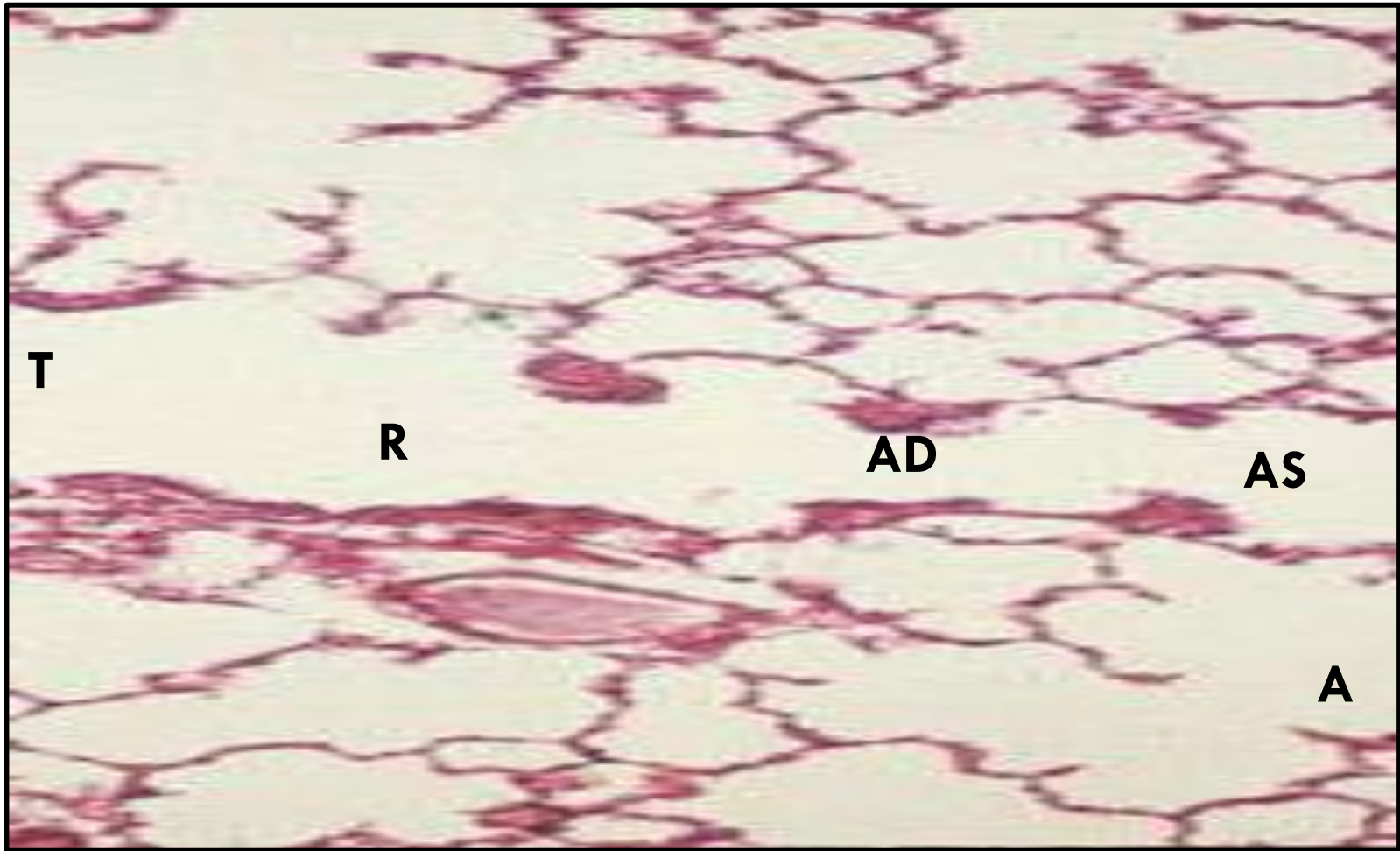
# Lung Anatomy

- **Cartilage is present to the level of proximal bronchioles.**
- **Beyond terminal bronchiole gas exchange occurs.**
- **The distal airspaces are kept open by elastic tension in alveolar walls.**



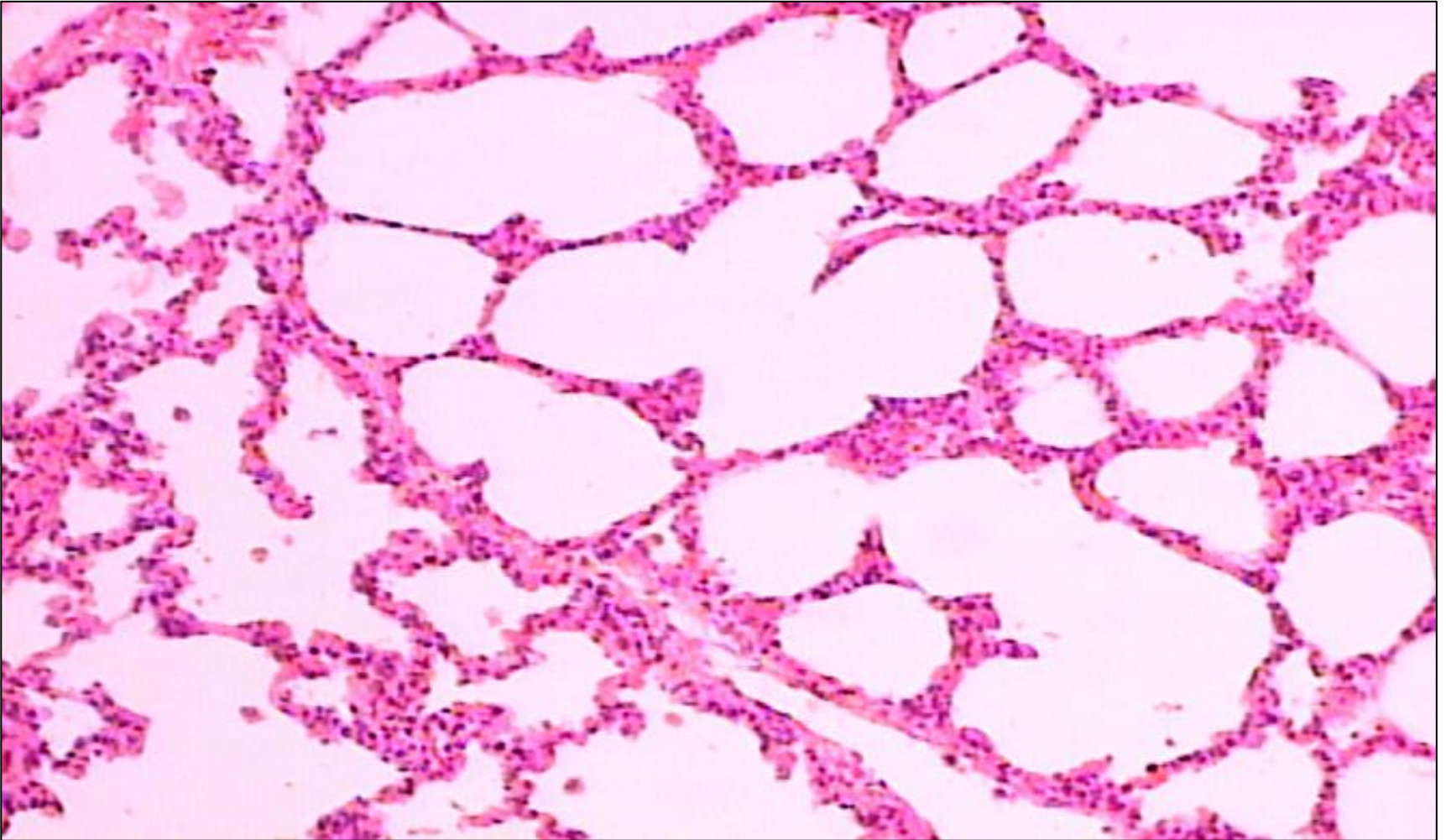


## Normal Histology of the Lungs



**Microscopic section of normal lung showing terminal bronchiole (T) , respiratory bronchiole (R), alveolar duct (AD), alveolar sac (AS), and alveoli (A).**

## Normal Histology of the Lungs - Alveoli



**Normal Alveoli:** These oval-shaped alveoli expand with air during inspiration, have very thin epithelial walls and are surrounded by capillaries creating the respiratory membrane where gas exchange occurs between air and blood

# Classification of Respiratory Diseases

## 1. Inflammatory lung diseases:

(Asthma, cystic fibrosis, & COPD)

## 2. Restrictive lung diseases:

(Allergic Alveolitis)

## 3. Obstructive lung diseases :

(Bronchial Asthma, Bronchiectasis, & (COPD- Ch. Bronchitis & Emphysema ))

## 4. Respiratory tract infections:

-Upper resp. tract infection (sinusitis, tonsillitis, otitis media, pharyngitis & laryngitis )

-Lower resp. tract infection (Pneumonia & Bronchopneumonia , T.B.)

## 5. Malignant tumors (Squamous CC, adenocarcinoma, Large CC & Small CC)

## 6. Benign tumors (Pulmonary hamartoma, pulmonary sequestration)

## 7. Pleural cavity diseases ( eg. Mesothelioma, effusion )

## 8. Pulmonary vascular diseases (Embolism, edema & hypertension)

## 9. Neonatal diseases (pulmonary hyperplasia.)



# ***RESTRICTIVE LUNG DISEASES***

## ***ALLERGIC ALVEOLITIS***

## ***Restrictive Lung Disease (Honeycomb lung) – Gross***



- ***Represent 15% of non-infectious diseases of lungs.***
- ***End-stage: diffuse interstitial pulmonary fibrosis (Honeycomb lung).***
- ***Acute: Acute Respiratory Distress Syndrome***
- ***Chronic : Occupational: Asbestosis, silicosis, coal worker pneumoconiosis.***
- ***Interstitial lung disease (interstitial pneumonia), Idiopathic pulmonary fibrosis.***

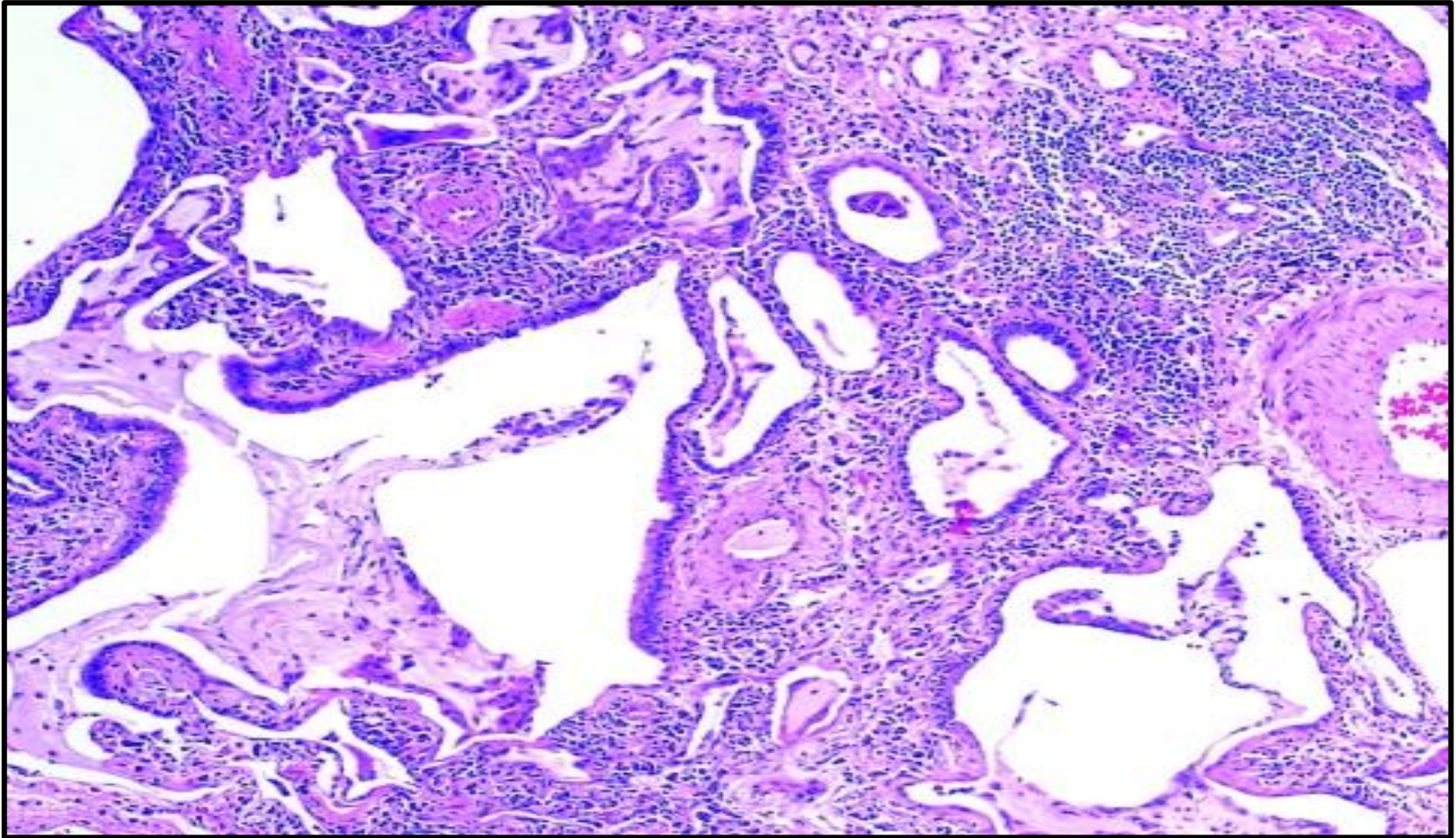
## ***Restrictive Lung Disease (Honeycomb lung) – Cut section***



***“Honeycomb” lung. (extensive fibrosis from restrictive lung disease)***

***The gross appearance, as seen here in a patient with organizing diffuse alveolar damage***

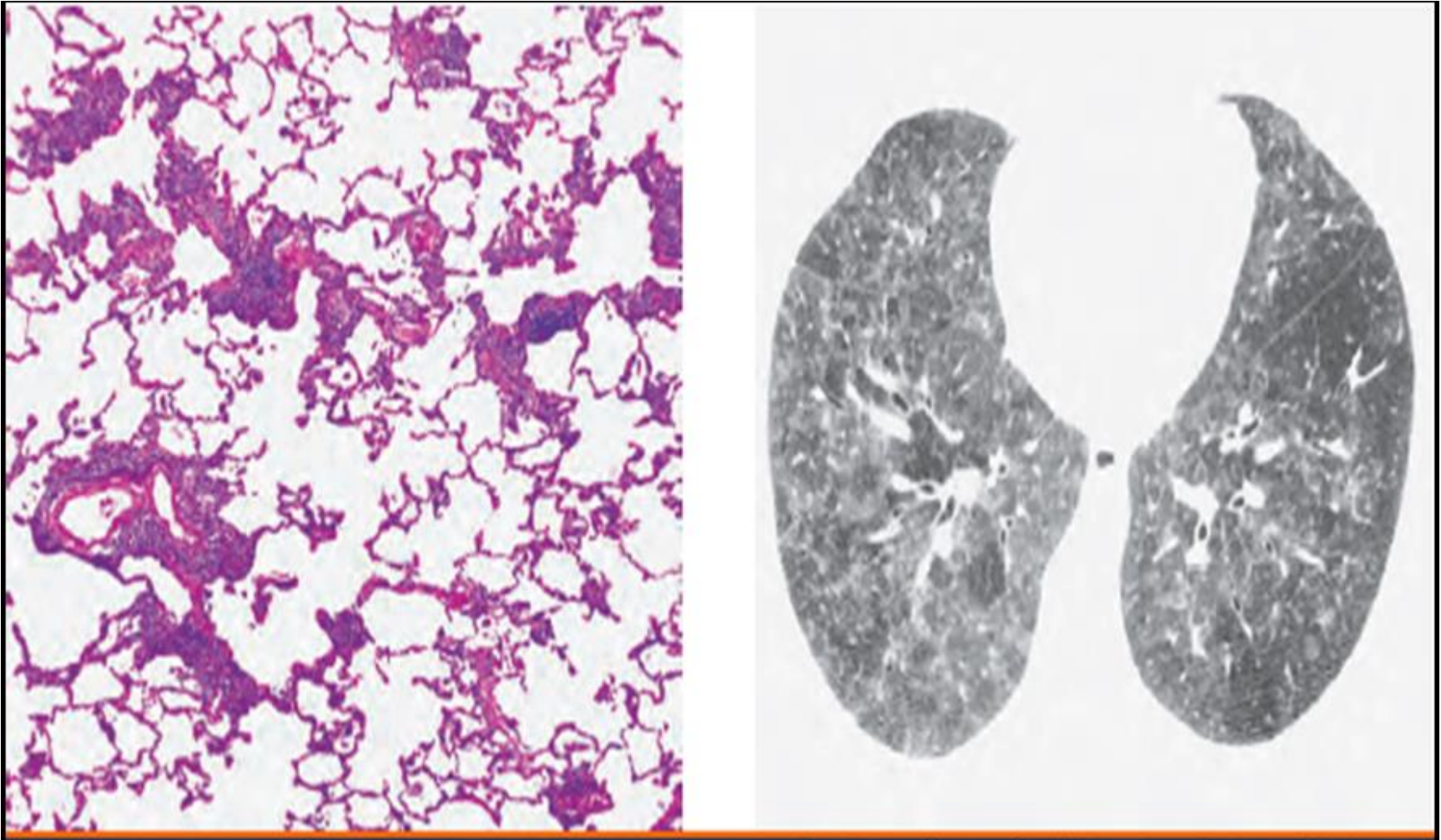
## **Restrictive Lung Disease (Honeycomb lung) – LPF**



### **Restrictive Lung Disease**

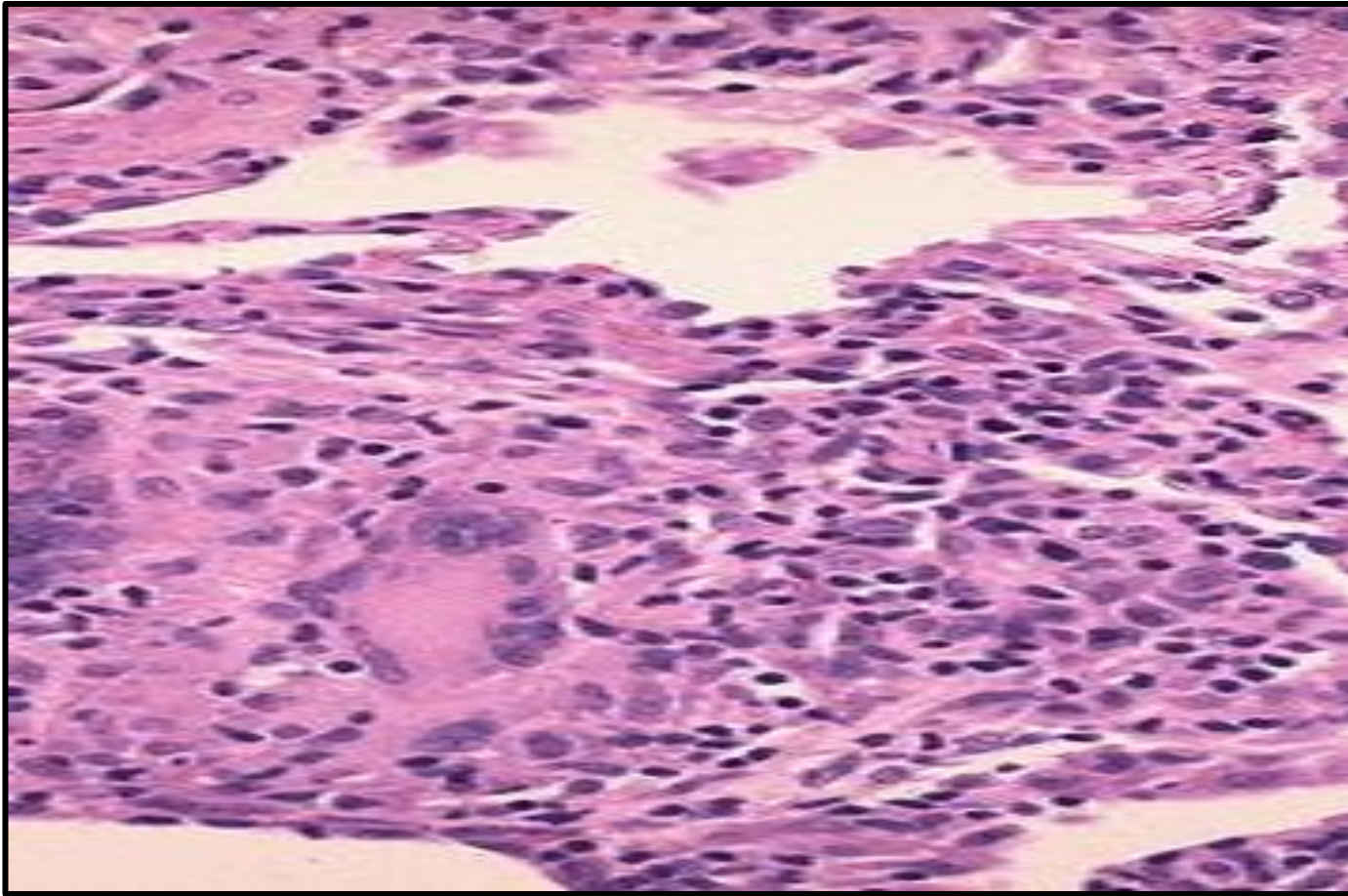
***Pulmonary fibrosis with extensive interstitial collagen deposition, minimal lymphocytic infiltrates, and residual airspace dilation.***

## Hypersensitivity Pneumonitis— Histopathology & Radiogram



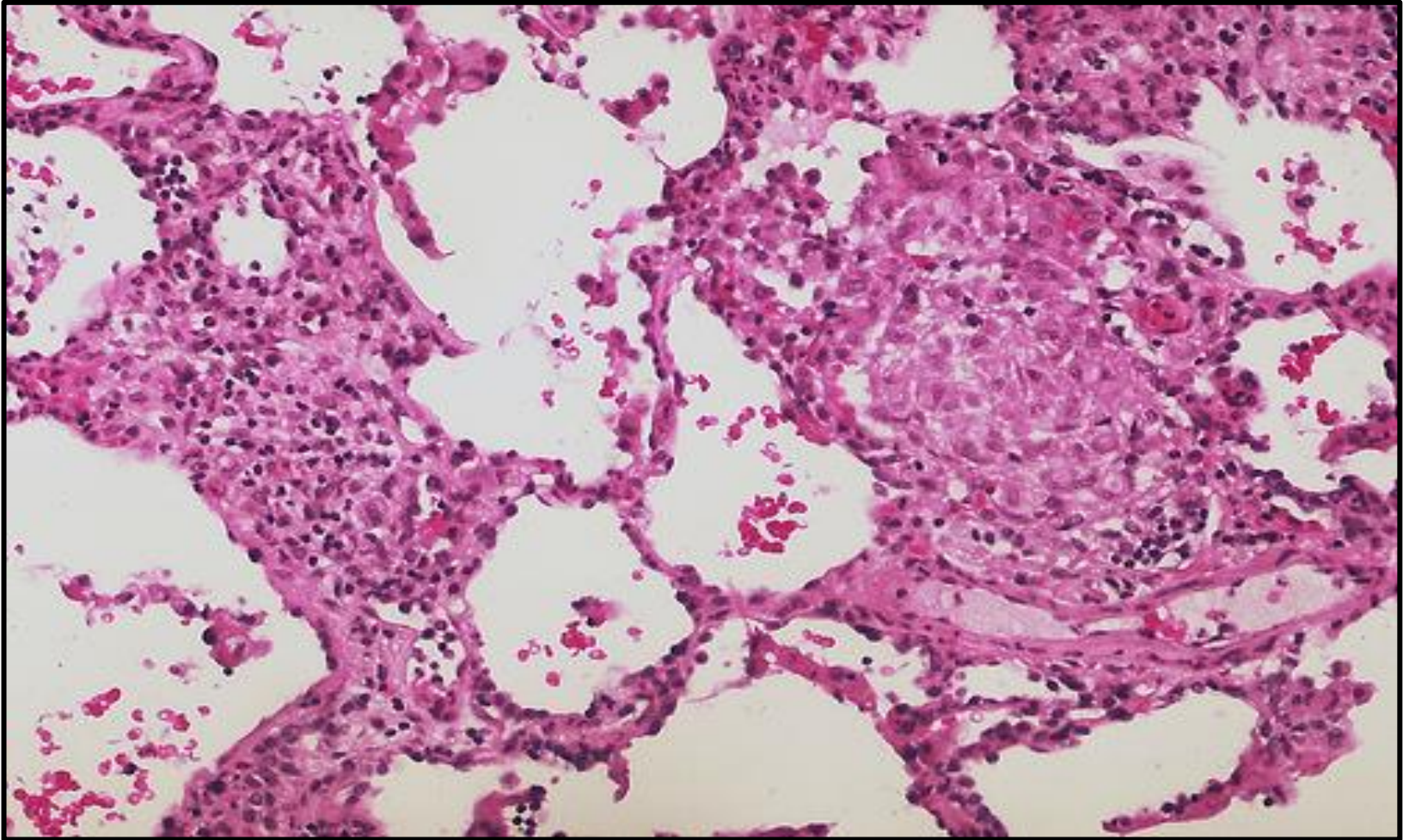
This case of **extrinsic allergic alveolitis** shows **interstitial inflammation along alveolar ducts (bronchiolocentric distribution)**. The inflammation is diffuse, lacks nodularity, and manifests radiologically as a ground-glass pattern

## **Hypersensitivity Pneumonitis ( HP)**



***Interstitial bronchiolocentric pneumonitis (Extrinsic allergic alveolitis) with lymphocytes, plasma cells and foamy macrophages in alveolar space and terminal airways . Interstitial fibrosis, obliterative bronchiolitis and intra-alveolar exudate . Nodules of organizing fibroblasts, histiocytes and other inflammatory cells***

## **Hypersensitivity Pneumonitis (HP)**



***Interstitial fibrosis, lymphocyte infiltration in the alveolar wall, mainly collagen fibers hyperplasia, especially in the bronchioles due to their respective muscle fibers and endothelial cell proliferation and thickening***

# ***OBSTRUCTIVE LUNG DISEASES***

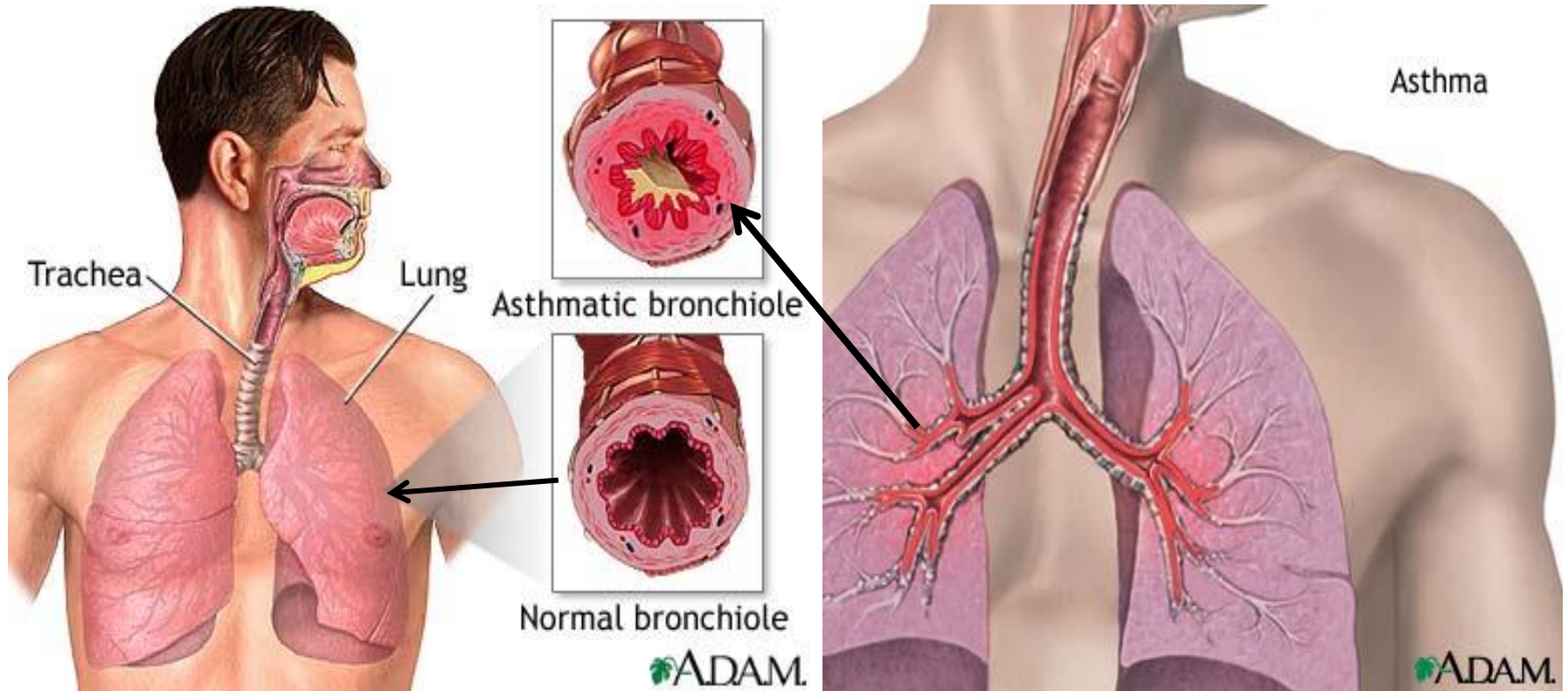


- 1. Bronchial Asthma**
- 2. Bronchiectasis**
- 3. COPD :**  
***(Chronic Bronchitis & Emphysema)***



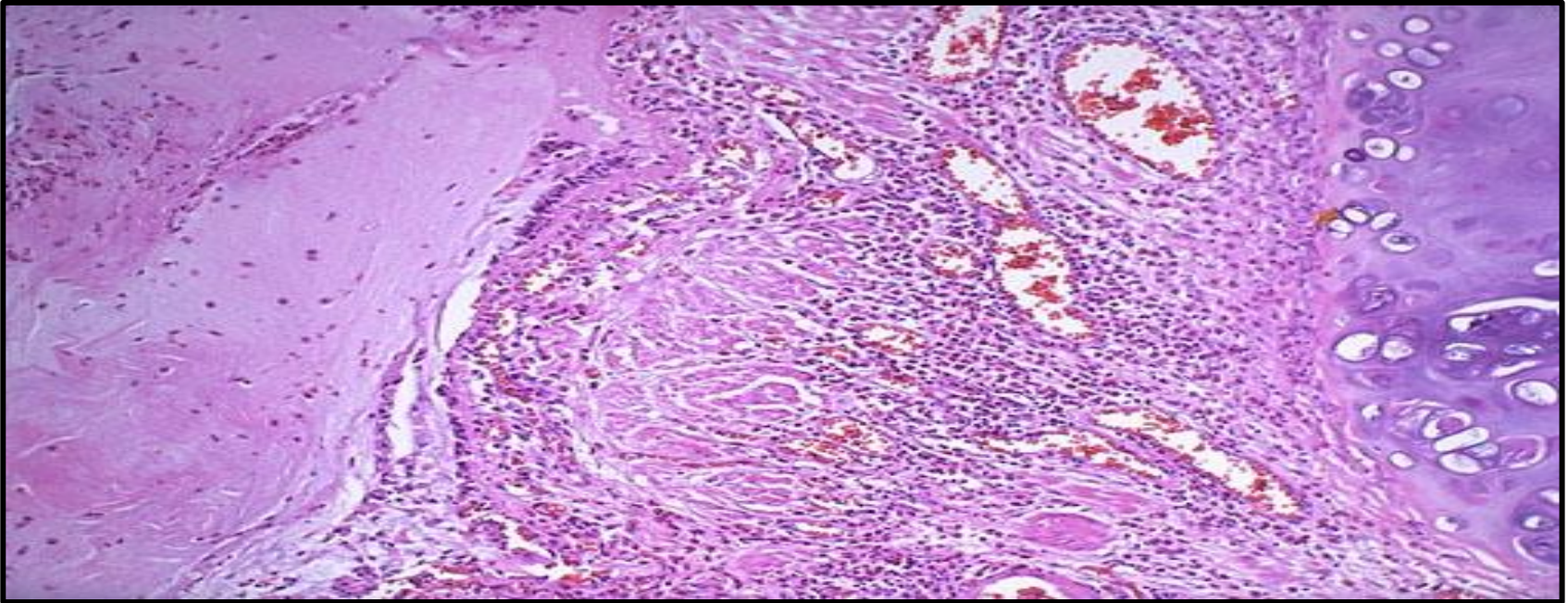
# 1. BRONCHIAL ASTHMA

# BRONCHIAL ASTHMA - Anatomy



**Bronchial Asthma:** Inflammation of the airways causes airflow into and out of the lungs to be restricted. The muscles of the bronchial tree become tight and the lining of the air passages swells, reducing airflow and producing the characteristic wheezing sound

## BRONCHIAL ASTHMA - LPF

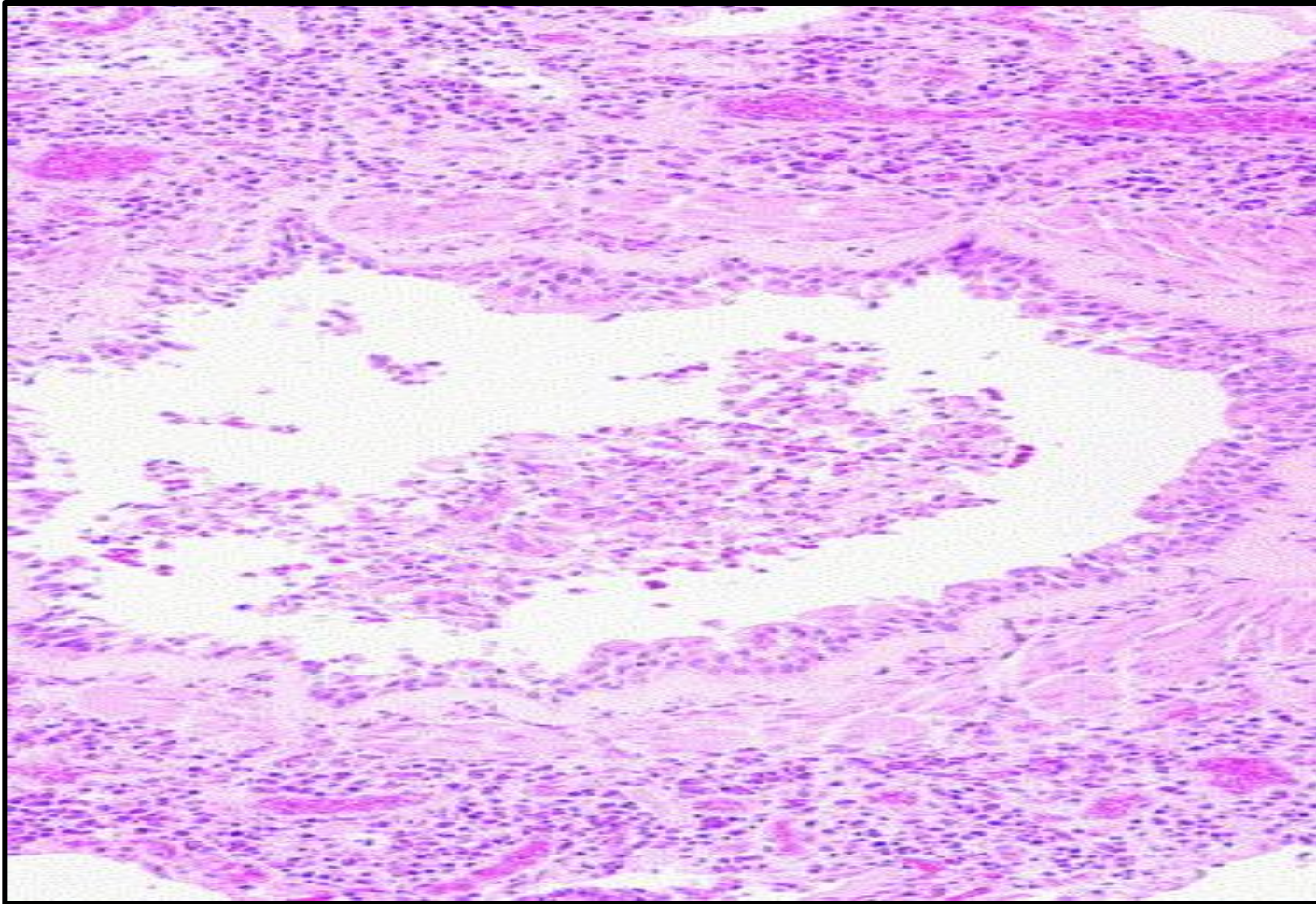


***Between the bronchial cartilage at the right and the bronchial lumen filled with mucus at the left is a submucosa widened by smooth muscle hypertrophy, edema, and inflammation (mainly eosinophils). These are changes of bronchial asthma.***

**Other pathologic morphological changes that can occur in asthma as a result of airway remodeling:**

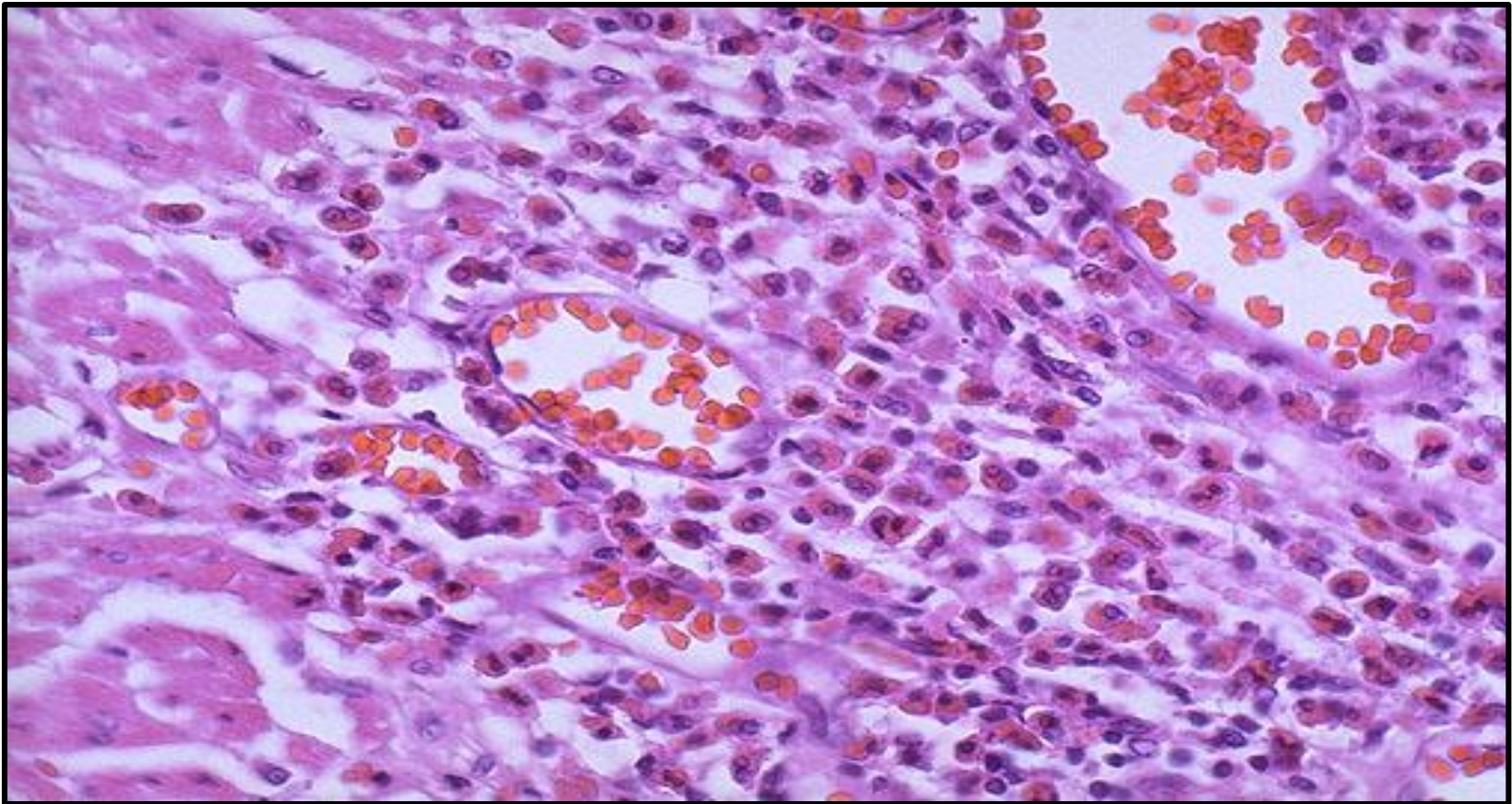
- Sub-basement membrane fibrosis and thickening.***
- Hypertrophy of bronchial glands and smooth muscles.***
- Increased submucosal vascularity.***

## BRONCHIAL ASTHMA - LPF



***Bronchus from a fatal case of bronchial asthma in a 4-year-old child. There is partial plugging of the lumen, an intense inflammatory infiltrate and vascular congestion.***

## BRONCHIAL ASTHMA - HPF

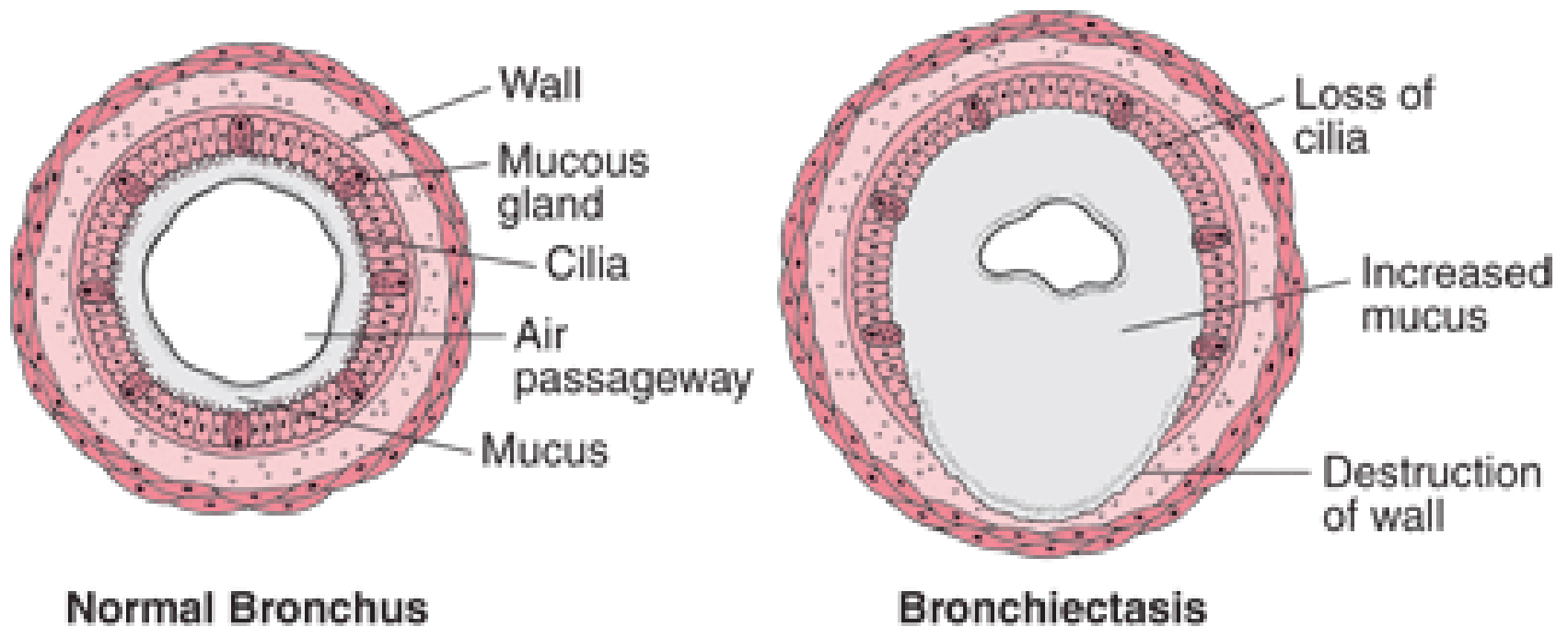


**Numerous eosinophils** are prominent from their bright red cytoplasmic granules in this case of bronchial asthma

Several “Needle-like” structures/crystals **known as Charcot Leyden Crystals** can be seen in the sputum of these patients.

## **2. BRONCHIECTASIS**

## Diagram of Normal & Bronchiectatic Bronchus



***In Bronchiectasis, mucus production increases, the cilia are destroyed or damaged, and areas of the bronchial wall become chronically inflamed and are destroyed.***

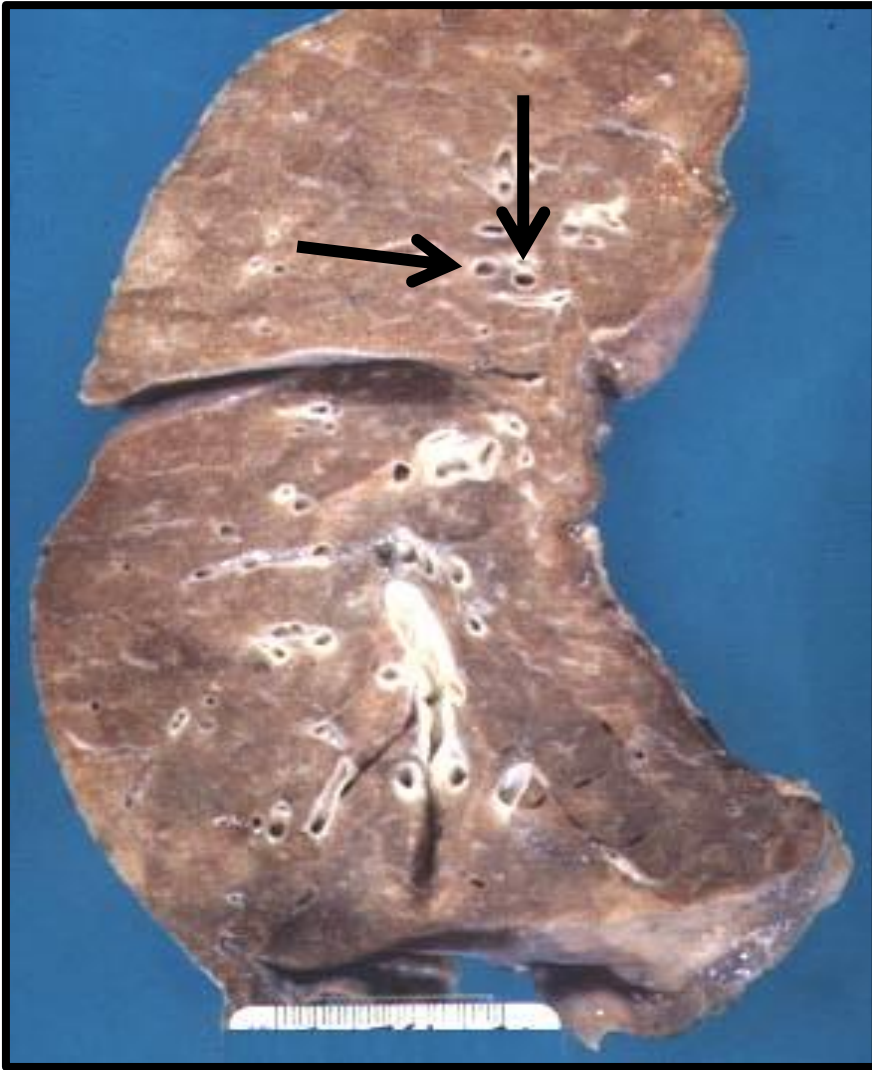
## Bronchiectasis – Gross pathology & Colored X-ray



**Permanent dilatation of bronchi and bronchioles caused by *destruction of muscle and elastic tissue resulting from or associated with chronic necrotizing infection* -Markedly distended peripheral bronchi.**



## Bronchiectasis – Gross pathology



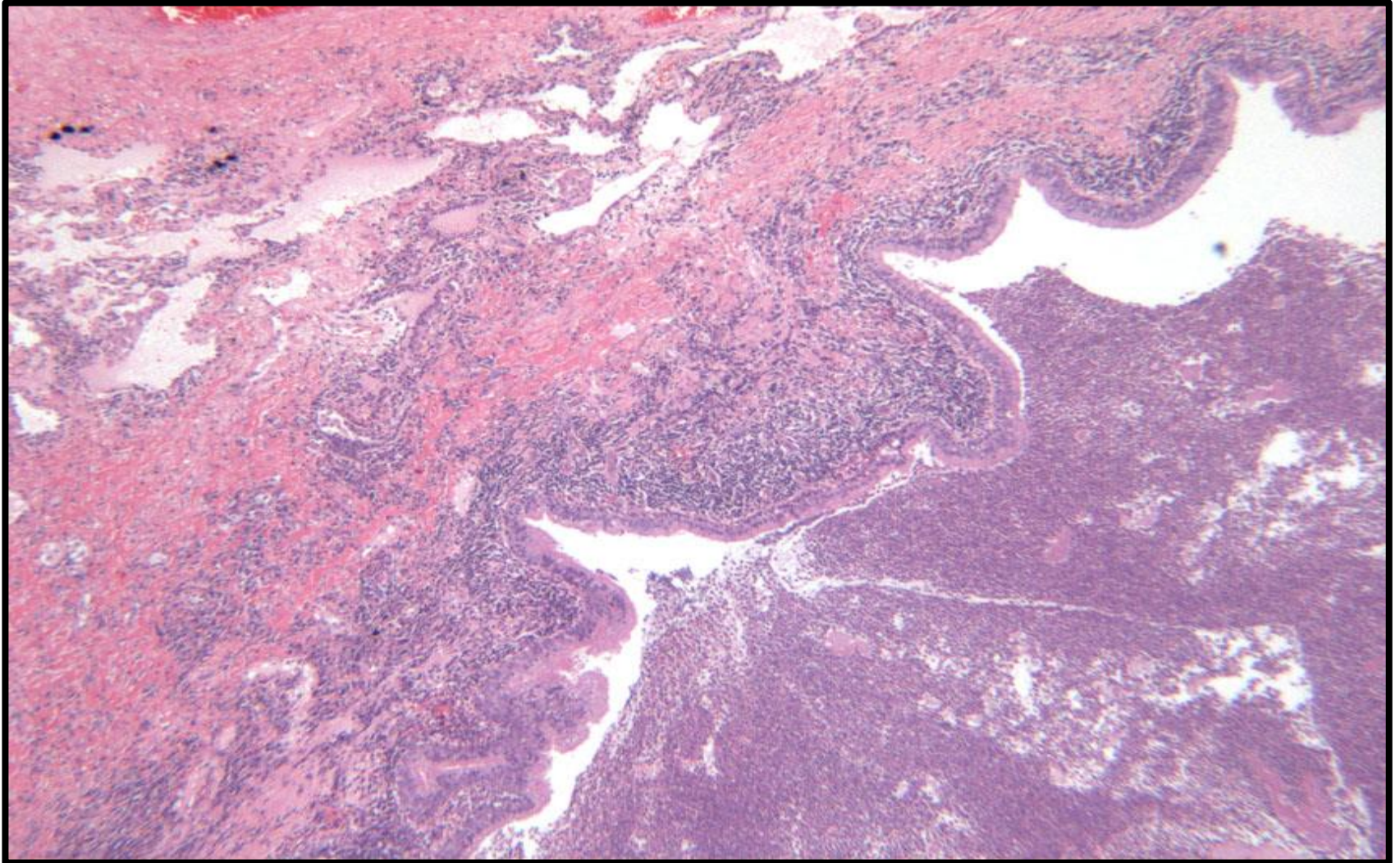
***Bronchiectasis occurs when there is obstruction or infection with inflammation and destruction of bronchi so that there is permanent dilation.***

## Bronchiectasis – Gross pathology



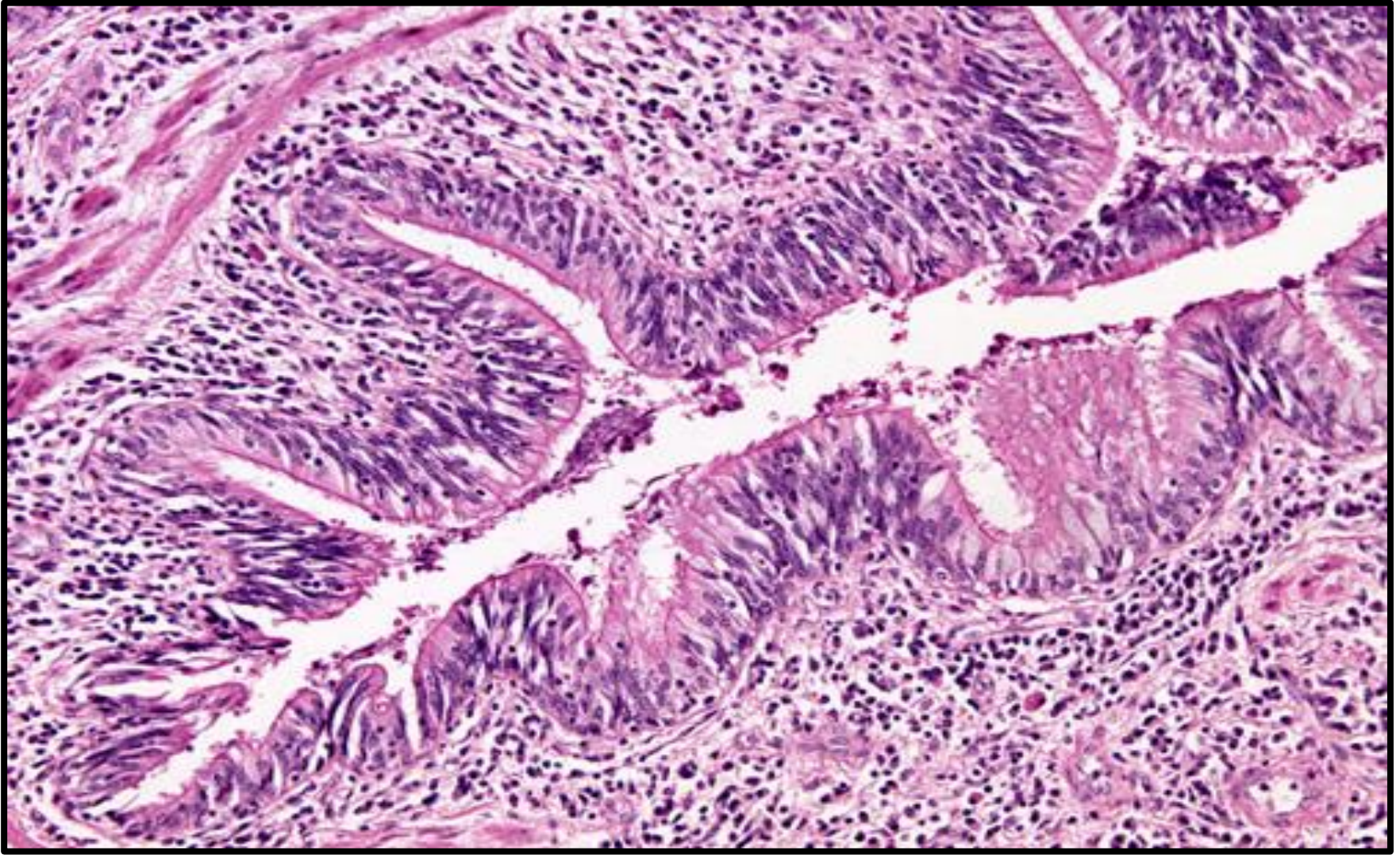
***Bronchiectasis is seen here. The repeated episodes of inflammation can result in scarring, which has resulted in fibrous adhesions between the lobes. Fibrous pleural adhesions are common in persons who have had past episodes of inflammation of the lung that involve the pleura.***

## **Bronchiectasis – LPF**



***Section of a dilated bronchus with florid acute on chronic inflammation of the bronchial wall and surrounding interstitial fibrosis.***

## Bronchiectasis – HPF



**Chronic inflammation, ulceration of bronchial wall, ossification of bronchial cartilage, thickened pleura . Variable inflammation and fibrosis of alveoli**

# **Chronic Obstructive Pulmonary Diseases (COPD)**

**also known as**

**Chronic Obstructive Lung Disease (COLD),  
Chronic Obstructive Airway Disease (COAD),  
Chronic Obstructive Respiratory Disease (CORD)**

**Include:**

**3. Chronic Bronchitis**

**4. Emphysema,**

**a pair of commonly co-existing diseases of the  
lungs in which the airways narrow over time.**

# 3. CHRONIC BRONCHITIS

## Normal vs Chronic bronchitis

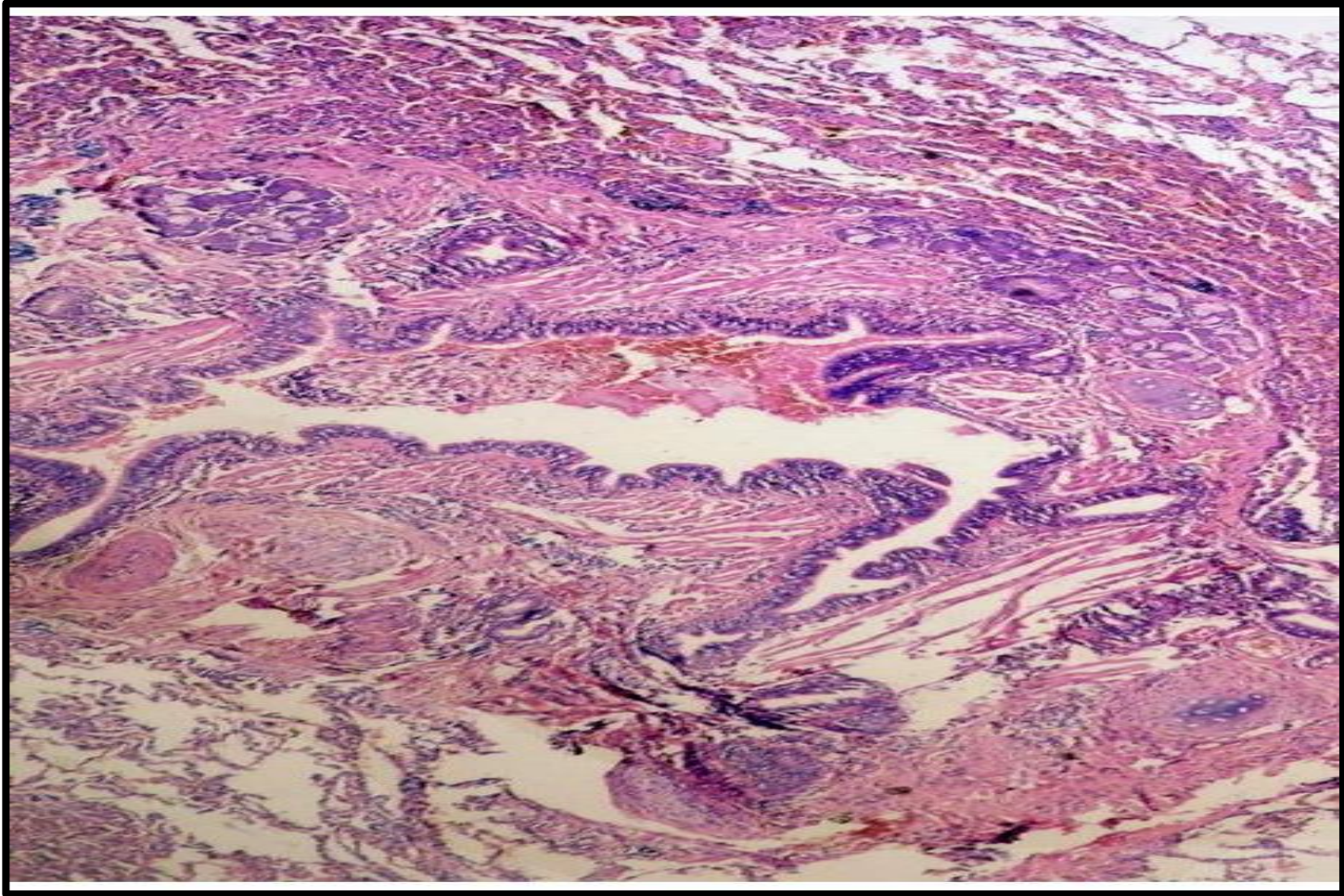


Normal



Chronic Bronchitis

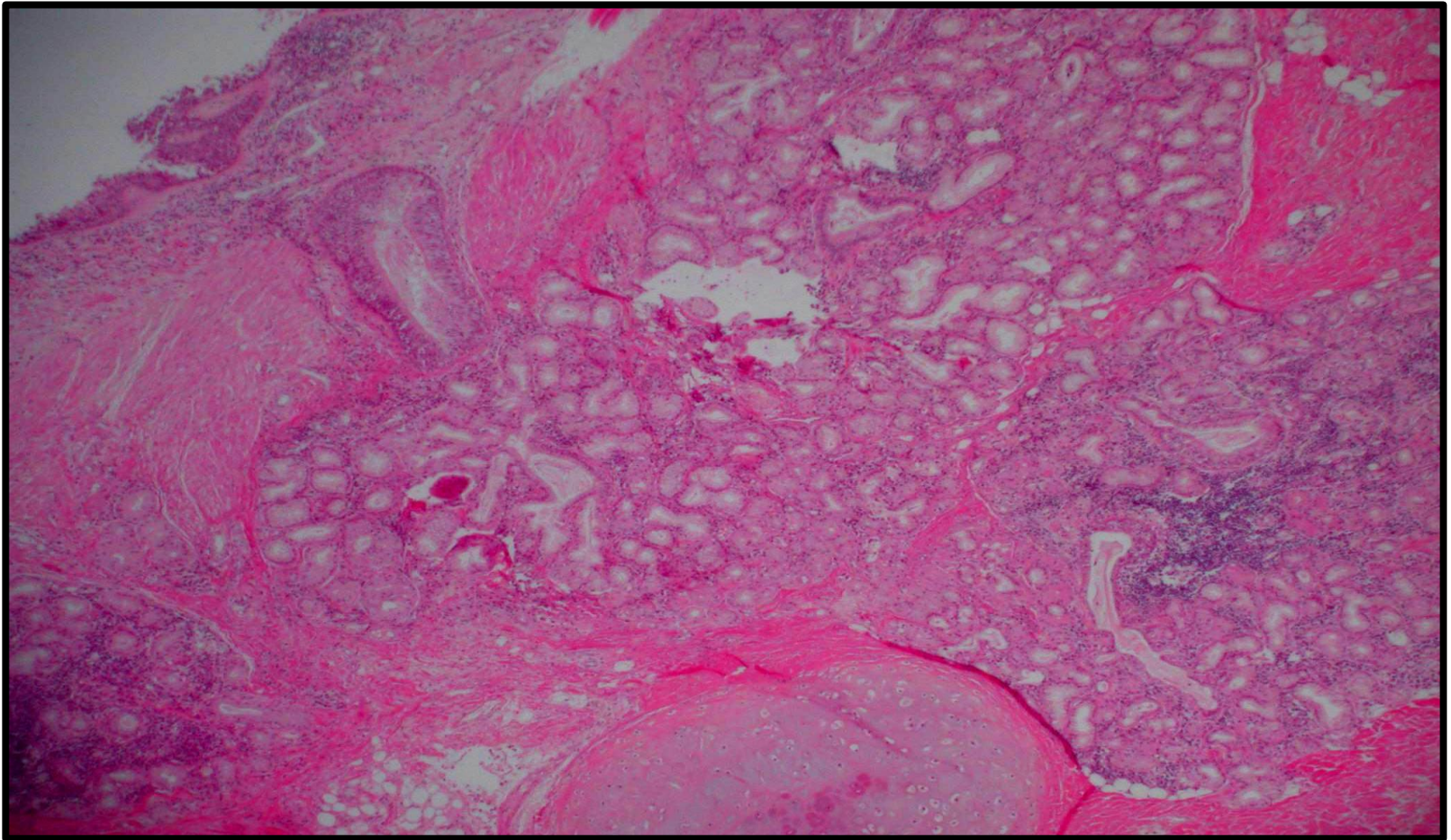
## Chronic Bronchitis - LPF



***Inflammatory infiltrate in bronchial walls is composed of lymphocytes and plasma cells. In the lumen desquamated epithelial cells (catarrhal inflammation) .In mucosa often occurs mataplasia of cylindric cilliated epithelium into multilayered squamous epithelium. Goblet cells are hyperplastic, hyperplastic are also the sero-mucous glands in the submucosal layer. Muscularis mucosae is hypertrophic***

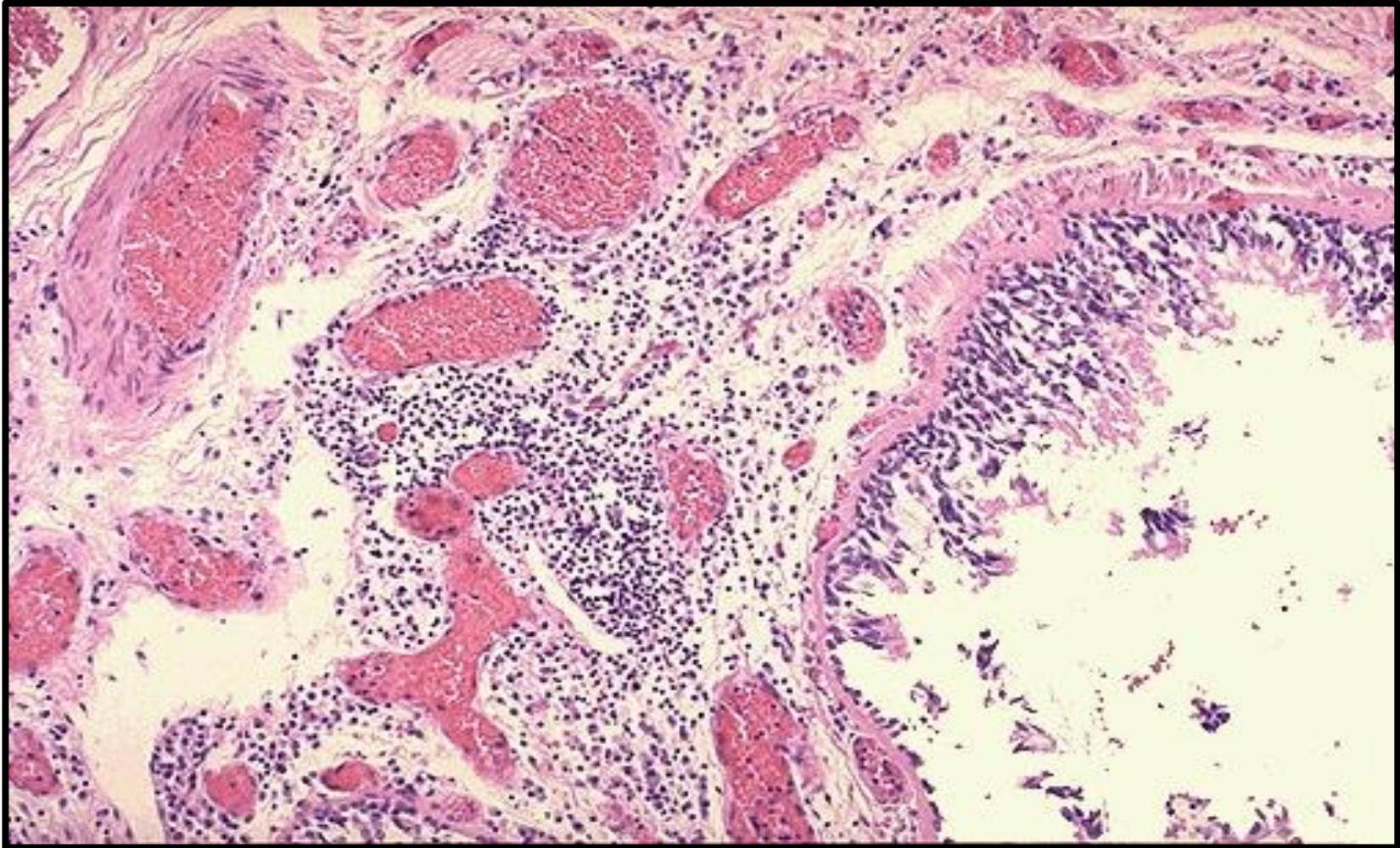


## Chronic Bronchitis - LPF



**Early - hypersecretion of mucus in large airways with hypertrophy of submucosal glands in tracheobronchial tree . Later - increase in goblet cells in small airways contributes to excessive mucus production and airway obstruction .**

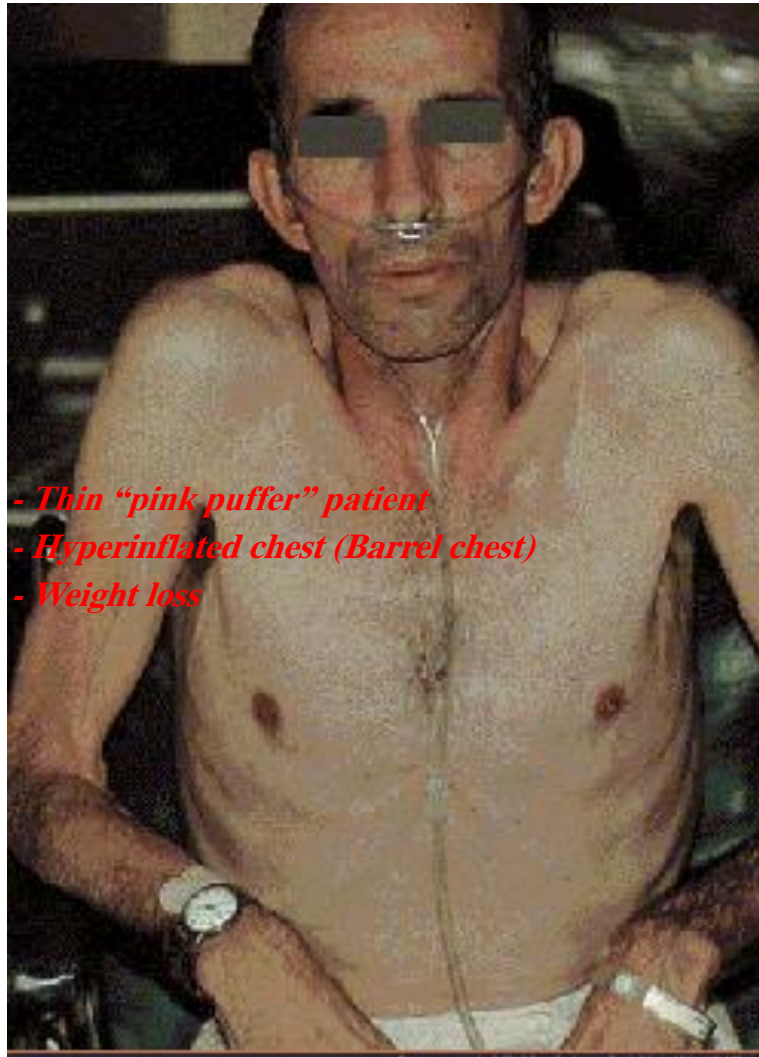
## Chronic Bronchitis - HPF



- **Chronic inflammatory infiltrates range from absent to prominent**  
**Increased percentage of bronchial wall is occupied by submucosal mucous glands, this directly correlates with sputum production, variable dysplasia, squamous metaplasia, bronchiolitis obliterans**

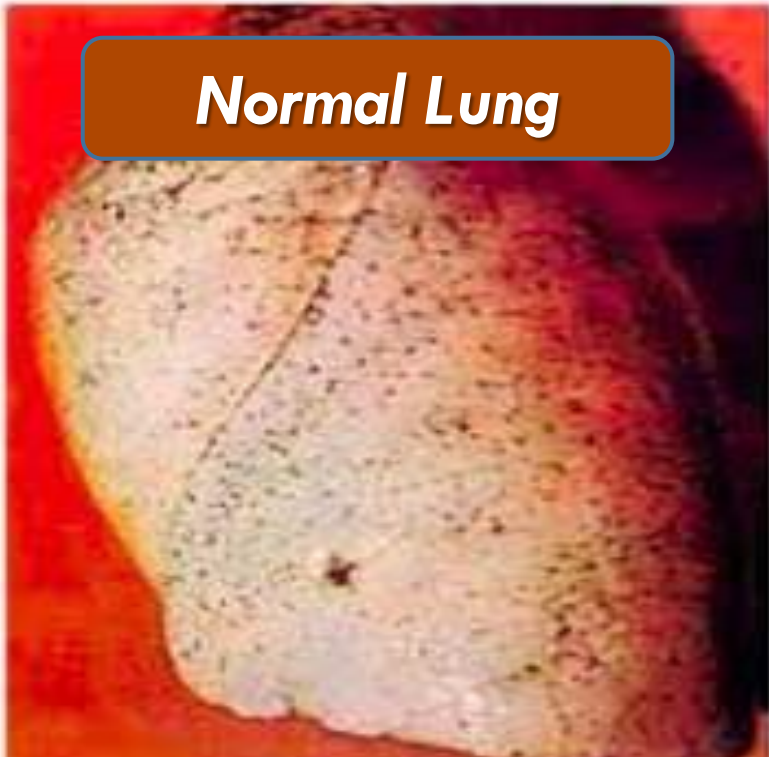
# **4. EMPHYSEMA**

## Emphysema – Clinical Features



- Thin "pink puffer" patient
- Hyperinflated chest (Barrel chest)
- Weight loss

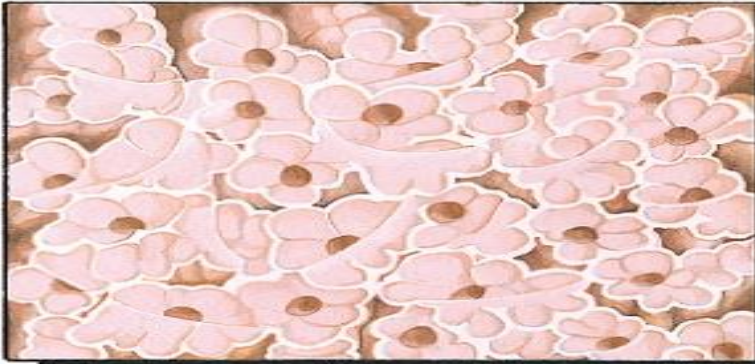
**Emphysema patient (so-called pink puffers) tend to be thin, have hyperinflated chest (Barrel chest) and can have weight loss.**



**Normal Lung**



**Emphysema**



**A**

**Normal Lung**

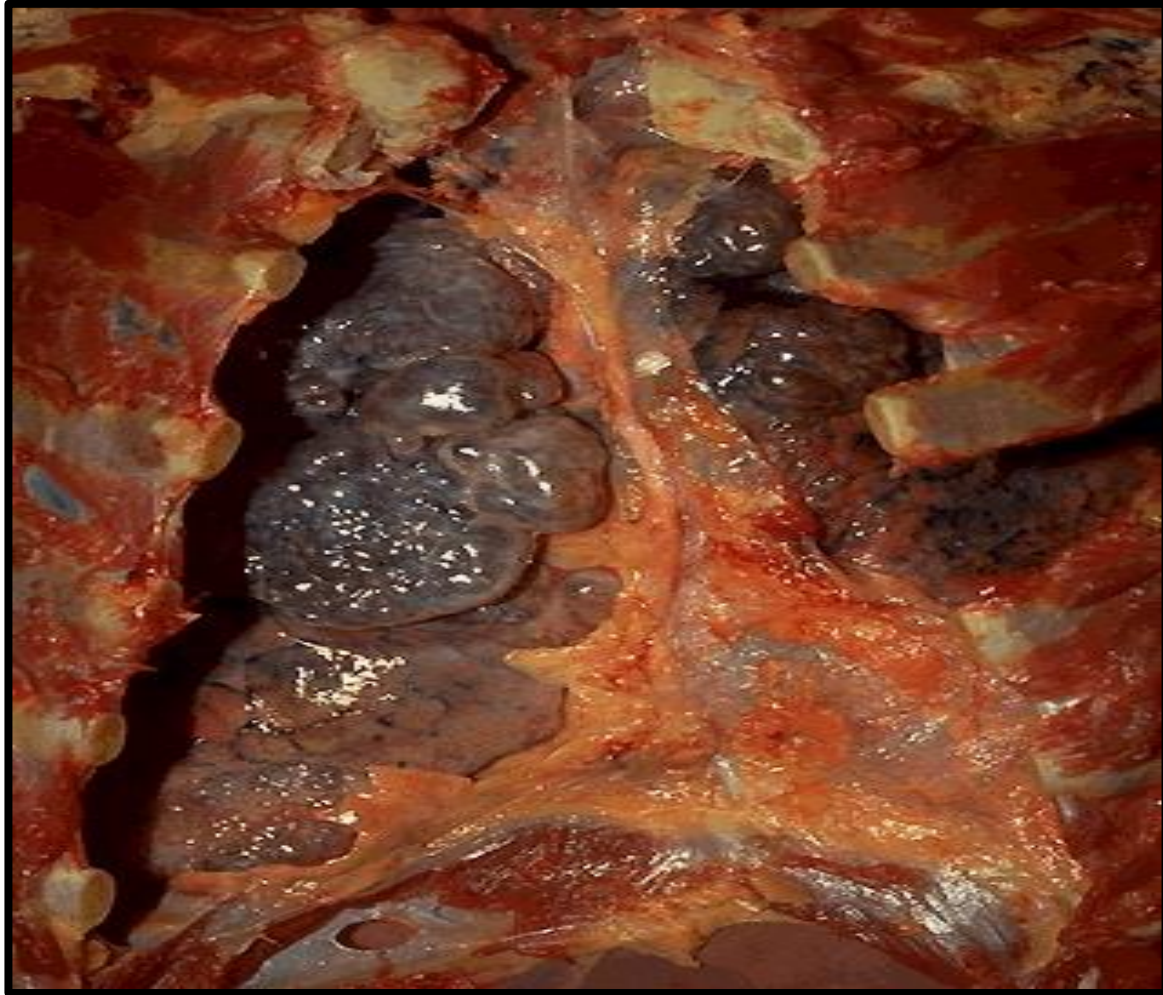


**B**

**Emphysema**

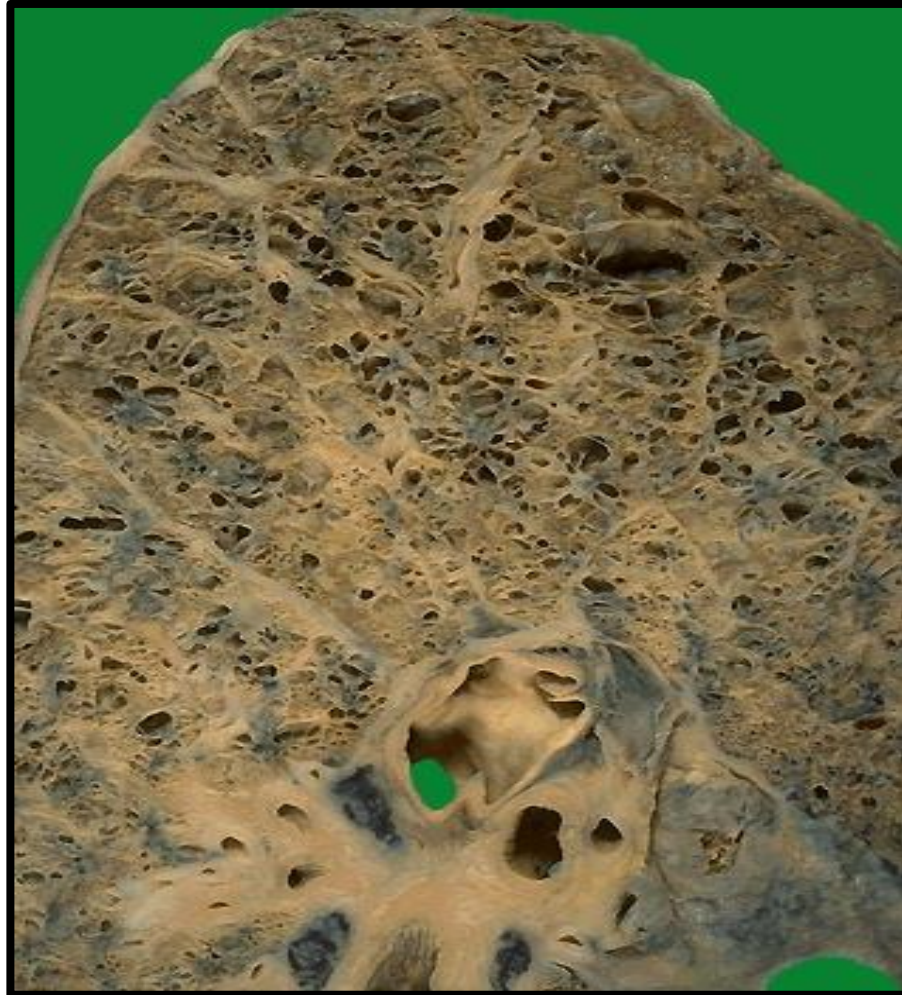
Enzyme deficiency that can lead to this condition- Alpha-1-Antitrypsin deficiency

## **Emphysema – Gross Anatomy**



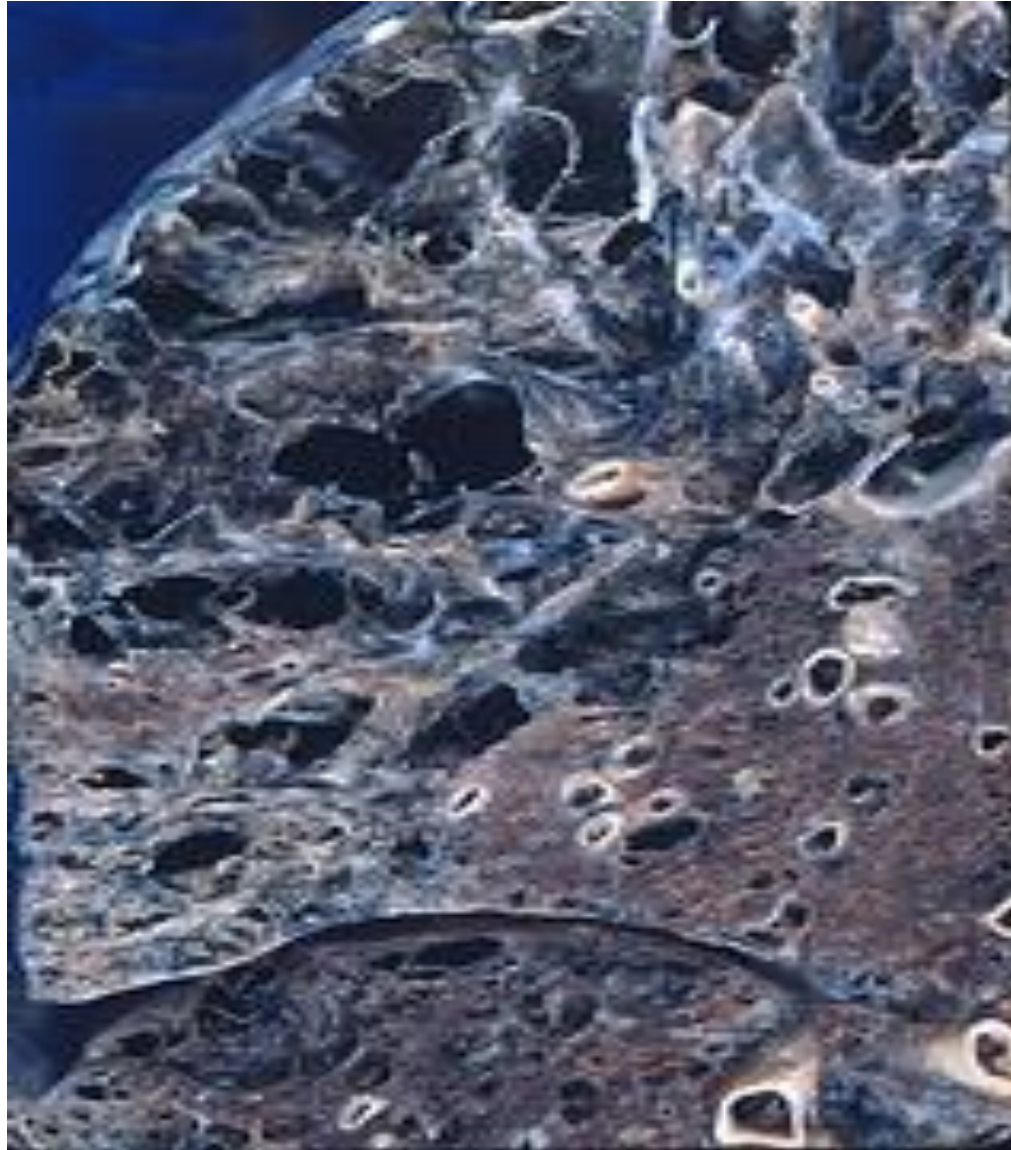
***Numerous large emphysematous bullae apparent on the surface of the lungs. Bullae are large dilated airspaces that bulge out from beneath the pleura.***

## ***Emphysema – Gross pathology***



***Dilated airspaces in emphysematous lung. Although there tends to be some scarring with time because of superimposed infections, the emphysematous process is one of loss of lung parenchyma, not fibrosis***

## ***Bullous Emphysema – Gross pathology***



***A bulla is defined as an emphysematous space larger than 1 cm.***

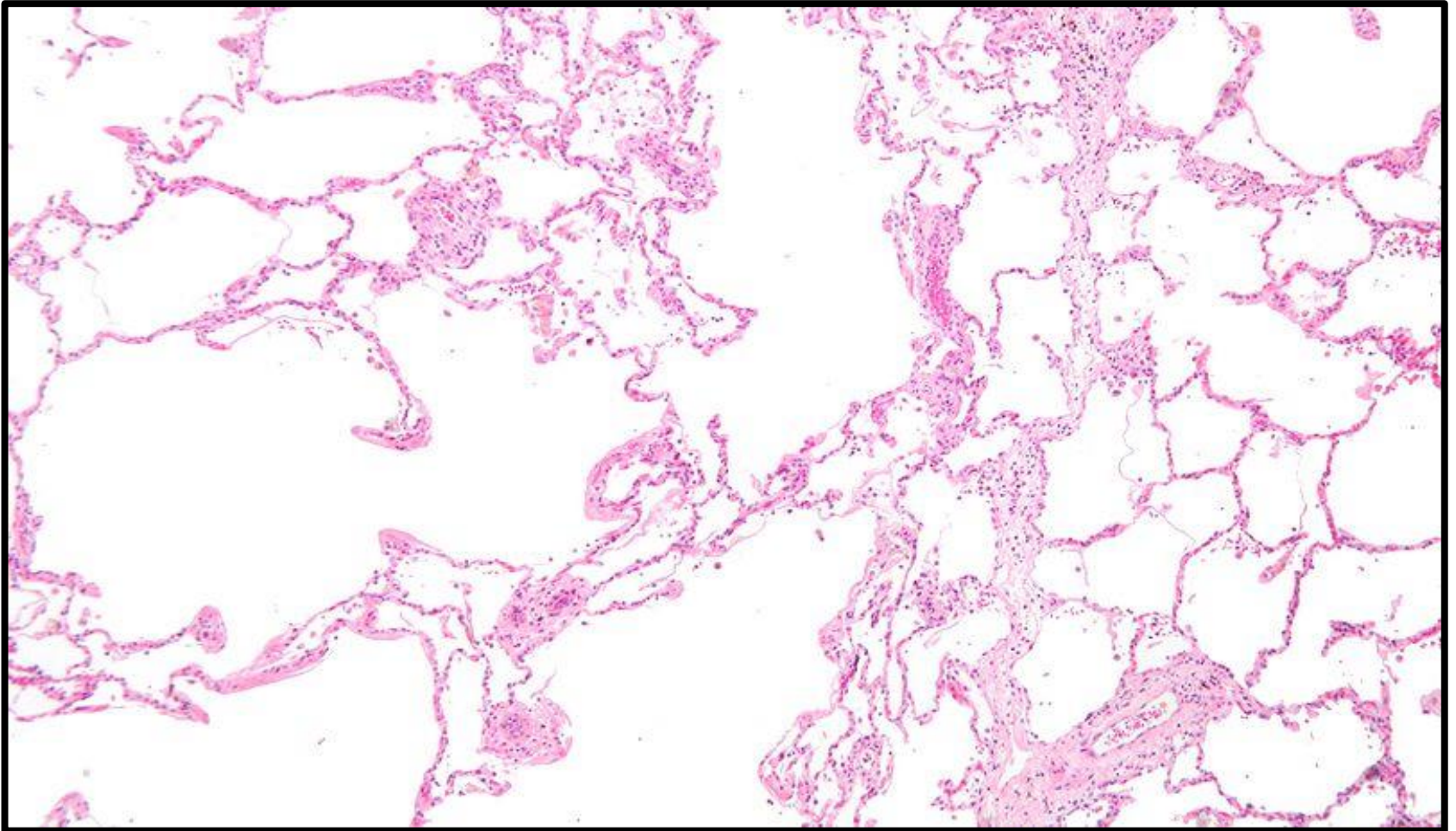


## ***Centrilobular Emphysema – Gross pathology***



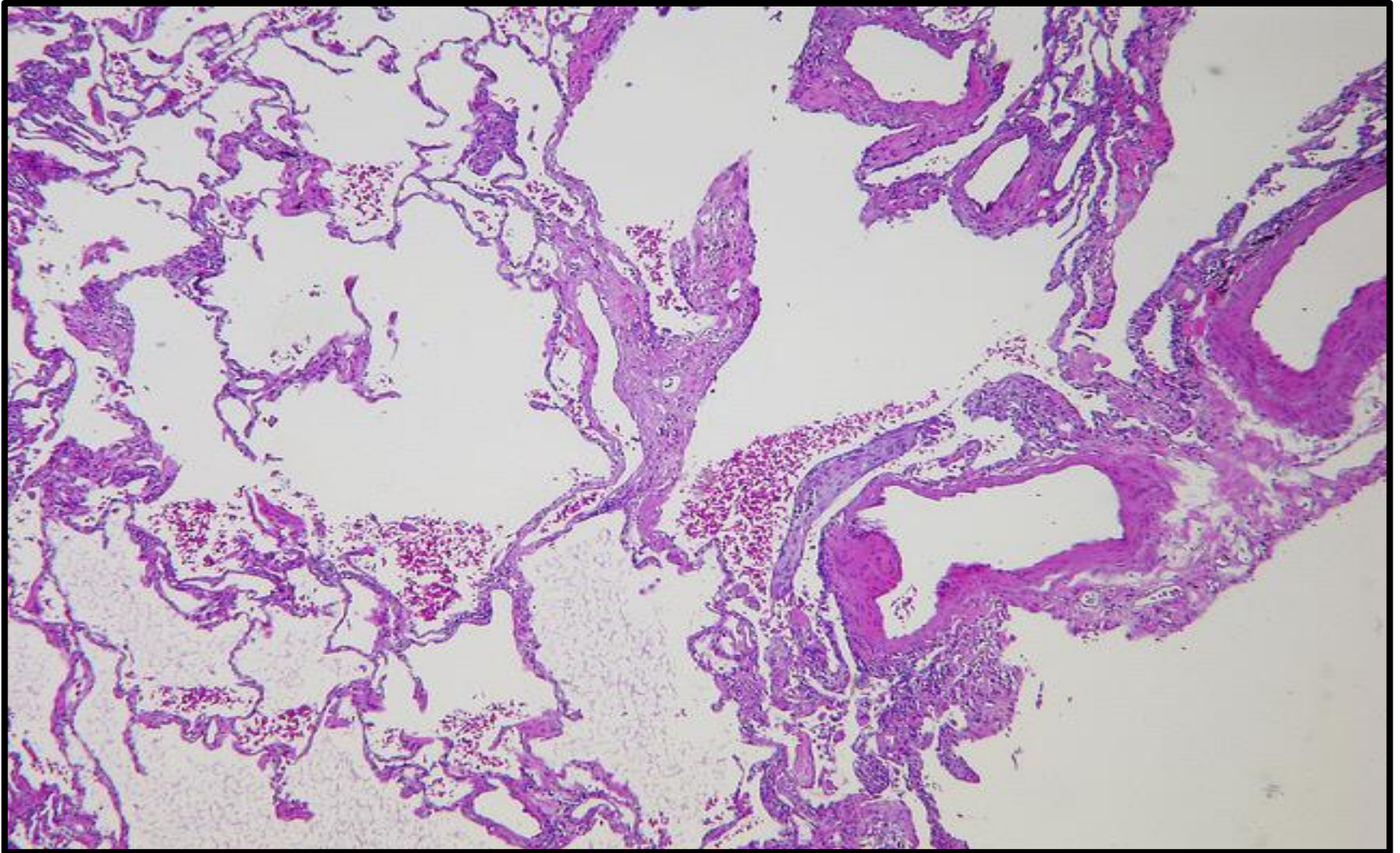
***Centrilobular emphysema : Fixed, cut surface of a lung shows multiple cavities lined by heavy black carbon deposits characteristic of smoking.***

## ***Panacinar Emphysema – LPF***



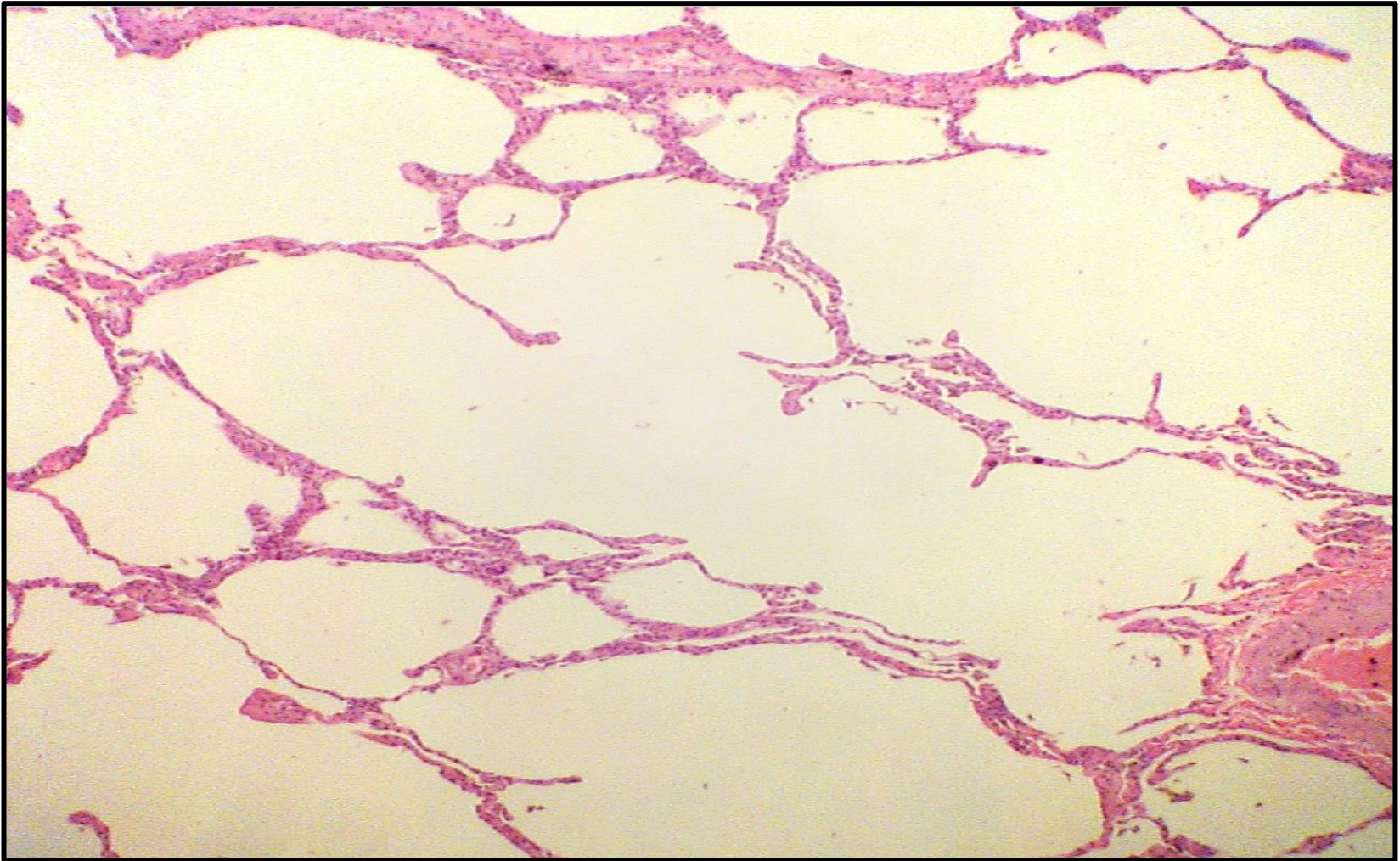
***Some of the alveolar septae are ruptured and the ruptured septa project with in air spaces on the form of spurs.***

## ***Panacinar Emphysema – LPF***



***Some of the alveolar septae are ruptured and the ruptured septa project within air spaces on the form of spurs.***

## ***Panacinar Emphysema - HPF***



***Destruction of tissue leaves emphysematous spaces with little surface area, few capillaries, and large air spaces. Large vessel at lower left***

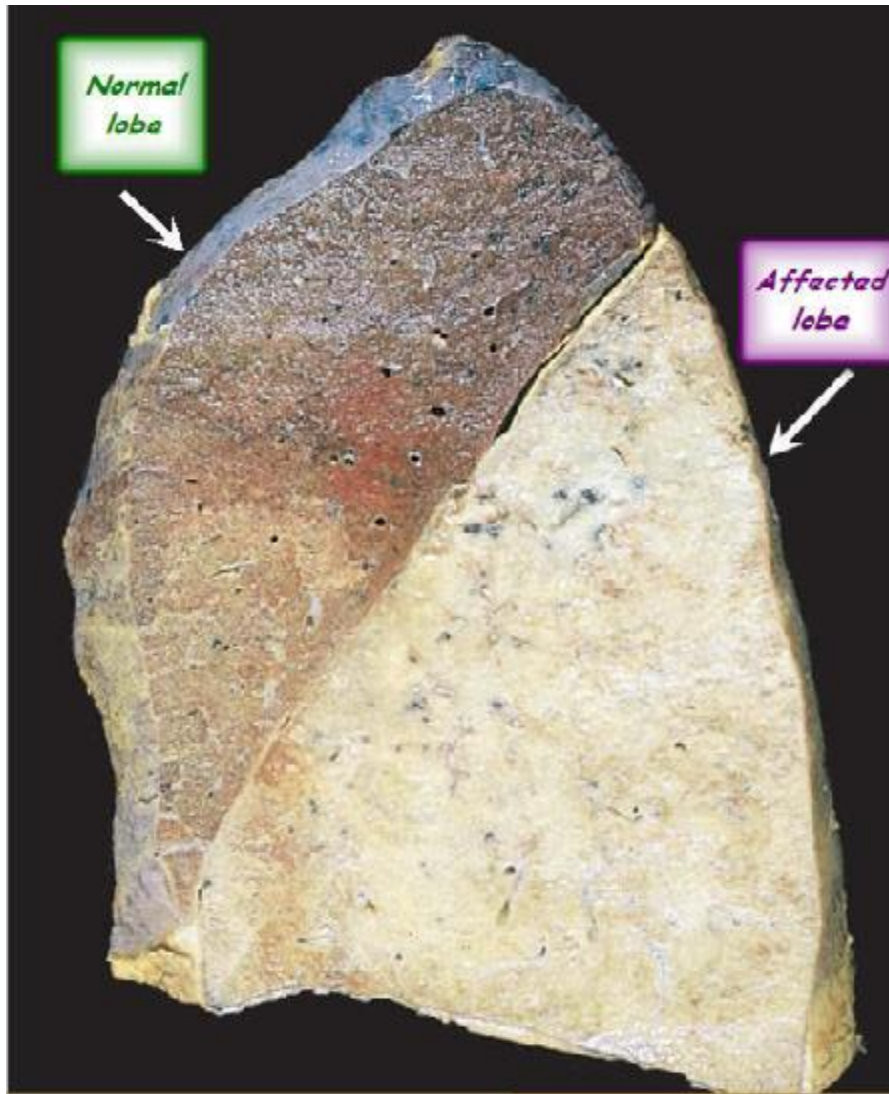
## **Different types of emphysema with their possible causes:**

- ***Centriacinar (Centrilobular) → smoking***
- ***Panacinar (Panlobular) →  $\alpha$ -1 antitrypsin deficiency.***
- ***Distal acinar (Paraseptal) → unknown cause leading to pneumothorax.***
- ***Irregular emphysema → inflammatory conditions.***

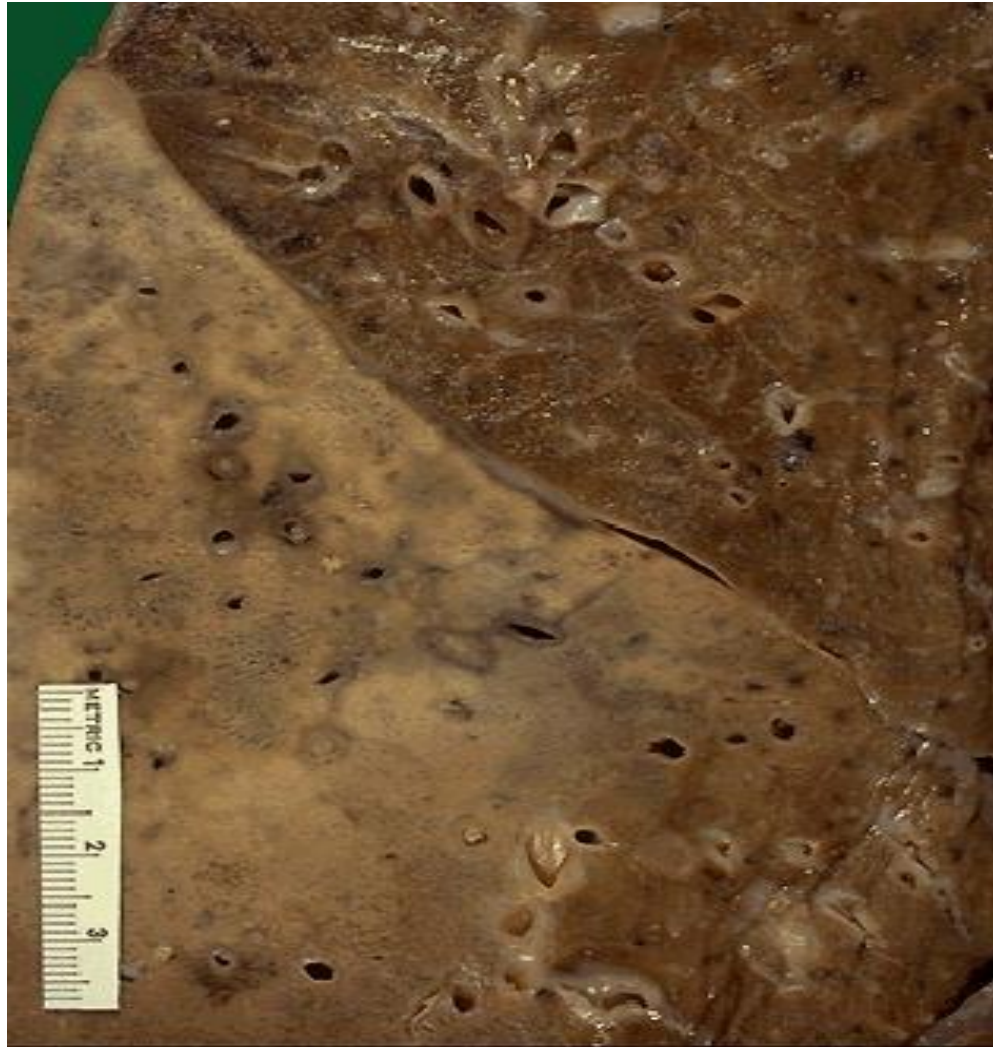
# ***LOWER RESPIRATORY TRACT INFECTIONS***

## ***1. Lobar Pneumonia***

# Lobar Pneumonia - Gross pathology



## Lobar Pneumonia - Gross pathology



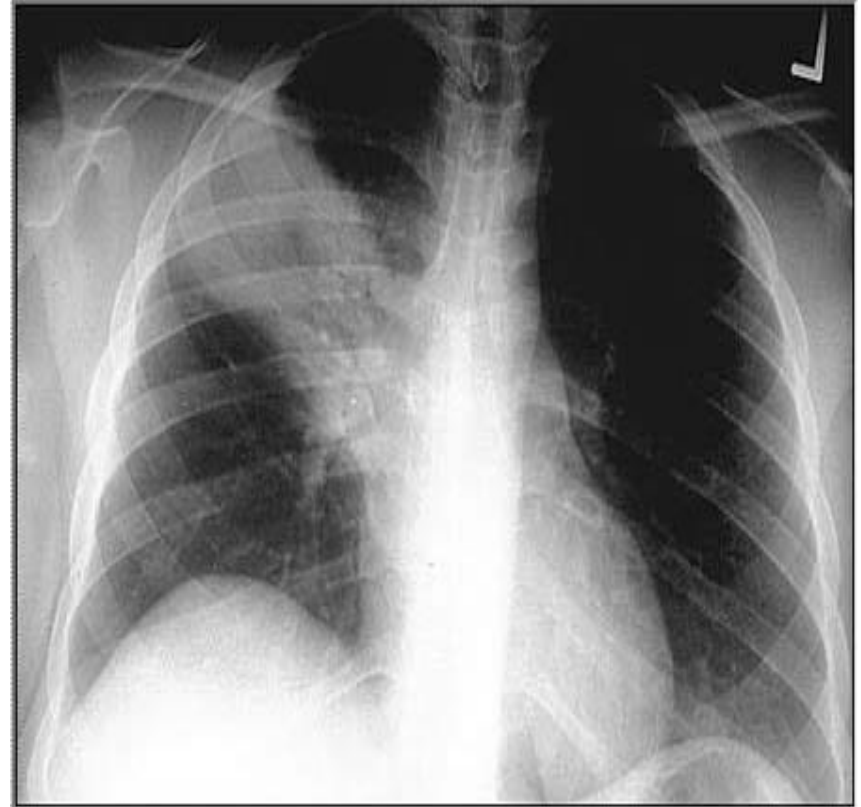
***A closer view of the lobar pneumonia demonstrates the distinct difference between the upper lobe and the consolidated lower lobe.***



## Lobar Pneumonia : X - Ray



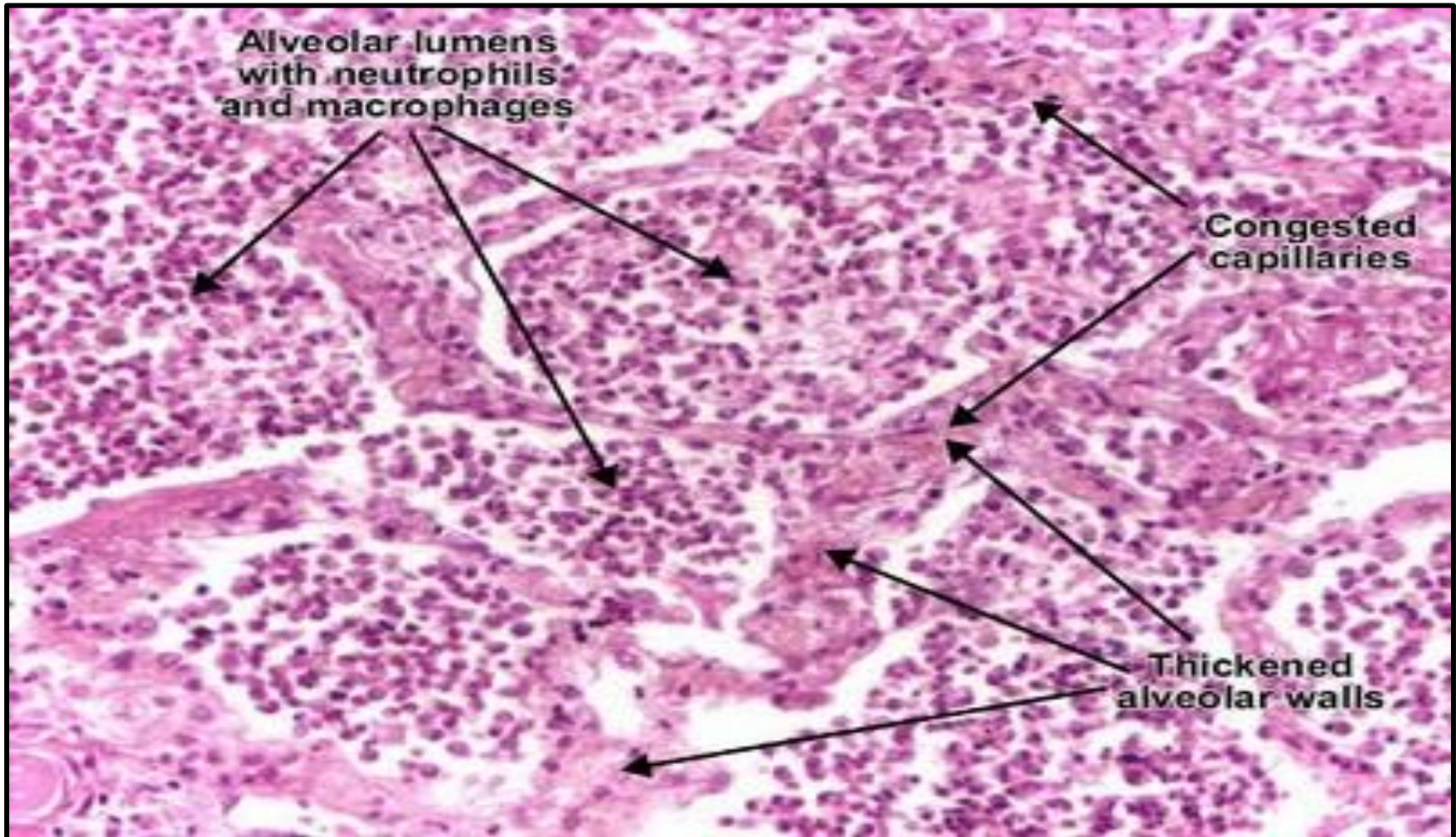
Lobar Pneumonia of the right Lower lobe



Lobar Pneumonia of the right middle lobe

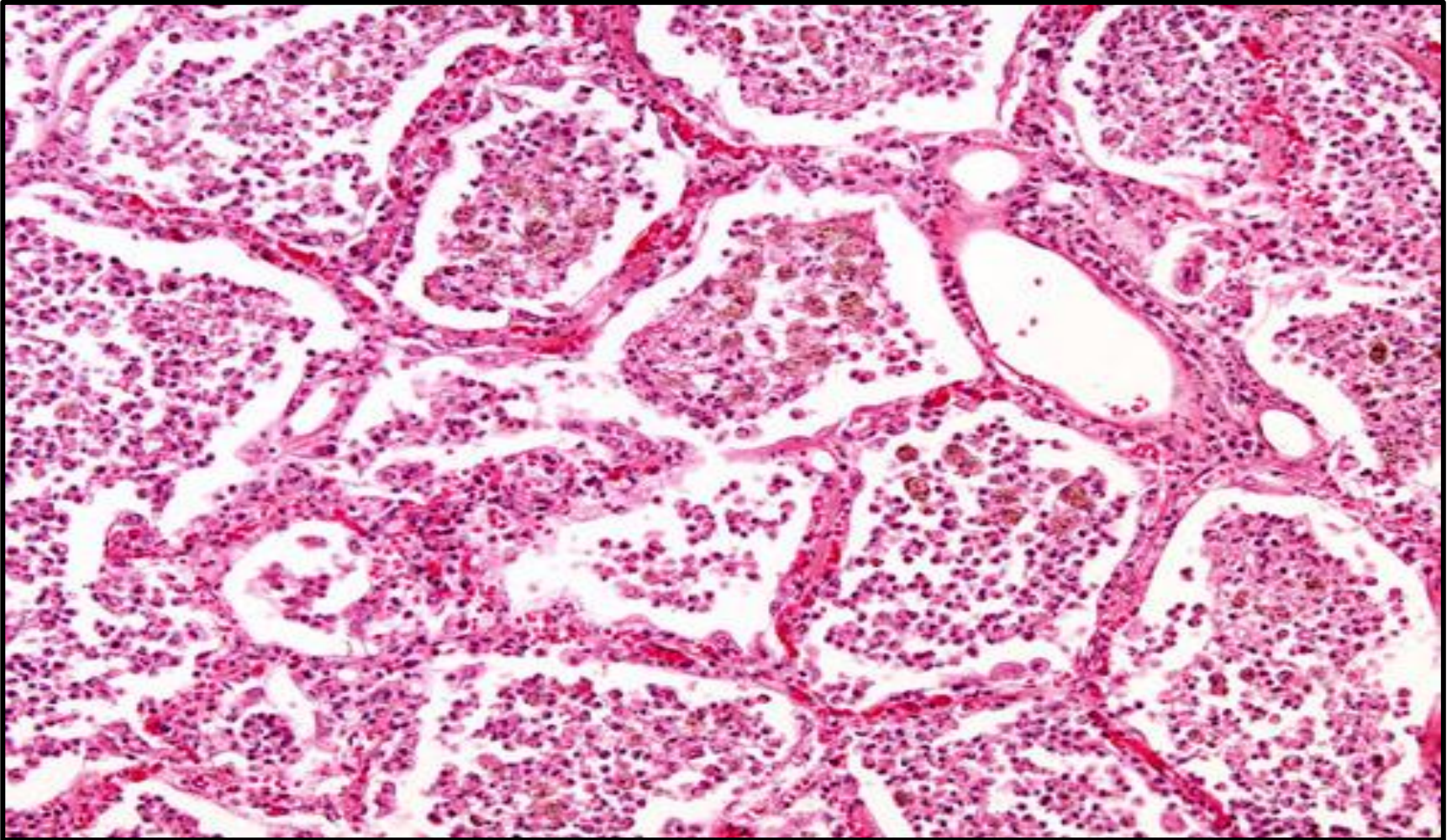
***A localized focus of consolidation caused by lobar pneumonia can be seen in both X-ray films taken from 2 different patients .***

## Lobar Pneumonia - Histopathology



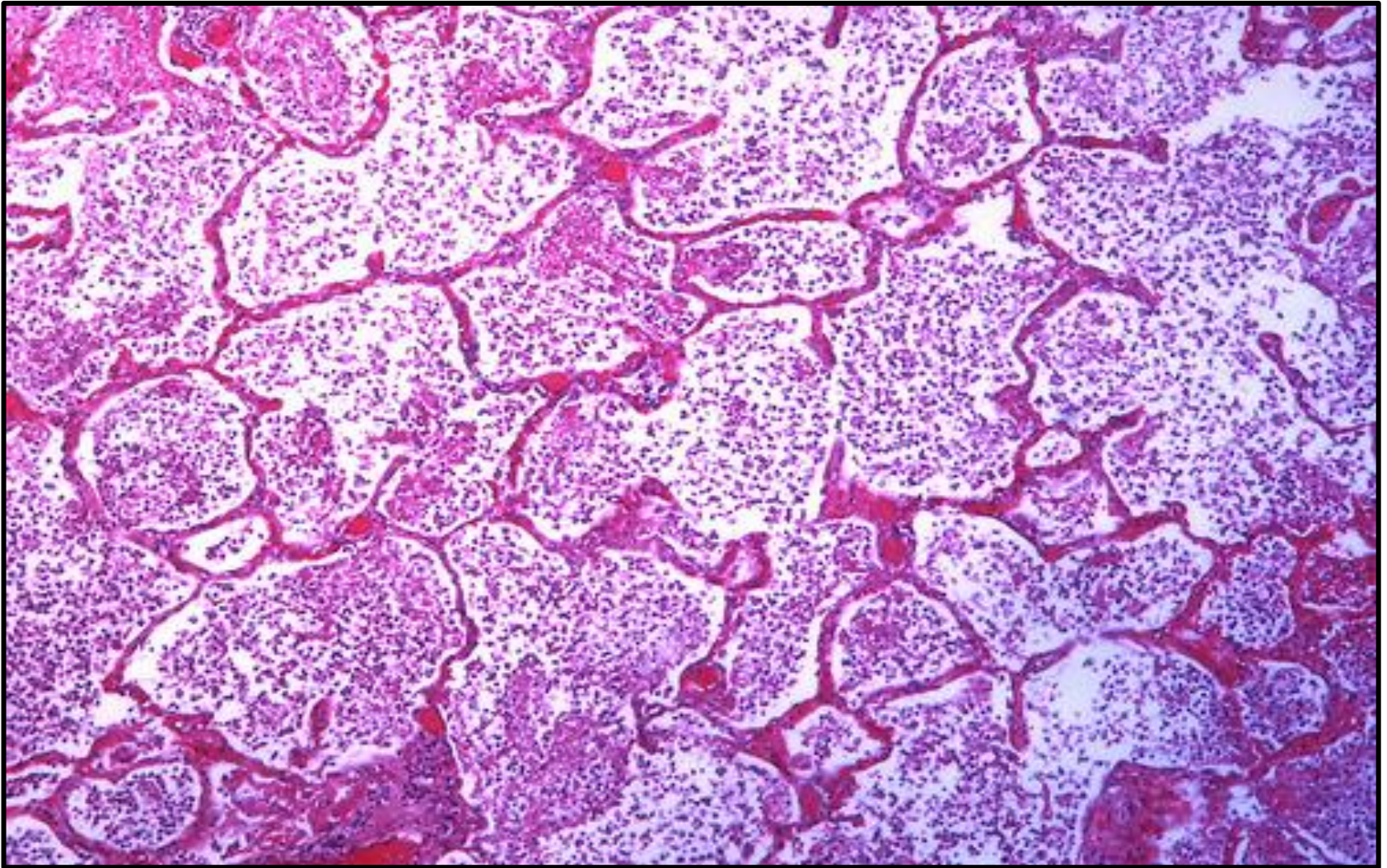
- \* **Congestion (first 2 days)**
- \* **Red hepatisation (fibrinous alveolitis) (2nd to 4th day)**
- \* **Grey hepatisation (leukocytic alveolitis) (4th to 8th day)**
- \* **Resolution (after 8th day)**

## Lobar Pneumonia - LPF



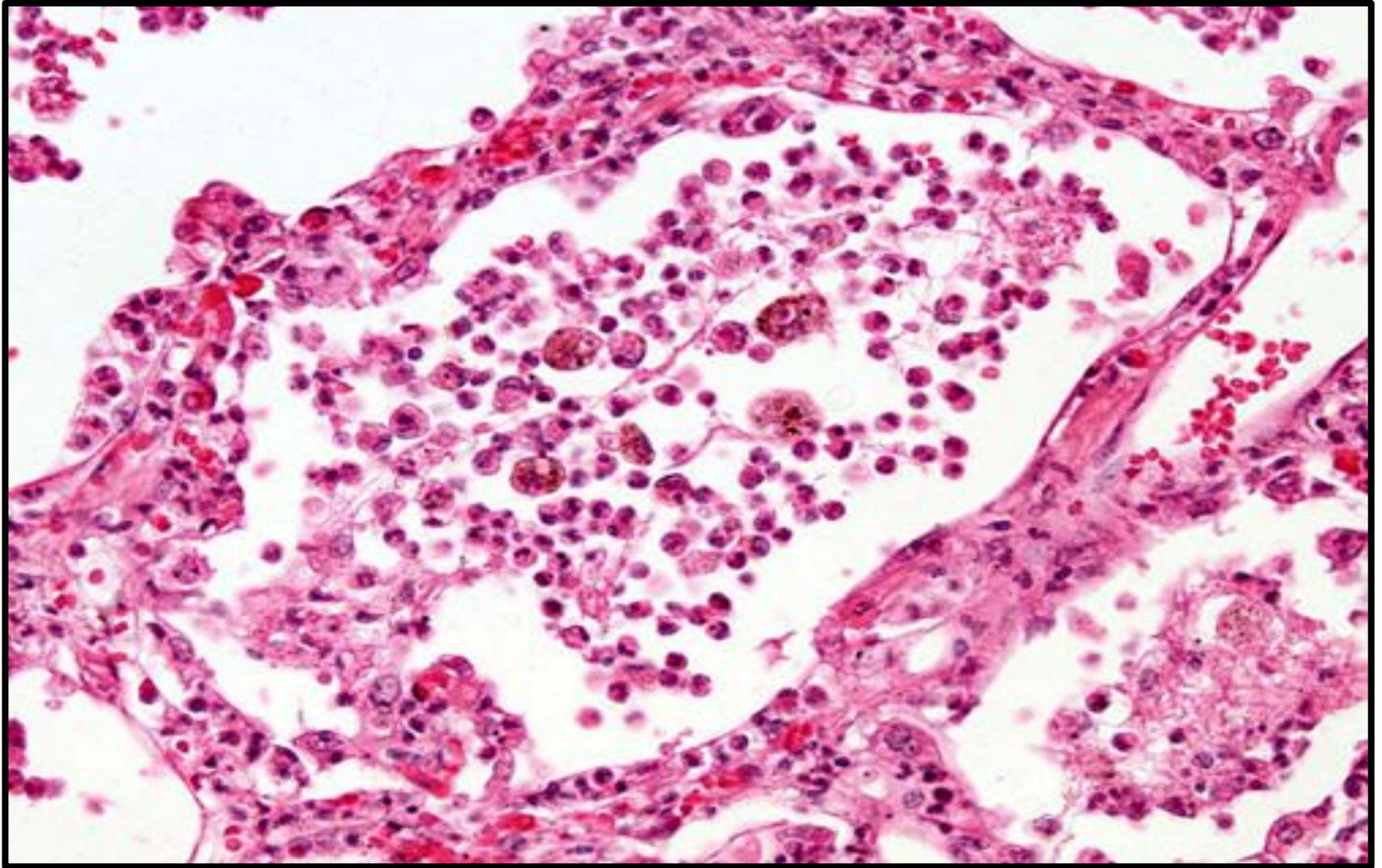
***All the alveoli are filled with fibrinous exudate containing fibrin threads, polymorphs, macrophages and red cells. Alveolar walls are congested. Pleura is covered by fibrinous exudate.***

## **Lobar Pneumonia - LPF**



***the alveoli are filled with fibrinous exudate containing fibrin threads, polymorphs, macrophages and red cells***

## **Lobar Pneumonia - HPF**



***High power field of alveolar exudate and thickened alveolar wall***

## ***2. Bronchopneumonia***

## Bronchopneumonia – Gross pathology



- **The consolidated areas here very closely match the pattern of lung lobules (hence the term "lobular" pneumonia).**
- **Bronchopneumonia is classically a "hospital acquired" pneumonia seen in persons already ill from another diseases e.g. DM , old age , immune deficiency process.**

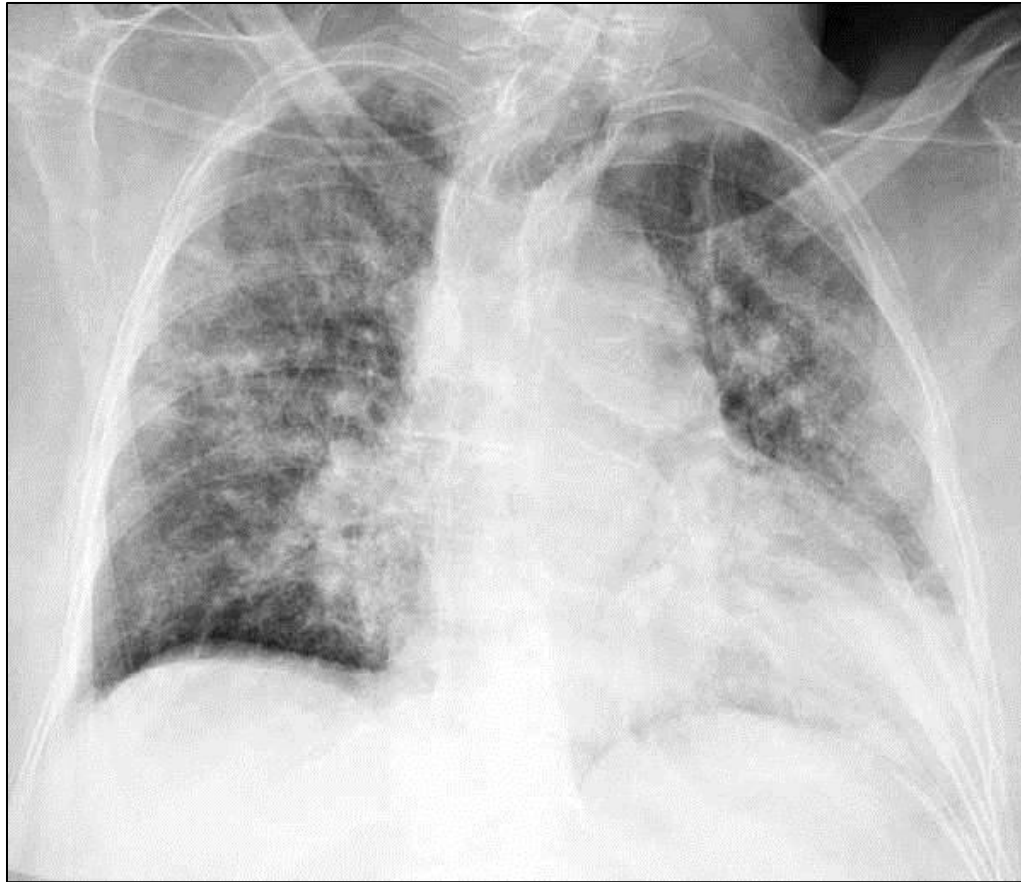
## Bronchopneumonia – Cut section



***This bronchopneumonia is more subtle, but there are areas of lighter tan consolidation. The hilum is seen at the lower left with radiating pulmonary arteries and bronchi***

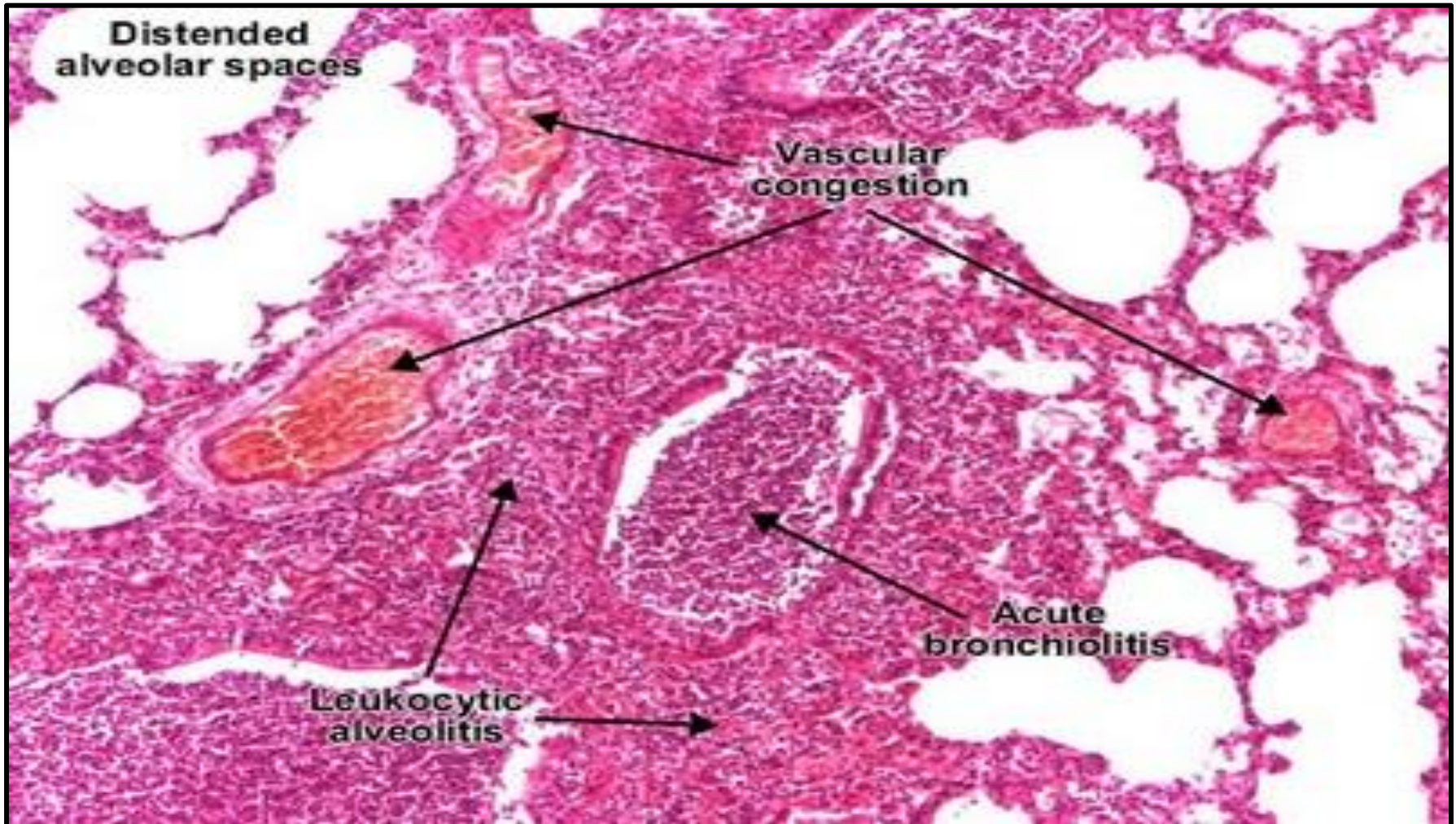


## **Bronchopneumonia – X-Ray**



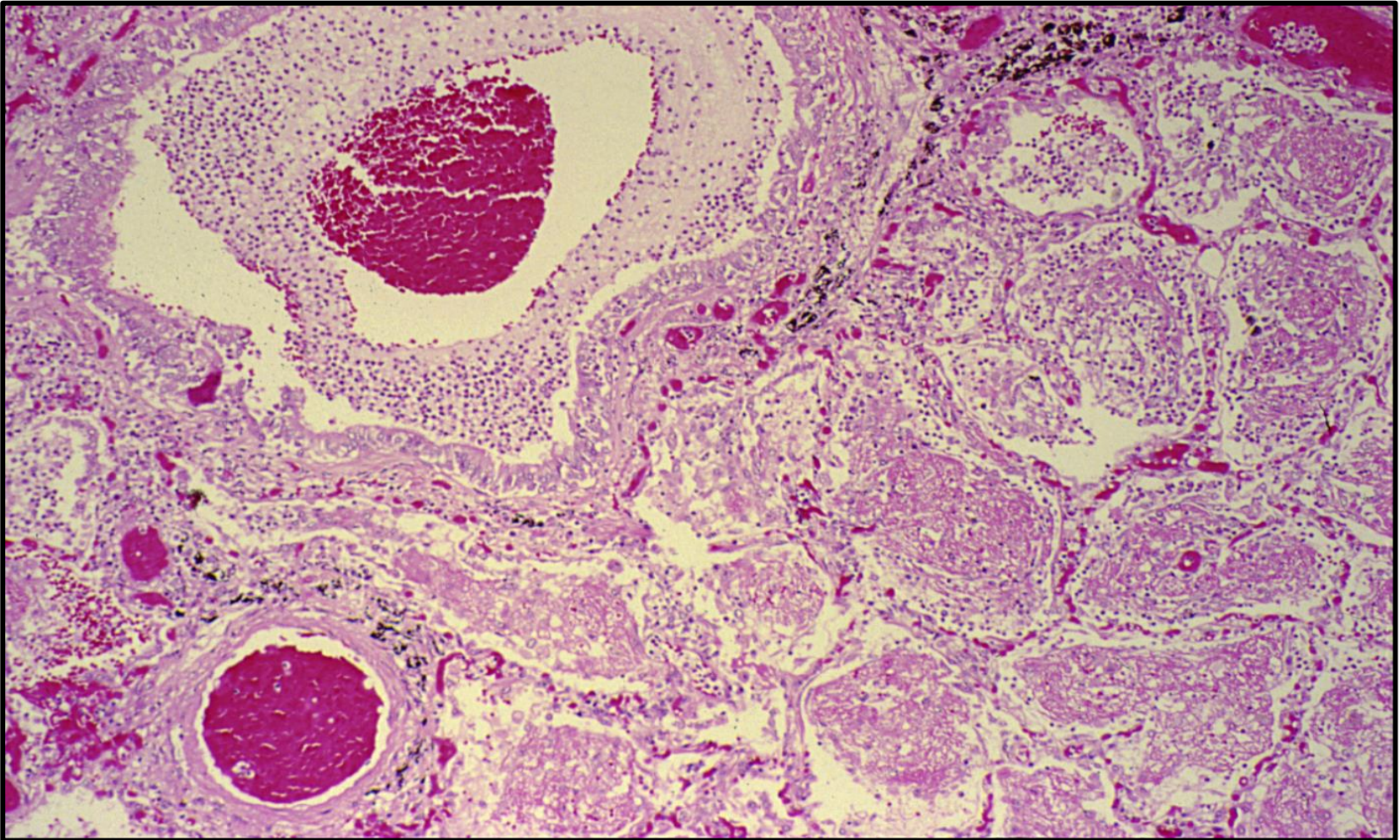
***This radiograph demonstrates patchy infiltrates consistent with a bronchopneumonia from a bacterial infection.***

## Bronchopneumonia – Histopathology



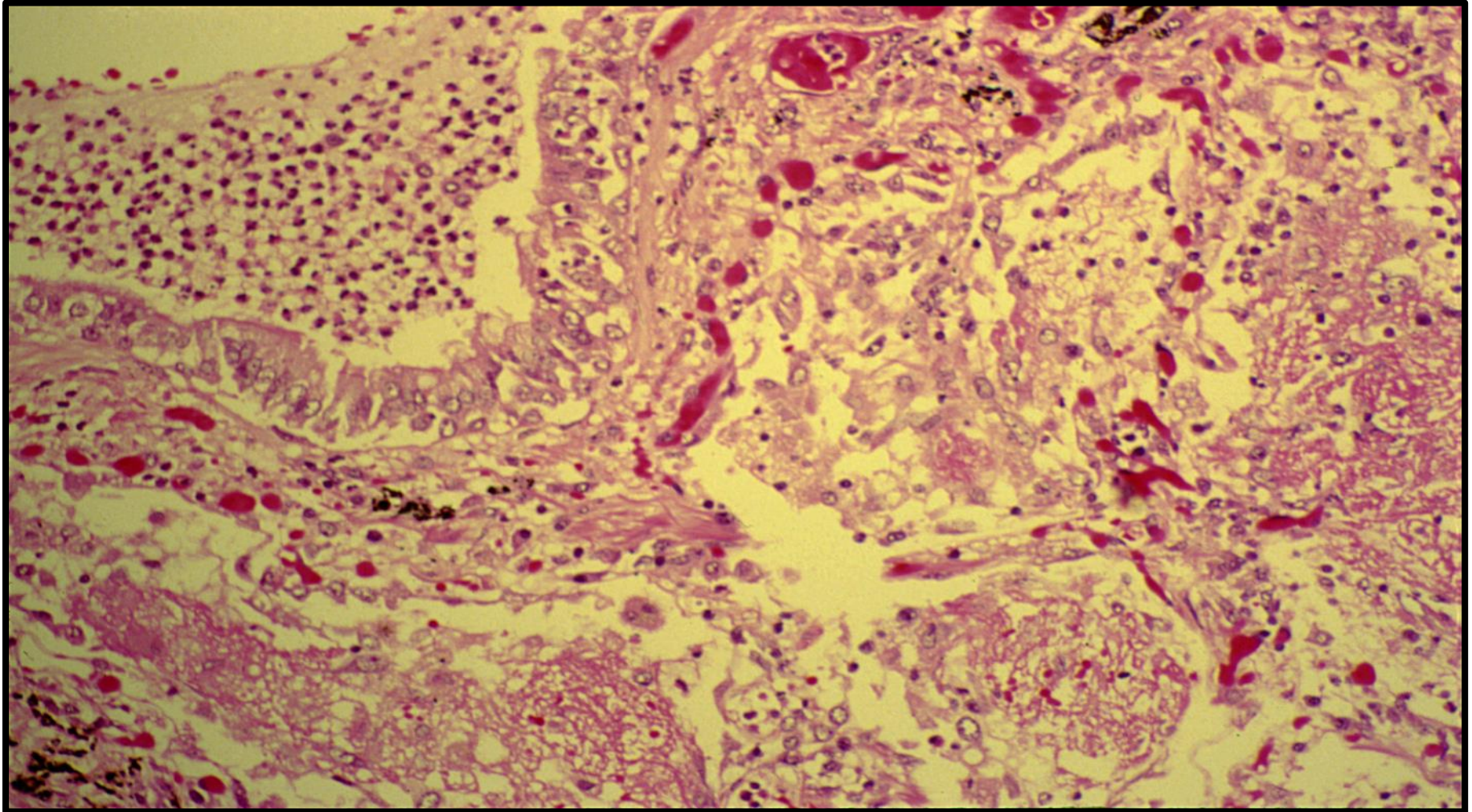
***Bronchopneumonia (Lobular pneumonia) is an acute exudative inflammation of the lungs characterised by foci of consolidation surrounded by normal parenchyma. Usually, bronchopneumonia affects one or more lobes and is bilateral.***

## Bronchopneumonia – LPF



**Section of the lung shows foci of inflammatory consolidation surrounding bronchioles: Bronchioles are filled with an inflammatory purulent exudate and show ulceration of mucosa, focal inflammation and necrosis of walls . Surrounding lung parenchyma shows congestion and edema**

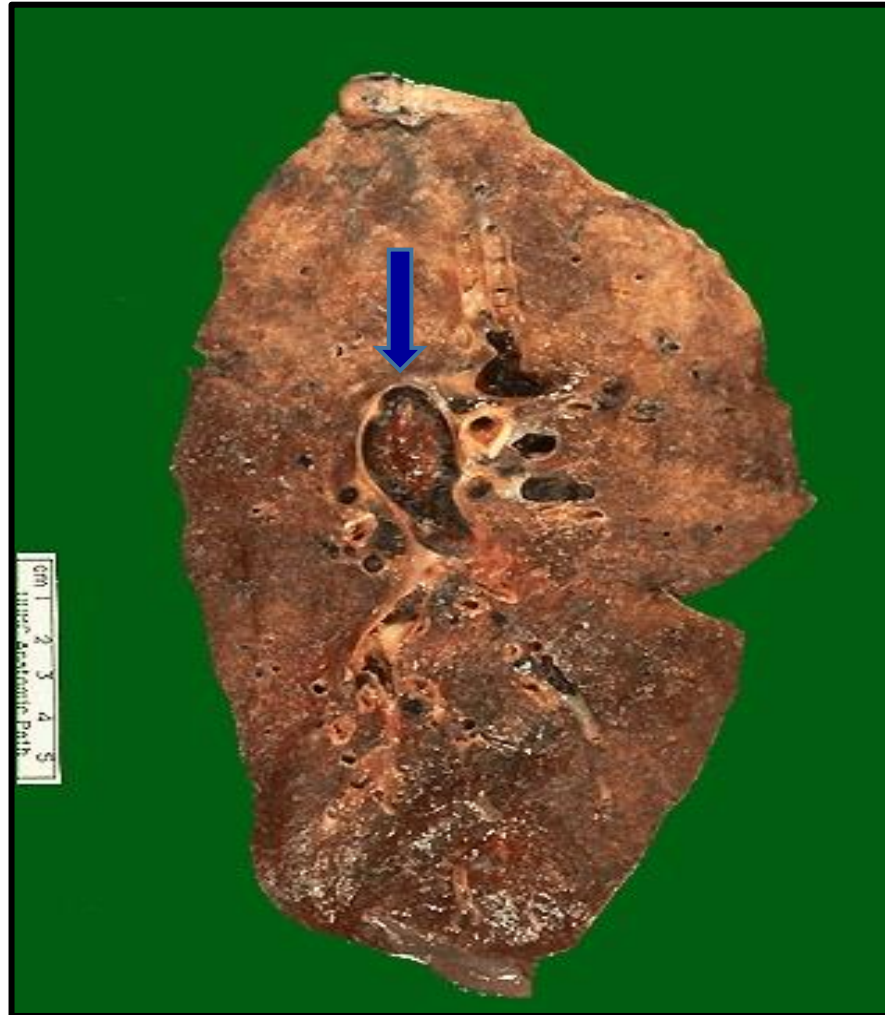
## Bronchopneumonia – MPF



***At high magnification, the alveolar exudate of mainly neutrophils is seen. The surrounding alveolar walls have capillaries that are dilated and filled with RBC's. Such an exudative process is typical for bacterial infection. This exudate gives rise to the productive cough of purulent yellow sputum seen with bacterial pneumonias***

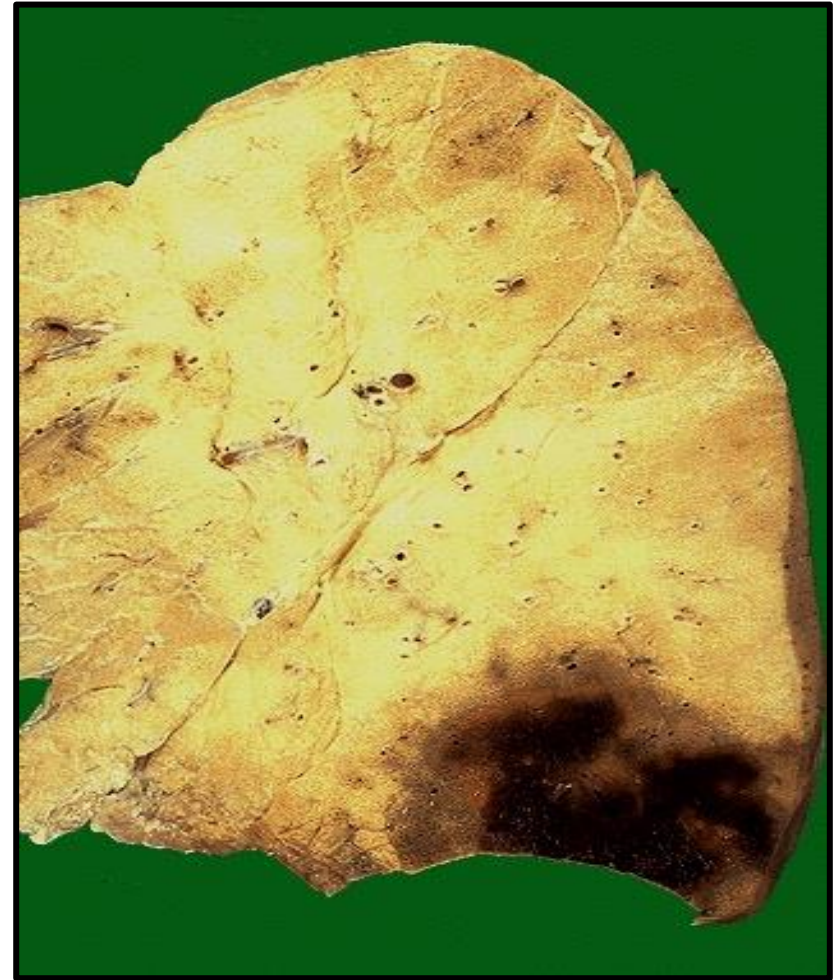
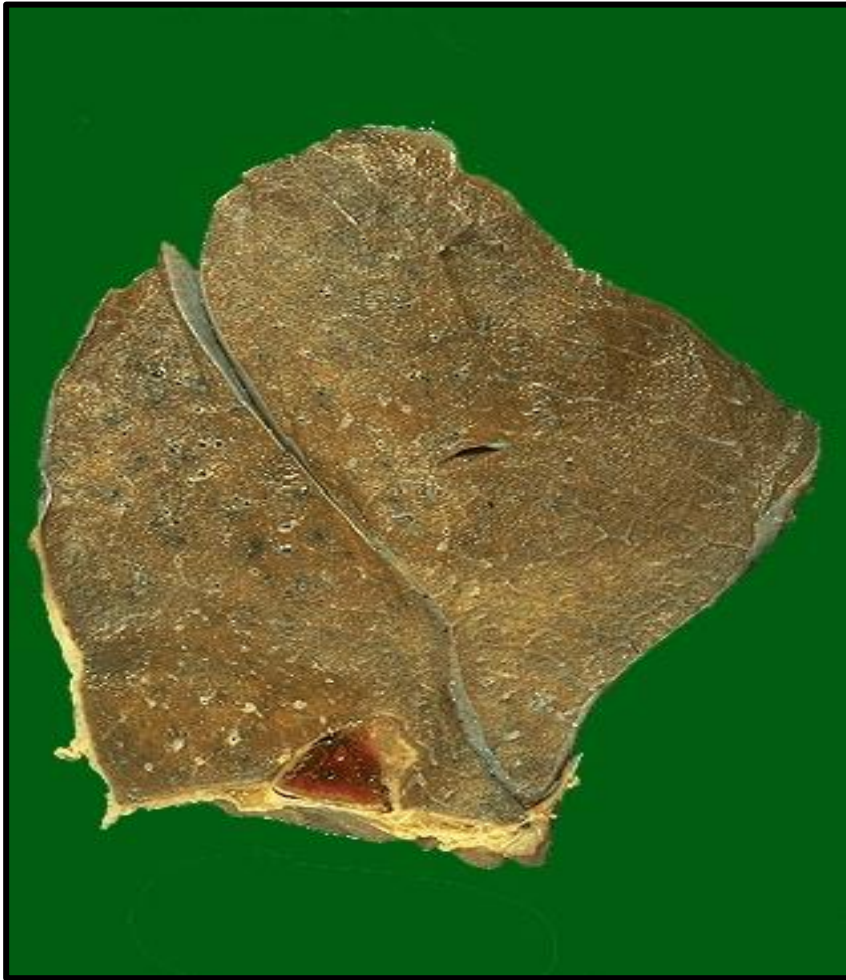
# PULMONARY EMBOLUS AND INFARCTION

## ***Thromboembolism in the Lung – Gross***



***A large pulmonary thromboembolus is seen in the pulmonary artery to the left lung. Such thromboemboli typically originate in the leg veins or pelvic veins of persons who are immobilized***

## Thromboembolism in the Lung – Gross

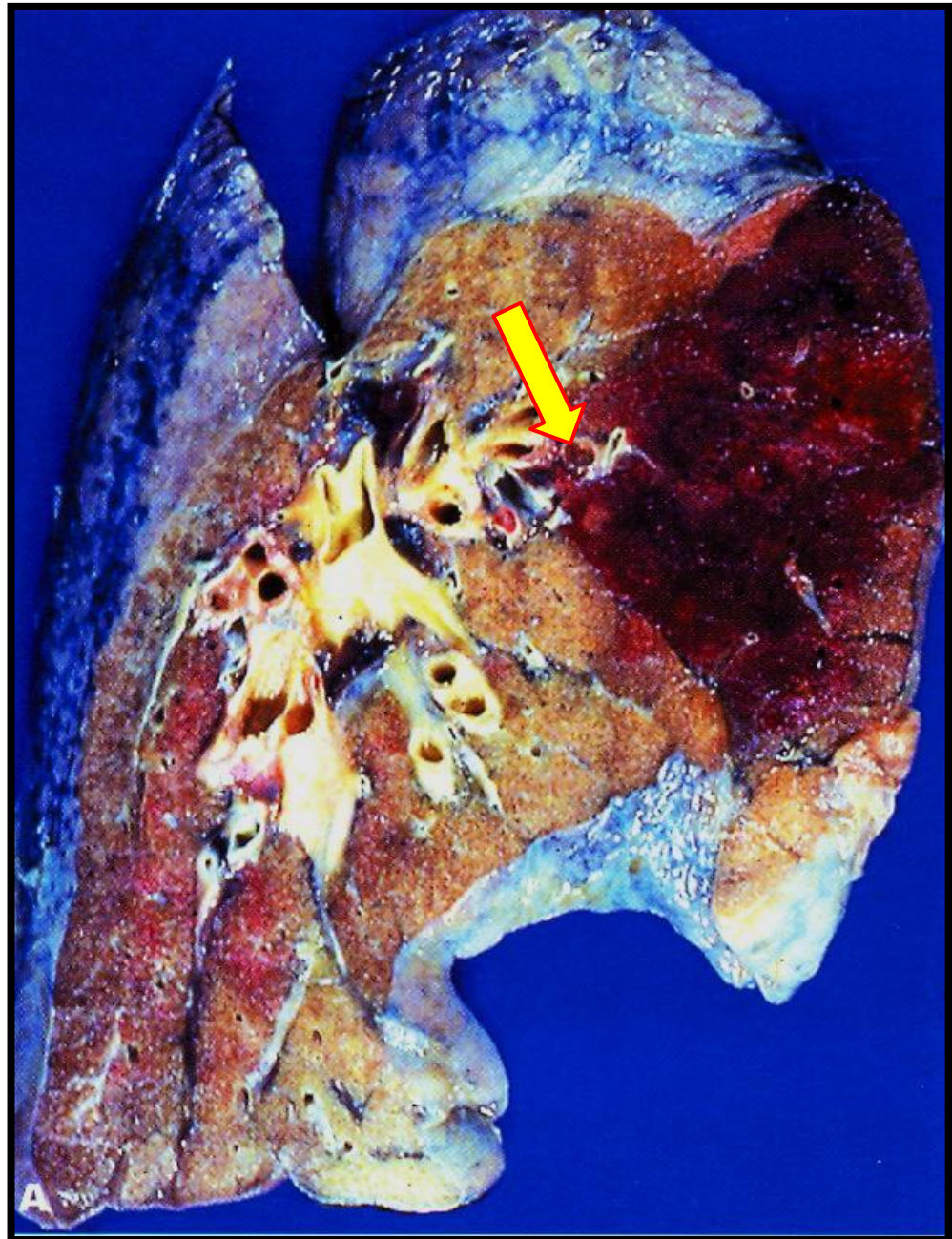


***Large thromboemboli can cause death. Medium sized thrombemboli (blocking a pulmonary artery to a lobule or set of lobules) can produce the lesion seen here -a hemorrhagic pulmonary infarction which is a wedge-shaped and based on the pleura.***

## ***Pulmonary embolus and infarction in the Lung***

***A Longitudinal transection of a lung showing a wedge shaped peripheral hemorrhagic infarction .***

***A thrombus is seen in a major branch of pulmonary artery ( arrow head ) .***





## ***Pulmonary Embolus with infarction – CT scan***



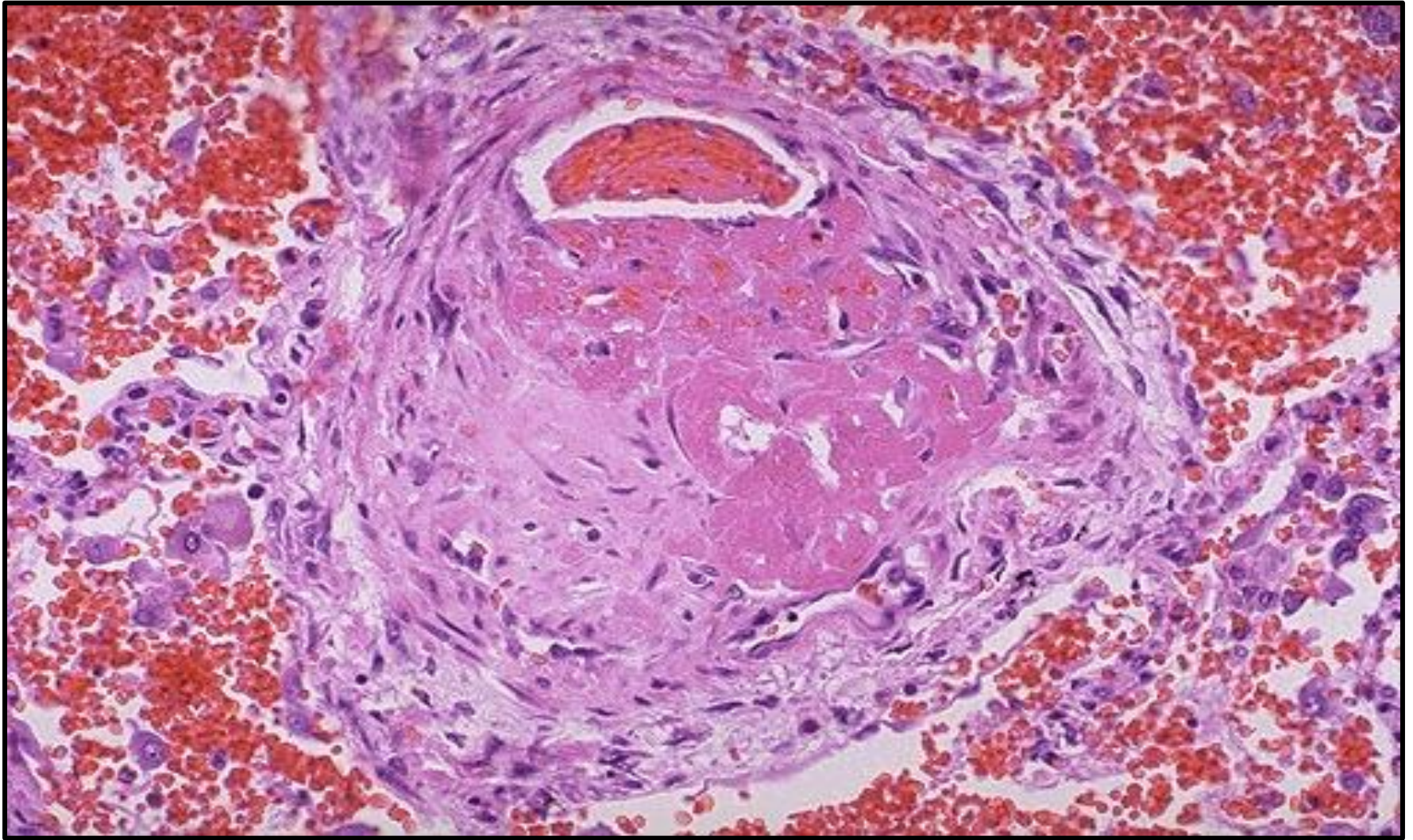
***CT scan - white arrows show pulmonary embolus with lung infarction***

## ***Pulmonary artery thromboembolus - LPF***



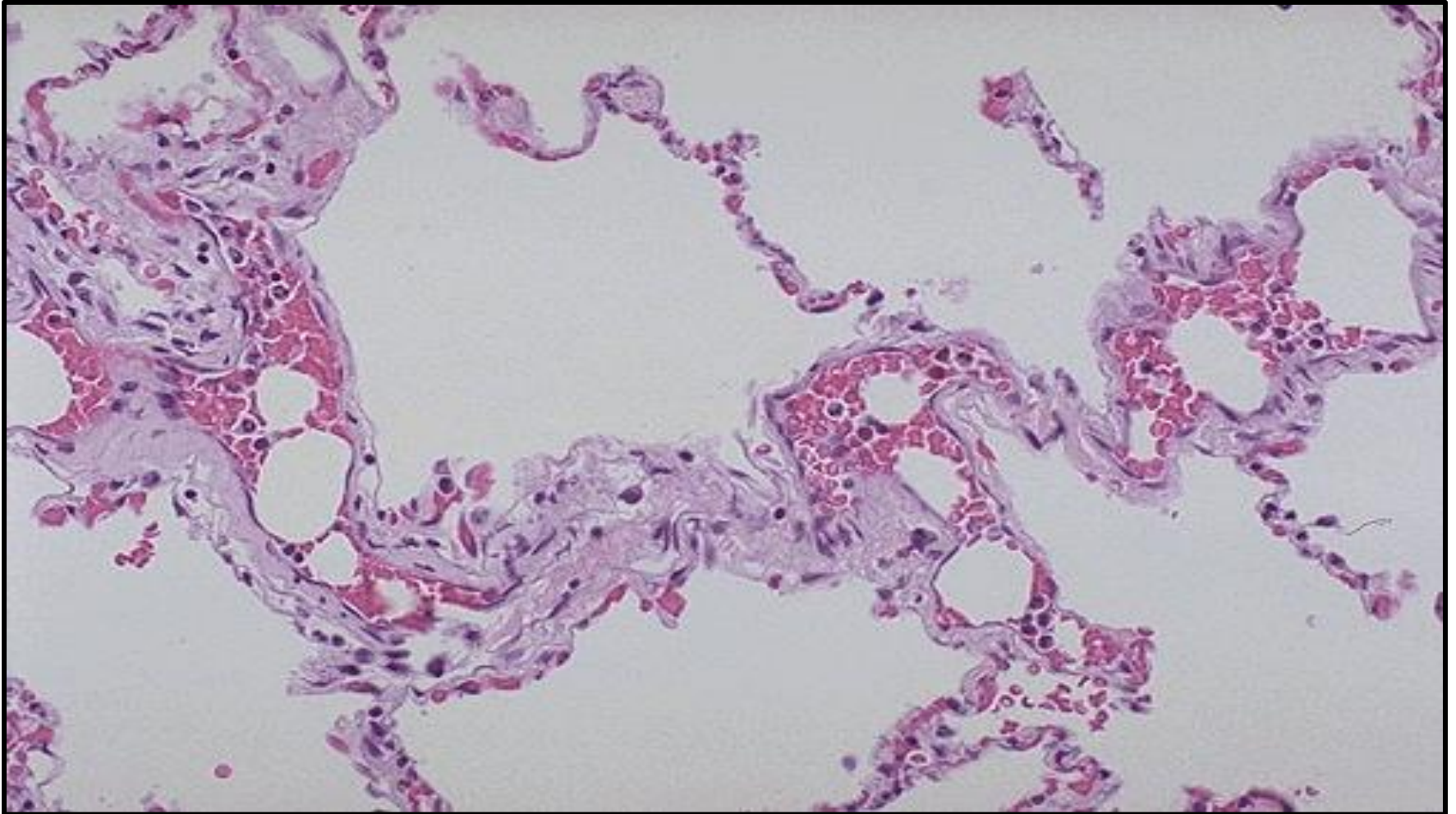
***Microscopic appearance of a pulmonary thromboembolus in a large pulmonary artery. There are interdigitating areas of pale pink and red that form the "lines of Zahn" characteristic for a thrombus.***

## ***Small pulmonary artery thromboembolus - HPF***



***A small peripheral pulmonary artery thromboembolus. If these small PE are showered into the pulmonary circulation at once or over a period of time will lead to pulmonary hypertension.***

## ***Fat Embolism in the Lung - HPF***



***The rounded holes that appear in the vascular spaces here in the lung are fat emboli. Fat embolization syndrome occurs most often following trauma with fracture of long bones that releases fat globules into the circulation which are trapped in pulmonary capillaries***