



Respiratory Pathology

Kristine Krafts, M.D.

Respiratory Pathology Learning Objectives

- Describe what happens to alveoli in acute respiratory distress syndrome (ARDS). List the causes of ARDS, and describe its clinical presentation and morphology.
- List the four obstructive lung diseases, and know which two often occur in the same patient population. Compare and contrast the causes, morphology, and symptoms of each of the four diseases.
- Describe the clinical course and morphology of idiopathic pulmonary fibrosis.

Respiratory Pathology Learning Objectives

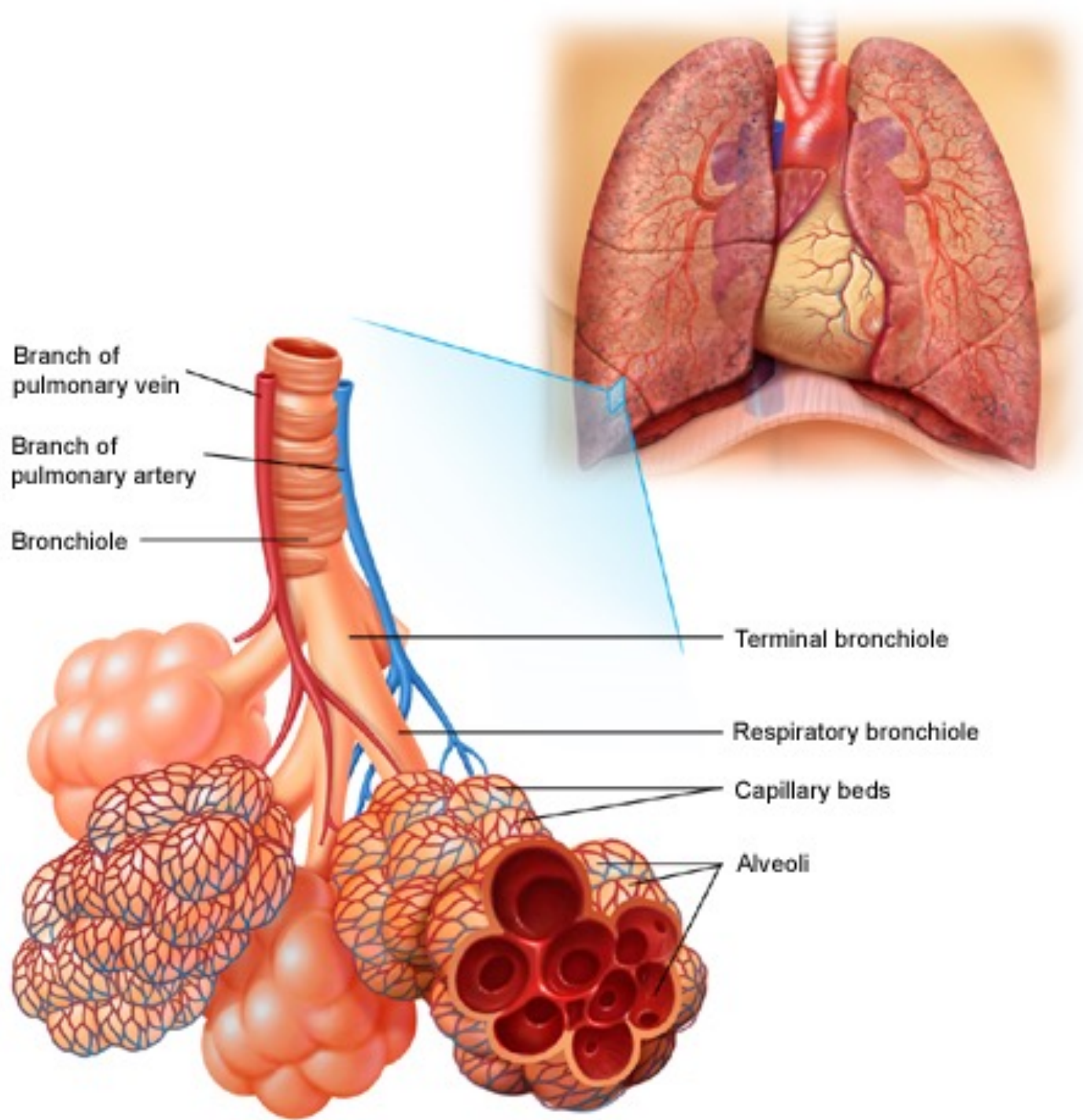
- What main category of lung disease do pneumoconiosis fall under? What causes them?
- Define “embolism.” Where do most pulmonary emboli come from? Describe the different clinical features of small, medium, and large pulmonary emboli.
- Explain why pneumonia occurring in different clinical settings (e.g., immunocompromised patients, patients in the hospital, patients in the community) is caused by different types of bacteria.

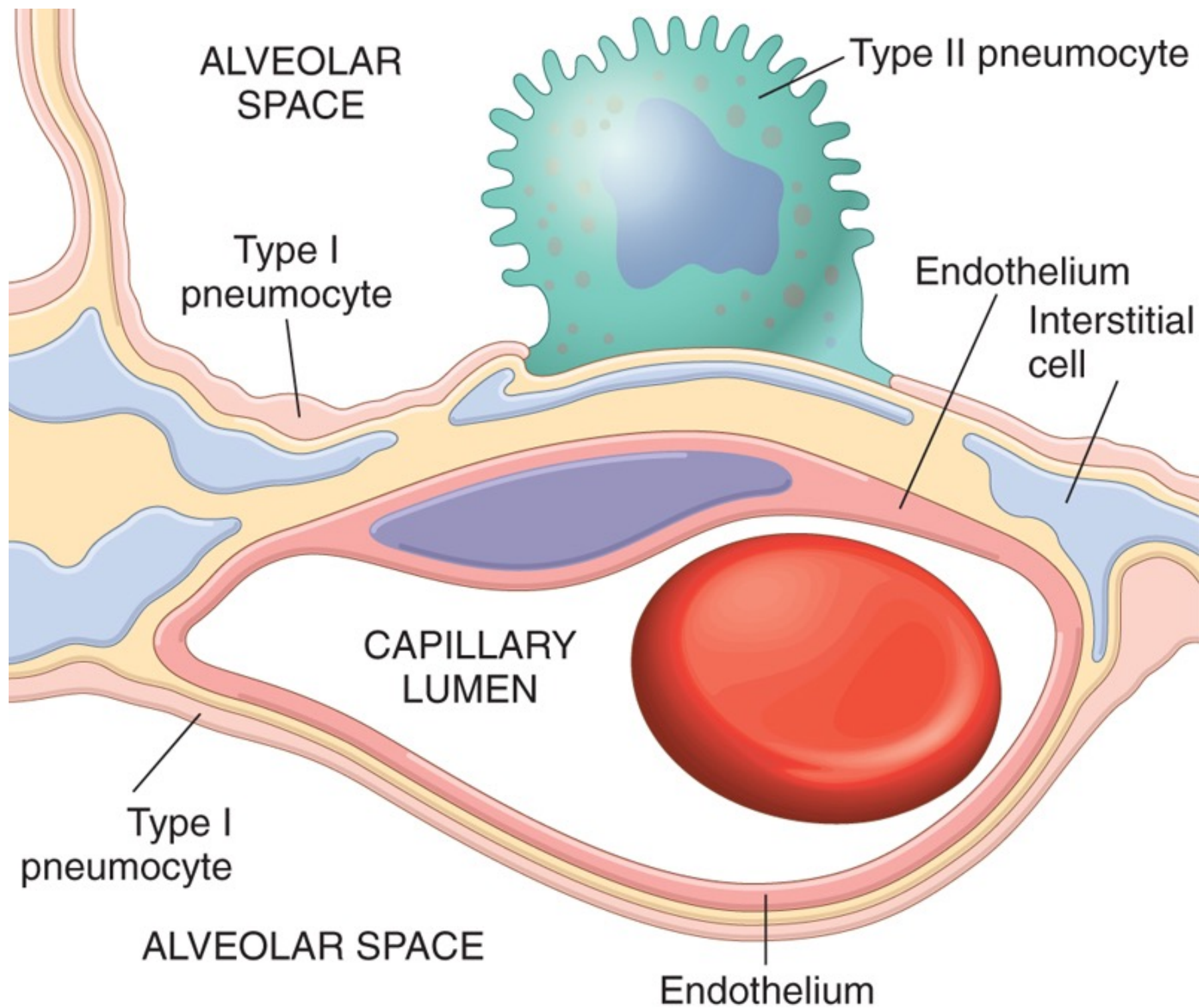
Respiratory Pathology Learning Objectives

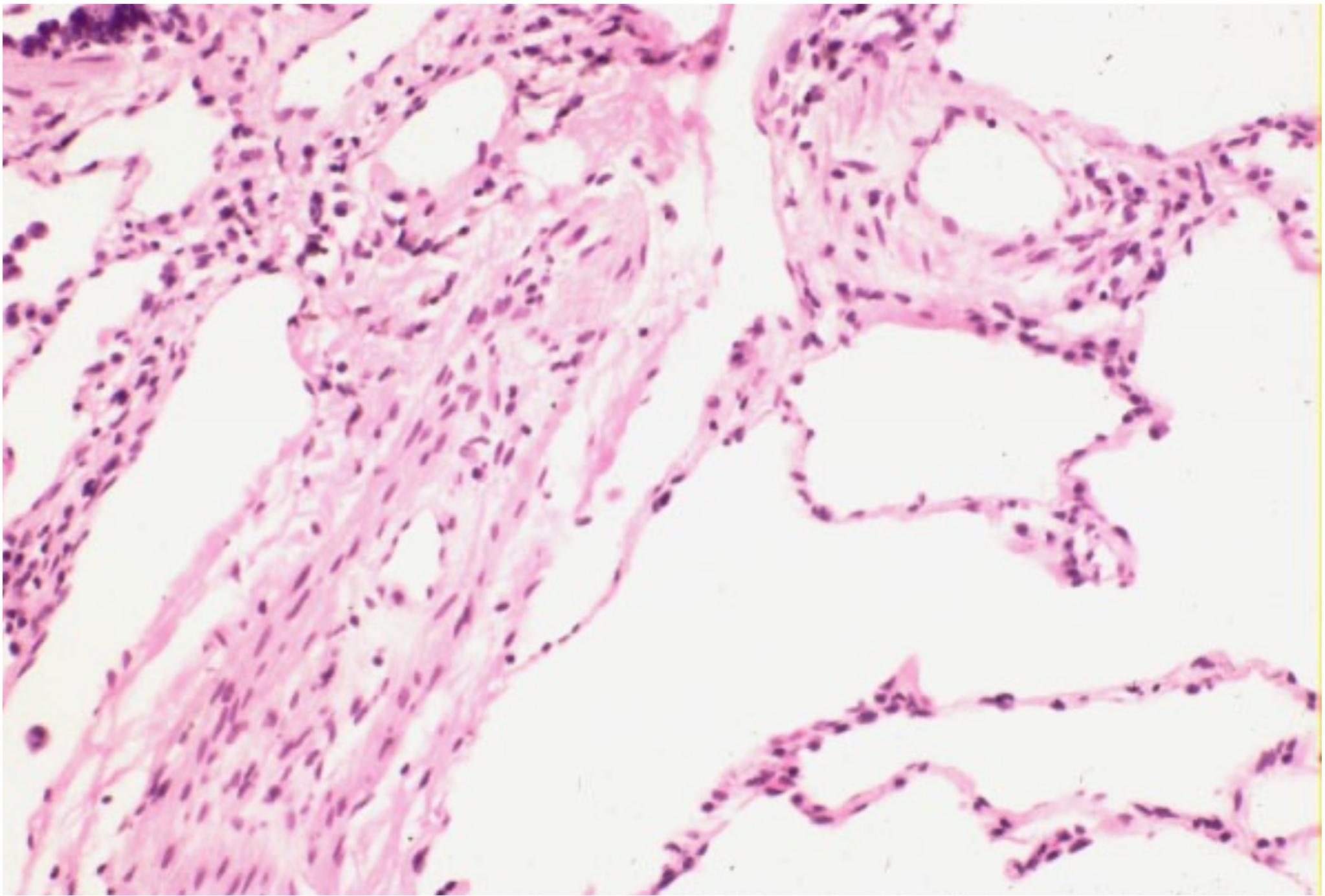
- What's the difference between interstitial and alveolar pneumonia? What type of infectious agent is most often associated with each?
- Describe how a lung abscess is different than pneumonia, and list some causes of lung abscess.
- Know what bacterium causes tuberculosis (TB), and the stain you need to use to be able to see it microscopically. Describe how TB is spread. What's the difference between primary and secondary TB? What's the difference between a regular granuloma and a caseating one?

Respiratory Pathology Learning Objectives

- What organisms commonly cause opportunistic pneumonia?
- What are some of the symptoms of lung cancer?
Describe the morphologic appearance of adenocarcinoma, squamous cell carcinoma, and small cell lung carcinoma. Which type has the worst prognosis?
- What are the similarities and differences between lung cancer (in general) and mesothelioma?







Normal lung: alveolar spaces

Respiratory Pathology Outline

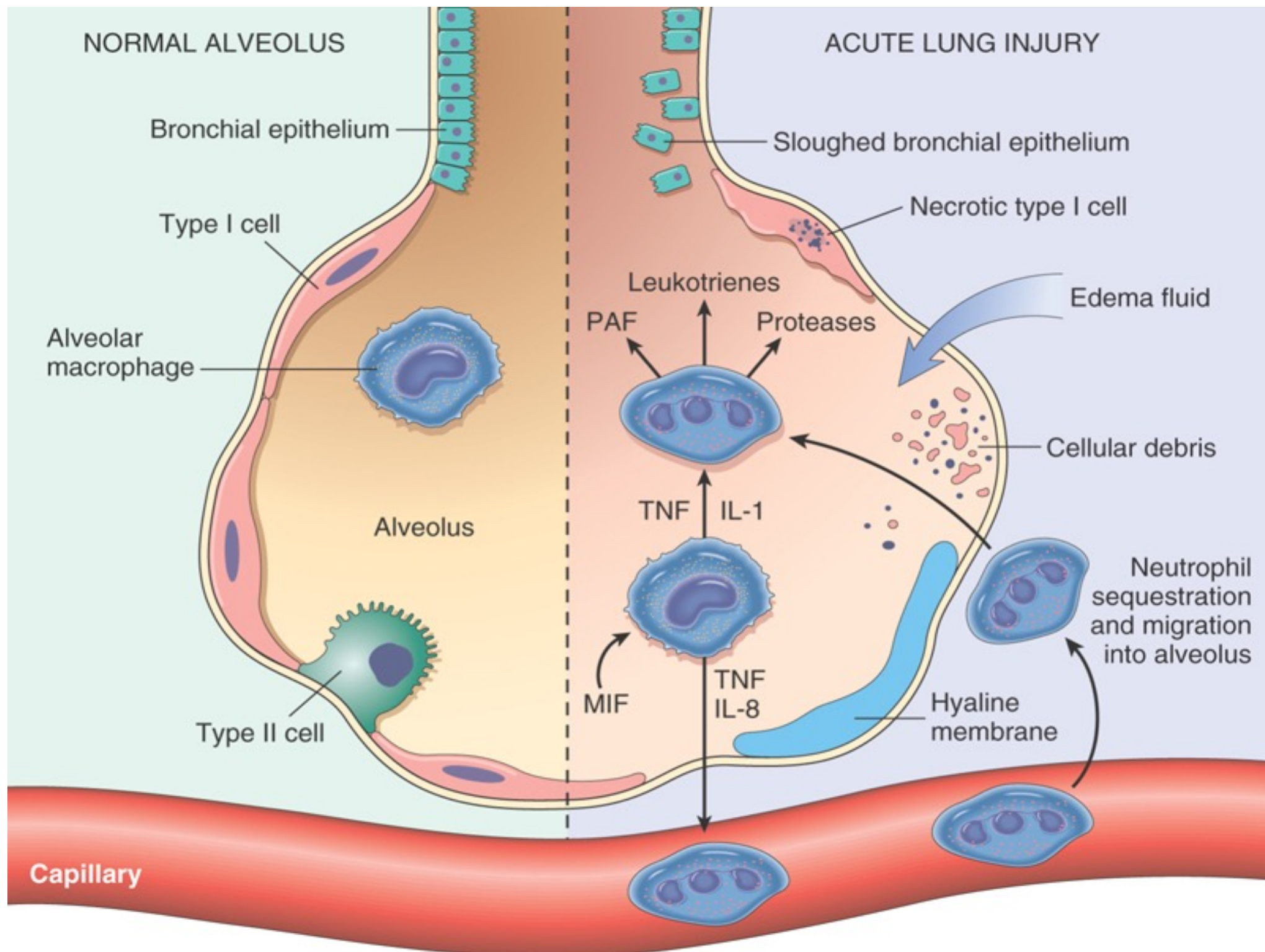
- Acute respiratory distress syndrome
- Obstructive lung diseases
- Restrictive lung diseases
- Vascular diseases
- Infections
- Carcinoma

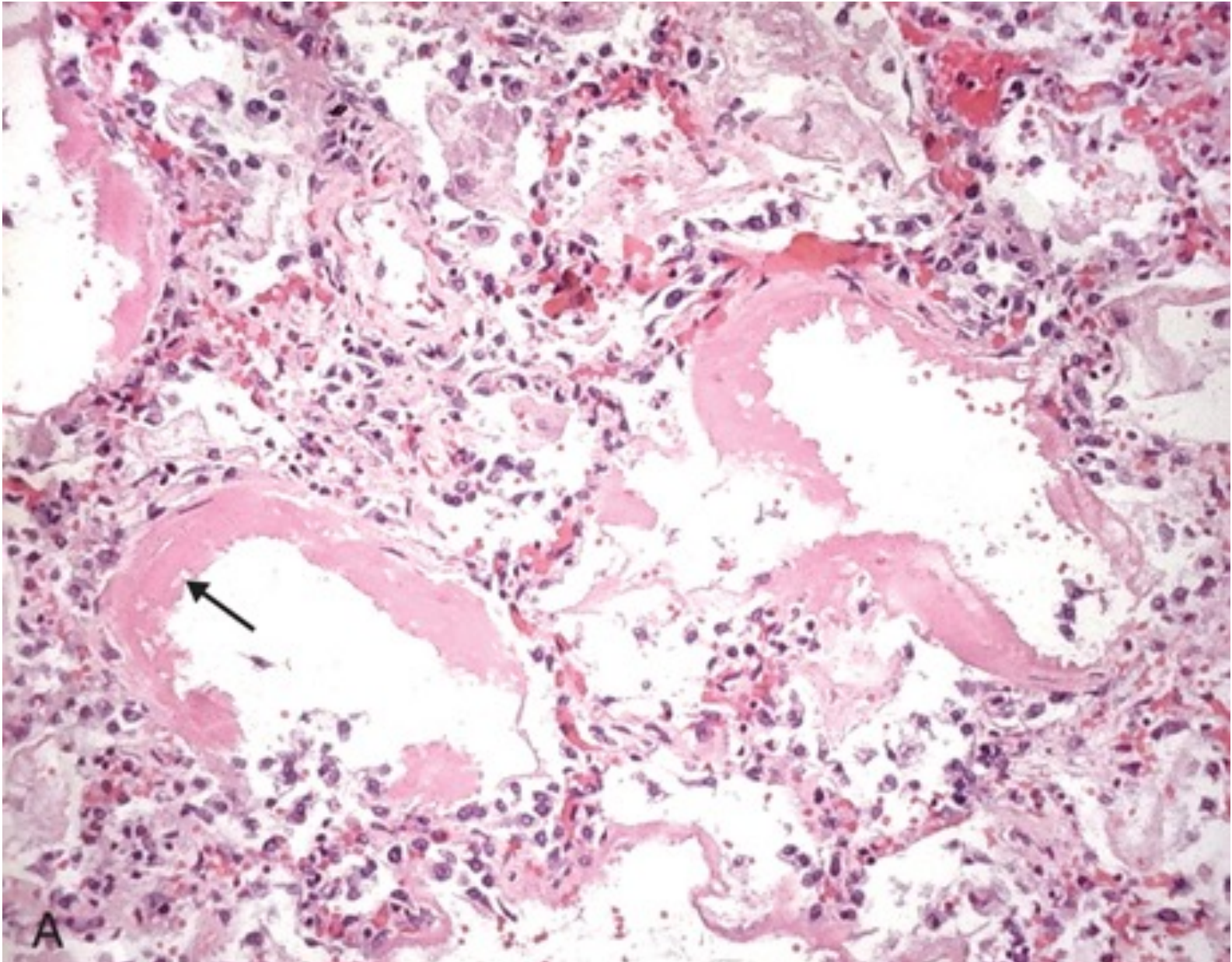
Respiratory Pathology Outline

- Acute respiratory distress syndrome

Acute respiratory distress syndrome

- Symptoms: rapid onset respiratory insufficiency that doesn't respond to oxygen
- Associated with pneumonia, aspiration of gastric contents, sepsis, severe trauma
- Pathogenesis: Damage to alveolar capillary membrane; neutrophils play a big role
- Morphology: “diffuse alveolar damage” with hyaline membranes





Diffuse alveolar damage: hyaline membranes

Respiratory Pathology Outline

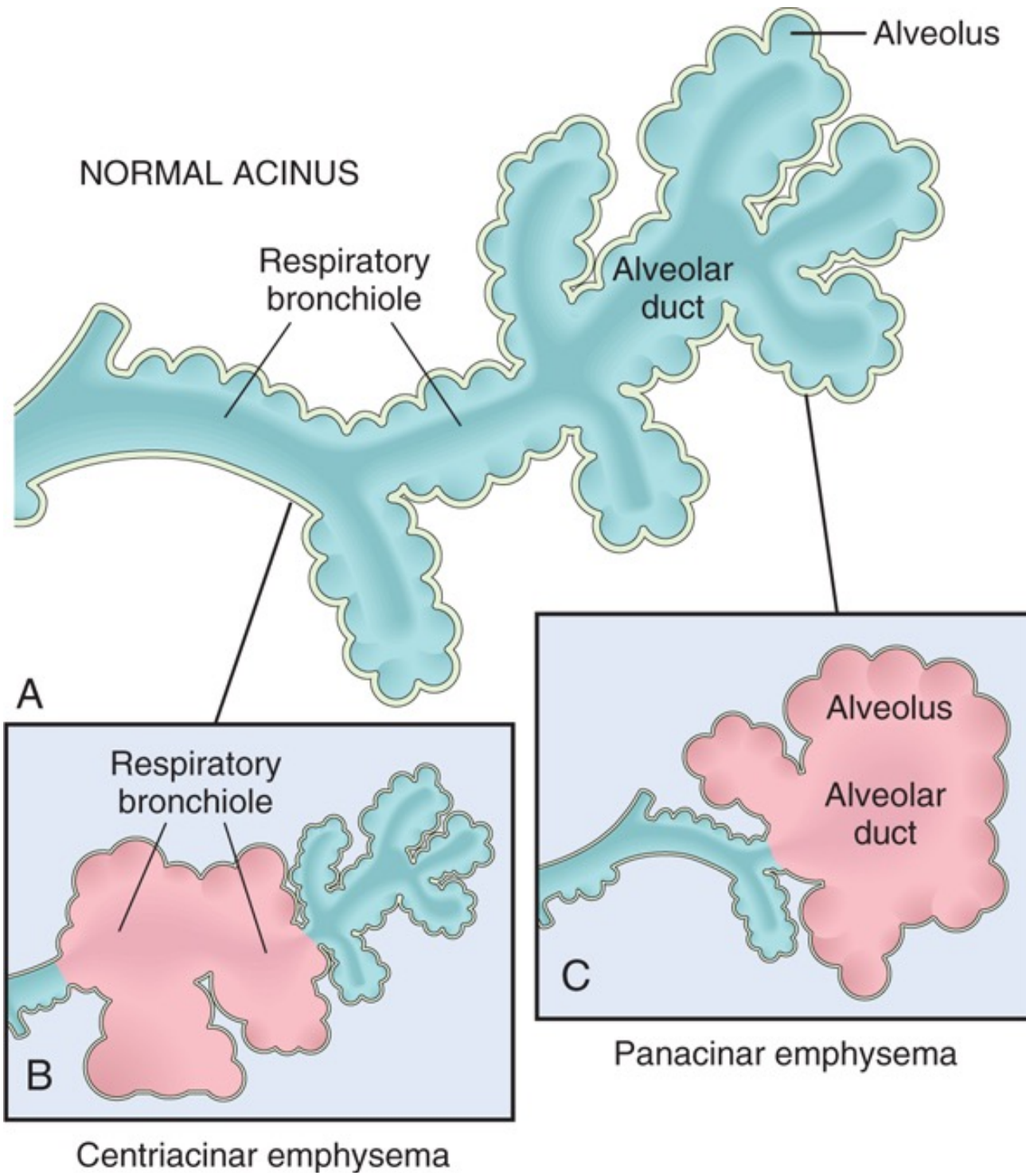
- Acute respiratory distress syndrome
- Obstructive lung diseases

Respiratory Pathology Outline

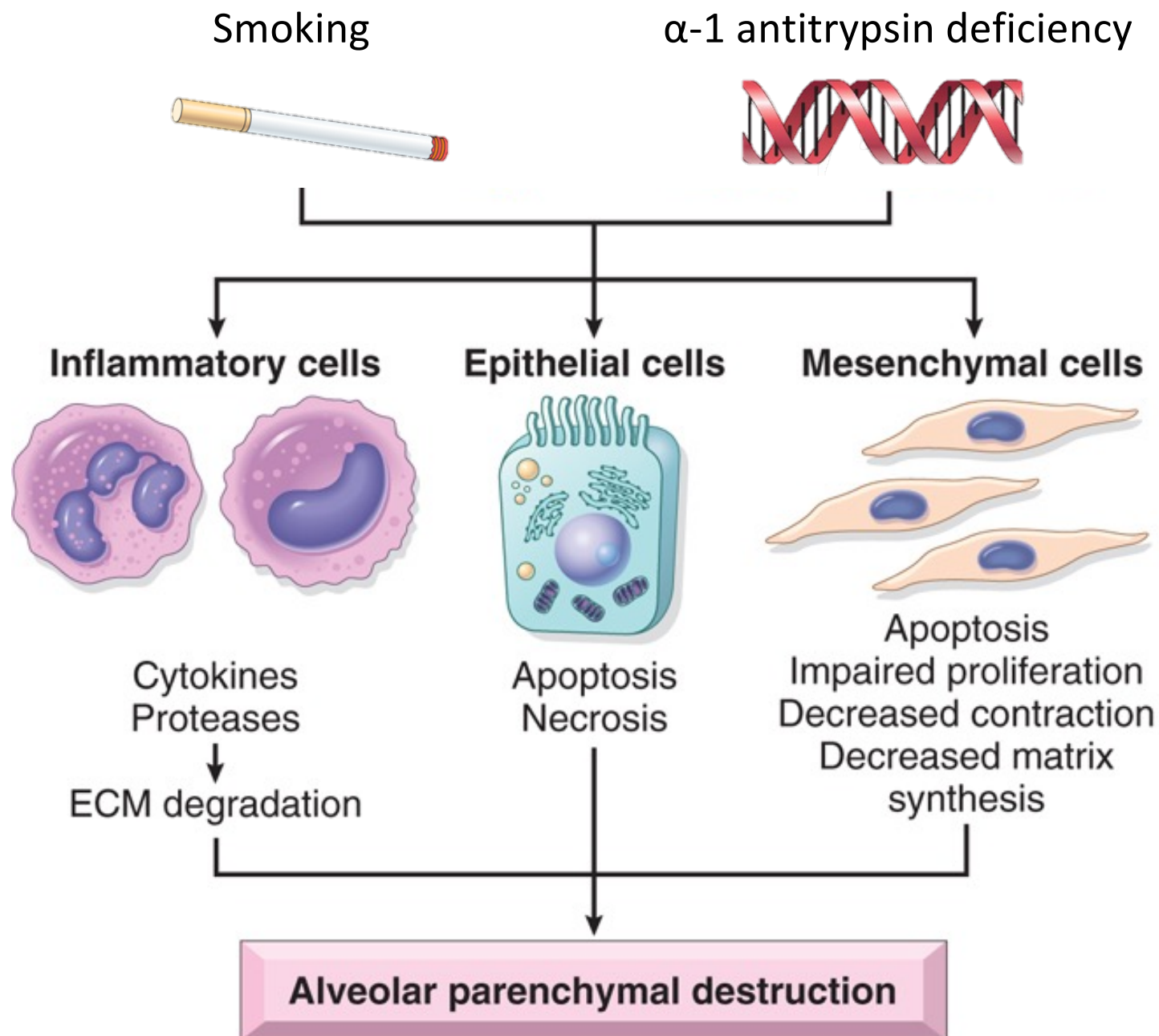
- Acute respiratory distress syndrome
- Obstructive lung diseases
 - Emphysema
 - Chronic bronchitis
 - Asthma
 - Bronchiectasis

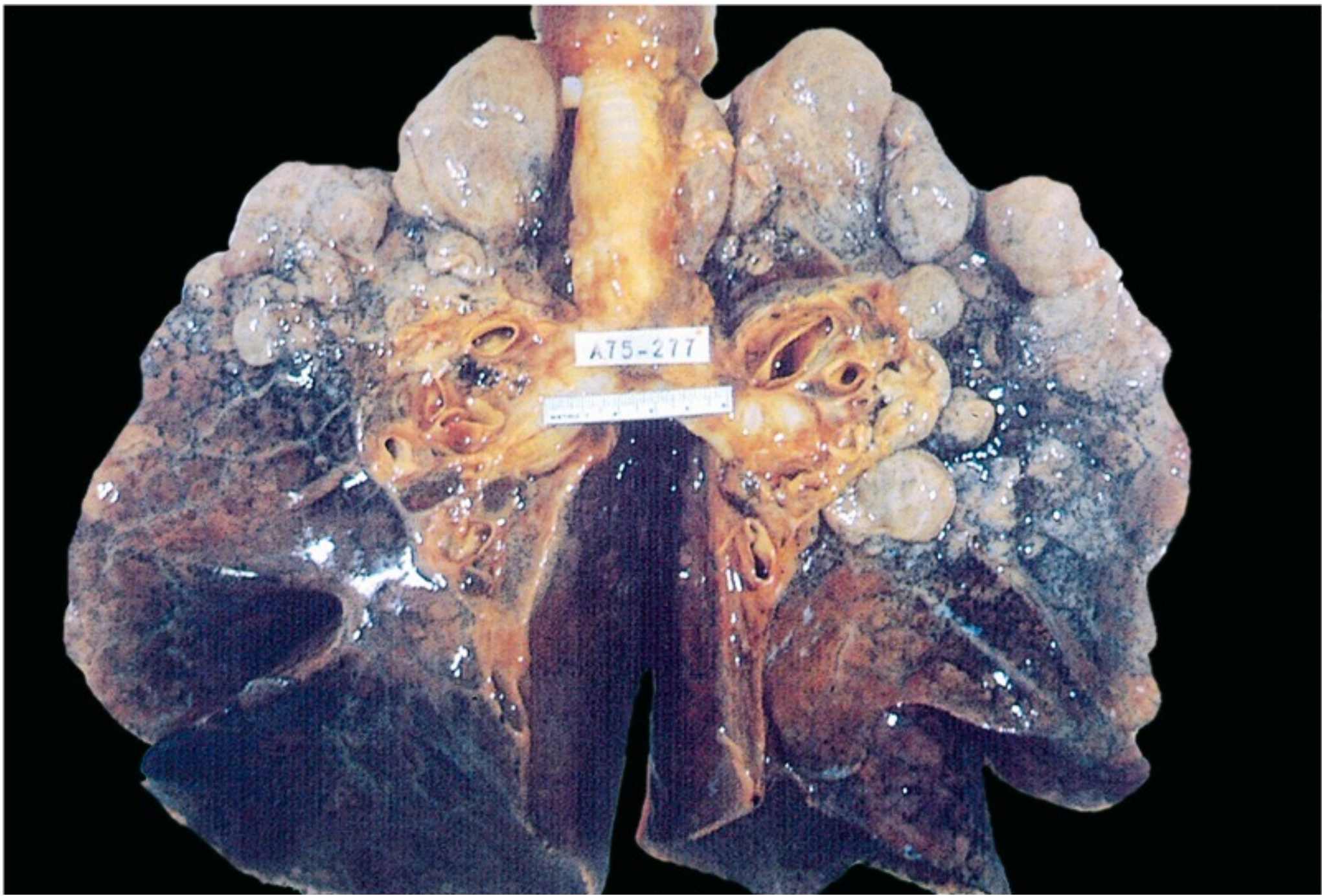
Emphysema

- Destruction/enlargement of airspaces
- Centriacinar emphysema
 - Destruction of proximal acinus
 - Worse in upper lobes of lung
 - Smoking
- Panacinar emphysema
 - Destruction of entire acinus
 - Worse in lower lobes of lung
 - Alpha-1-antitrypsin deficiency

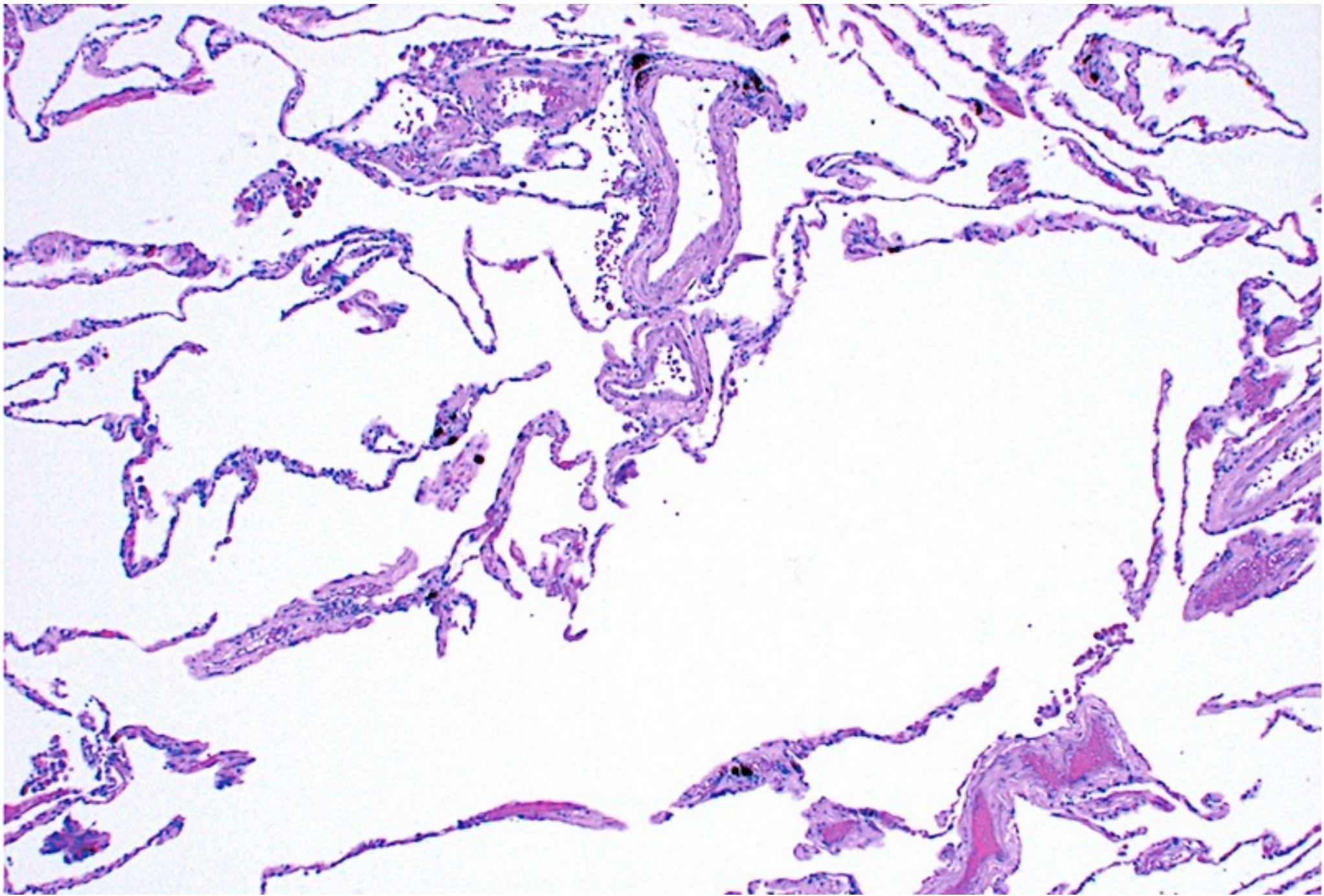


Pathogenesis of emphysema





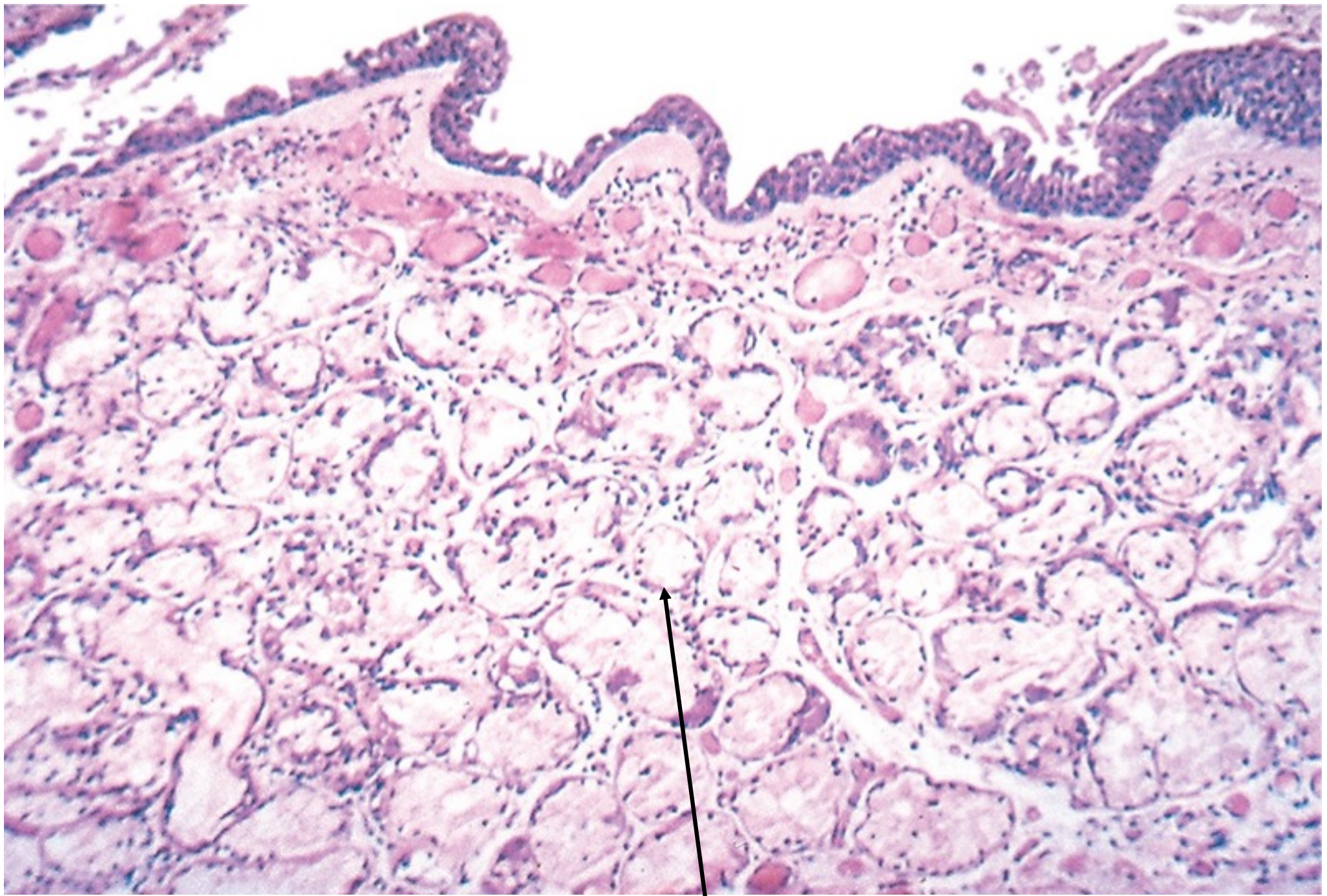
Emphysema: dilated air spaces



Emphysema: dilated air spaces

Chronic Bronchitis

- Definition: persistent, productive cough for ≥ 3 months in ≥ 2 consecutive years
- Pathogenesis: hypersecretion of mucous
- Cause: smoking (mostly) and pollution

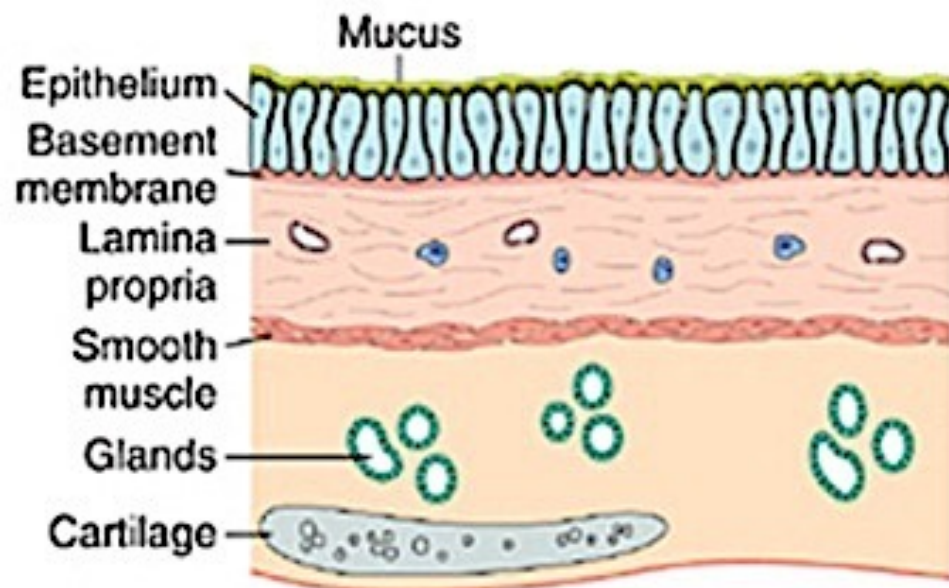


Chronic bronchitis: mucous gland hyperplasia

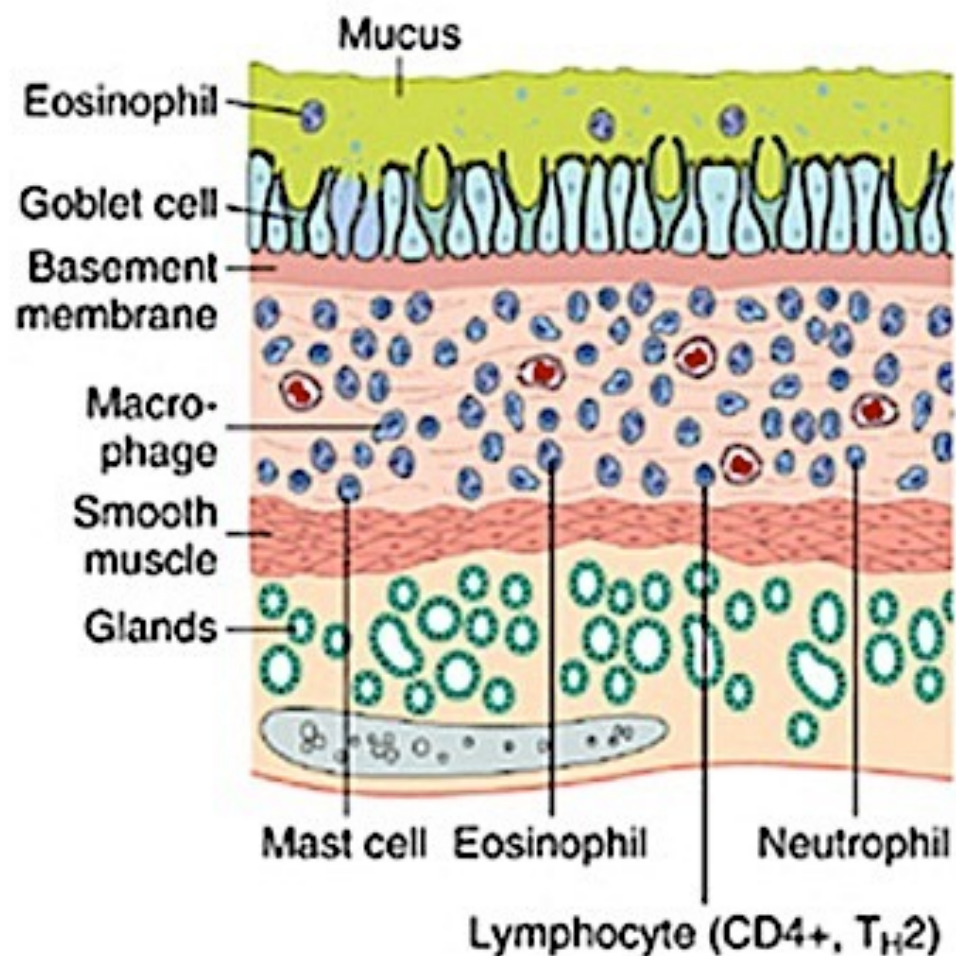
Asthma

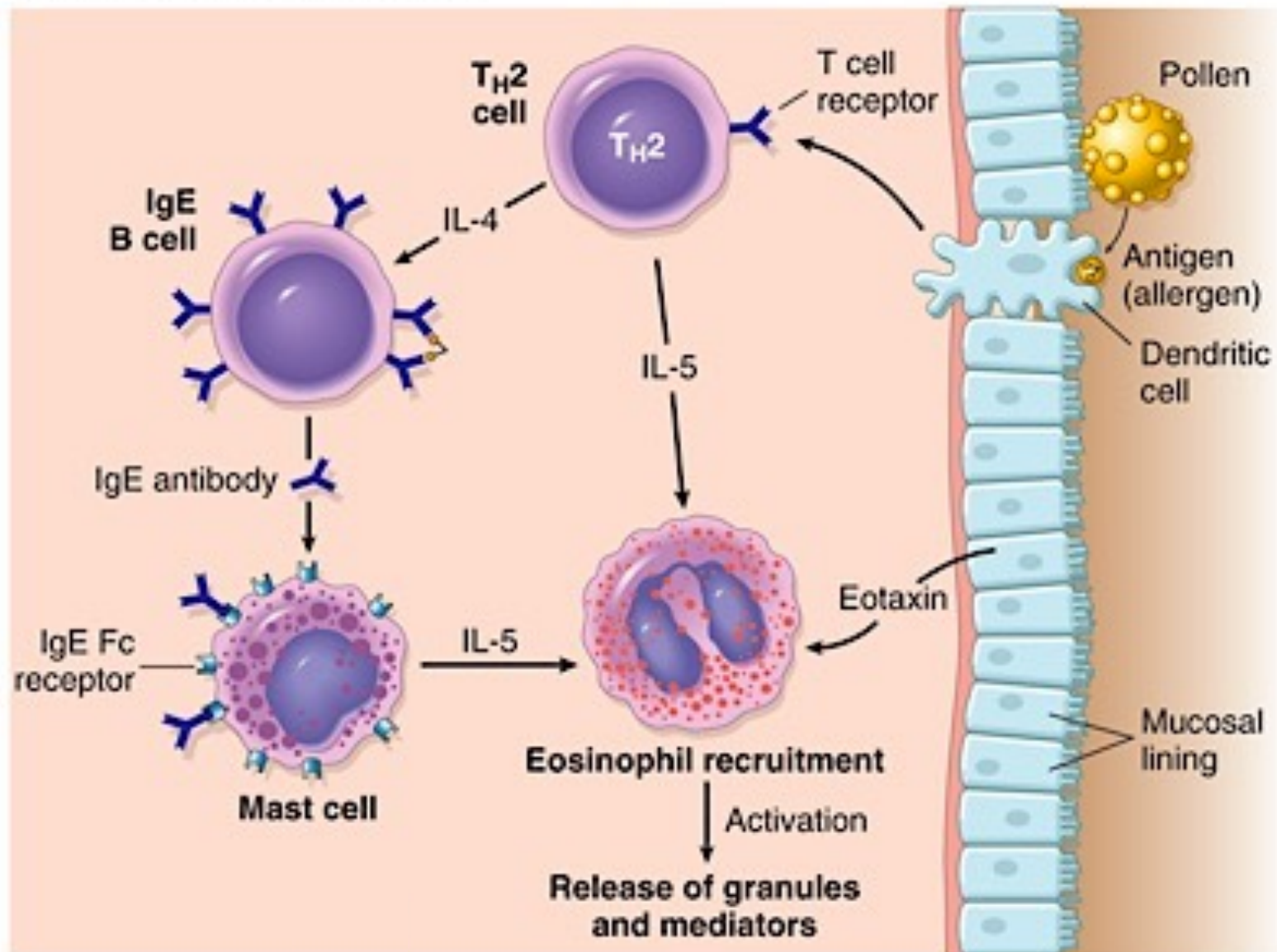
- Chronic inflammatory disease of airways leading to bronchial constriction
- Symptoms: wheezing, breathlessness
- Hallmarks: intermittent, reversible airway obstruction, chronic inflammation, increased mucus.
- Atopic (allergic) vs. non-atopic
- Triggers: allergens, infection, smoke, cold, exercise

NORMAL AIRWAY

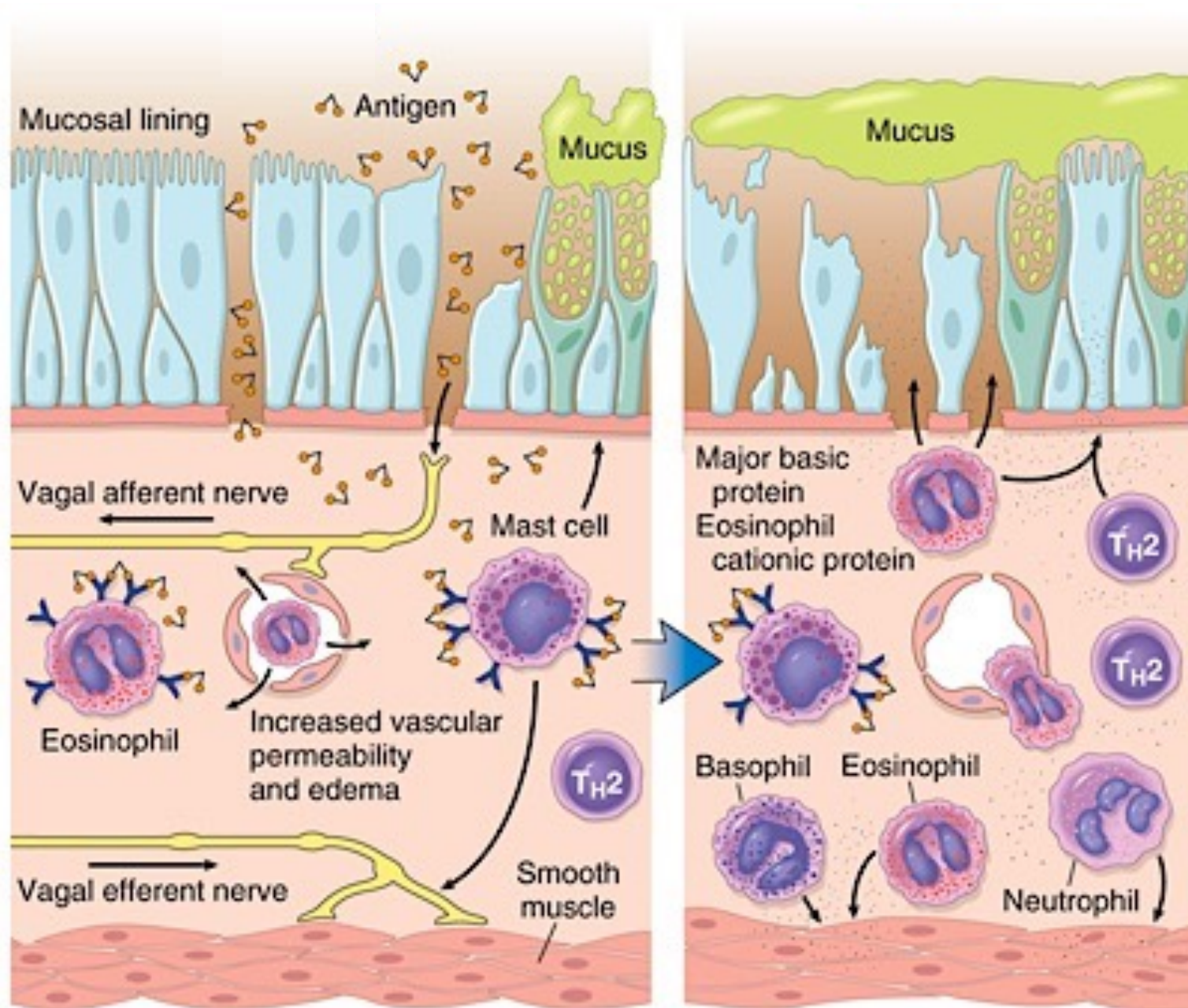


AIRWAY IN ASTHMA





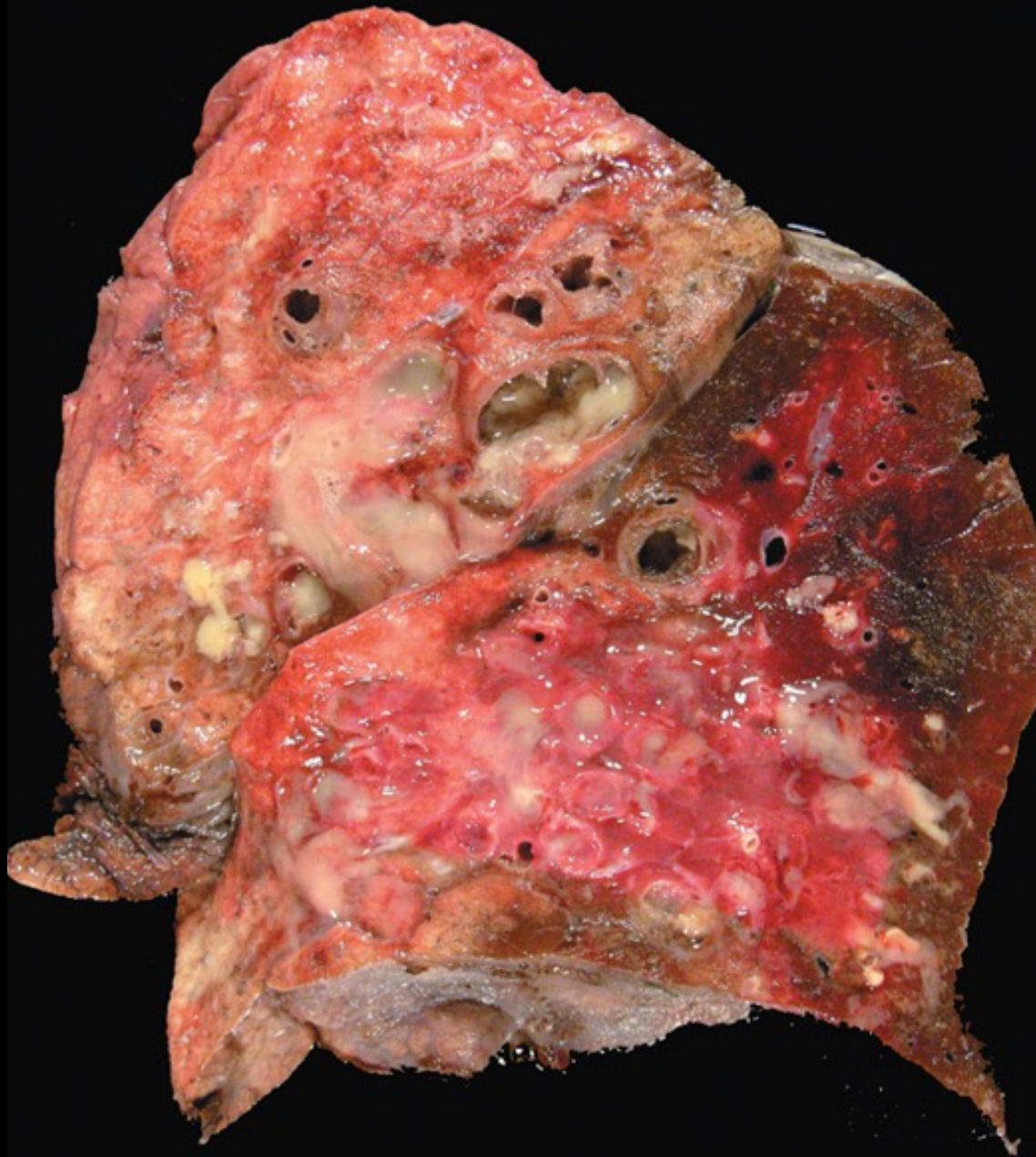
How is asthma triggered?



Then what happens?

Bronchiectasis

- Permanent dilation of bronchi and bronchioles due to chronic inflammation
- Secondary to:
 - obstruction (tumor)
 - congenital conditions (cystic fibrosis)
 - bad pneumonia



Bronchiectasis

Respiratory Pathology Outline

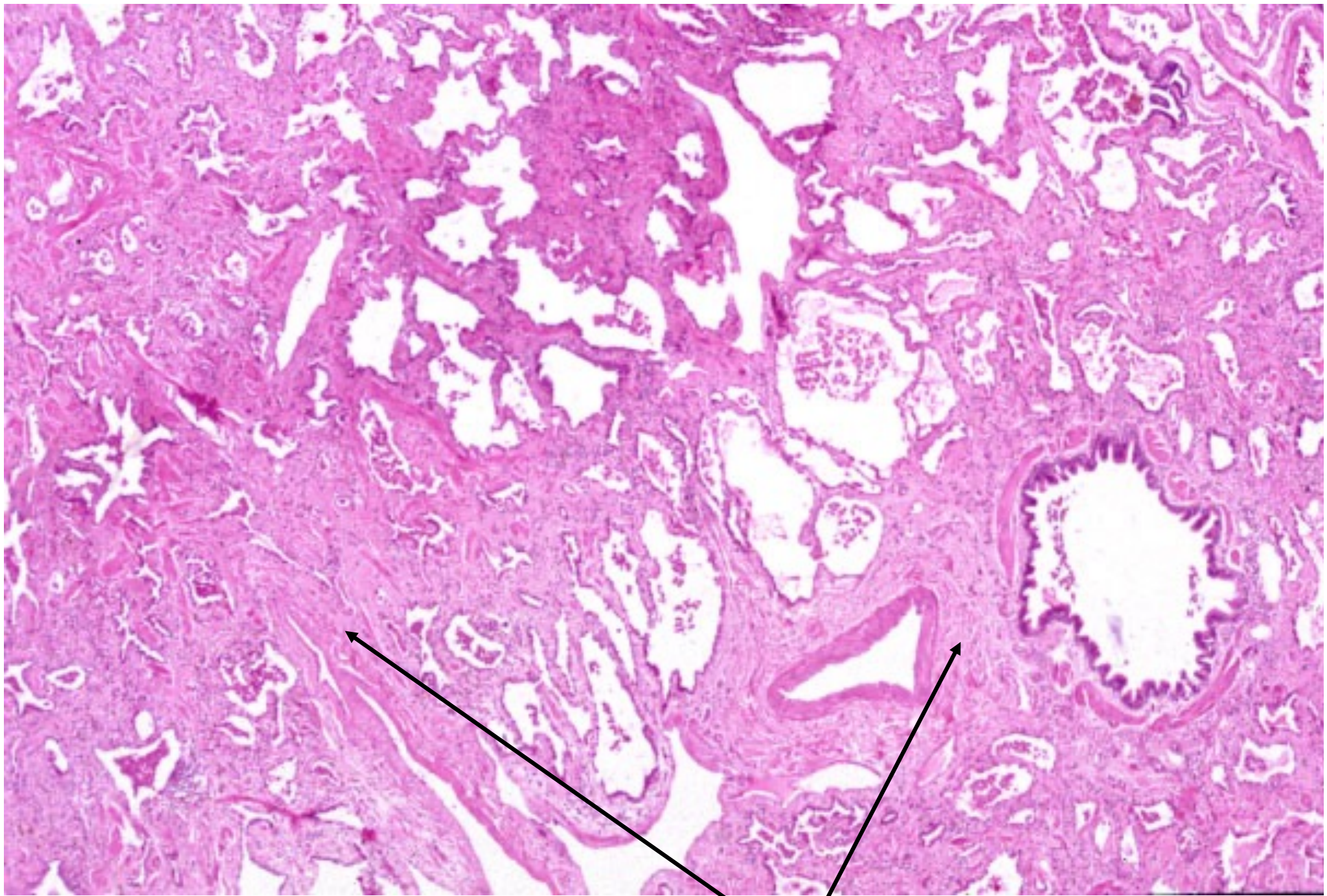
- Acute respiratory distress syndrome
- Obstructive lung diseases
- Restrictive lung diseases

Idiopathic pulmonary fibrosis

- Patchy, progressive lung fibrosis
- Symptoms: gradual onset cough, dyspnea. Respiratory failure and cor pulmonale within about 3 years
- Radiologic and histologic term: “usual interstitial pneumonia”



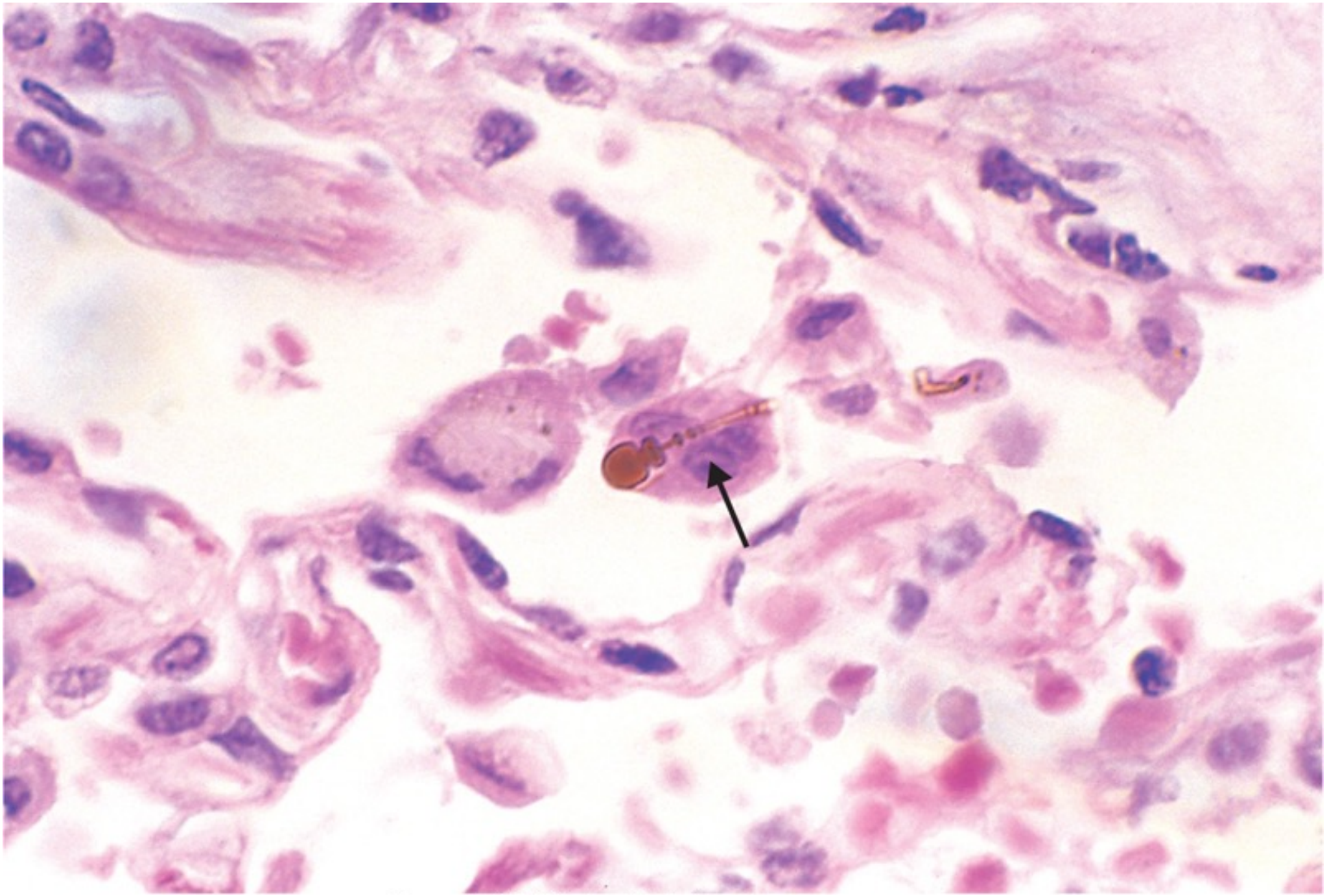
IPF: fibrotic lung



IPF: tons of fibrosis

Pneumoconioses

- Disorders caused by inhalation of mineral dusts
- Size matters (1-5 μm particles are worst)
- Three main dust particles:
 - Carbon (coal workers)
 - Silica (sandblasting, mining, ceramics)
 - Asbestos (mining, insulation removal)



Asbestos fibers

Respiratory Pathology Outline

- Acute respiratory distress syndrome
- Obstructive lung diseases
- Restrictive lung diseases
- Vascular diseases

Pulmonary embolism

- Most arise from leg veins
- Small emboli may be asymptomatic, cause infarction, or cause hemoptysis
- Medium-sized emboli (less common) cause shortness of breath and infarction
- Large emboli (even less common) can cause sudden death



Pulmonary embolism



Pulmonary infarcts

Respiratory Pathology Outline

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- Infections

Pneumonia

- 1/6 of all deaths in the US!
- Can be acute or chronic
- Causes: bacteria, viruses
- Different anatomic patterns
- Different clinical settings

Typical bugs in different clinical settings

Community-acquired

- *Streptococcus pneumoniae*
- *Haemophilus influenzae*
- *Mycoplasma pneumoniae*
- viruses

Nosocomial

- gram-negative rods
- *Staphylococcus aureus*

Aspiration

- Anaerobic bacteria

Immunocompromised

- Cytomegalovirus
- *Pneumocystis jiroveci*
- *Aspergillus*

Chronic

- *Mycobacterium tuberculosis*
- *Histoplasma capsulatum*

Most community-acquired pneumonias are one of these:

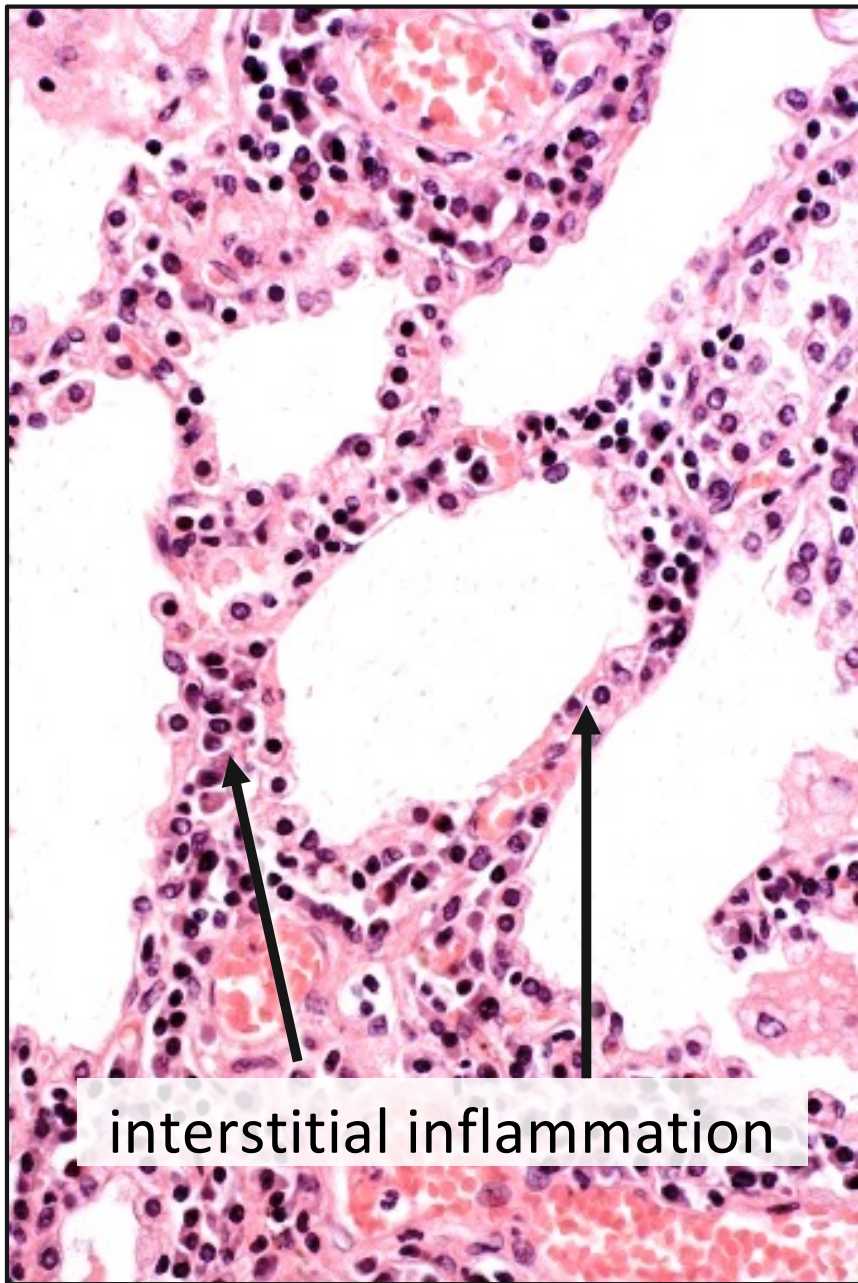
Alveolar

- *Streptococcus pneumoniae**
- *Staphylococcus aureus*
- *Hemophilus influenzae*

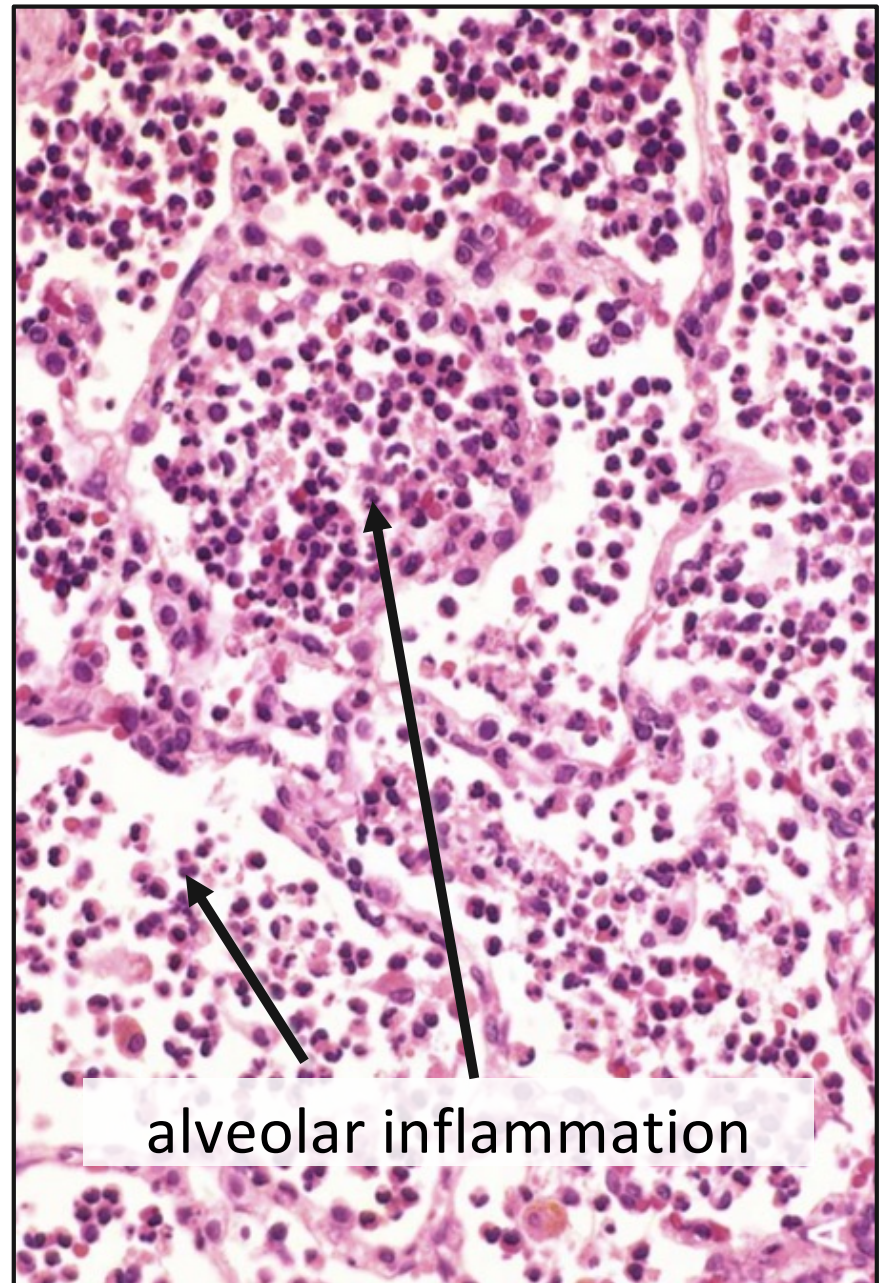
Interstitial

- viruses
- *Mycoplasma pneumoniae*

* Most common



Viral pneumonia



Bacterial pneumonia

Lung abscess

- Localized collection of pus
- Bugs: *Staph*, *Strep*, gram-negative bugs, anaerobes, or mixture
- Pathogenesis: aspiration of infected material (from teeth, sinuses), aspiration of gastric contents, as complication of nasty bacterial pneumonia



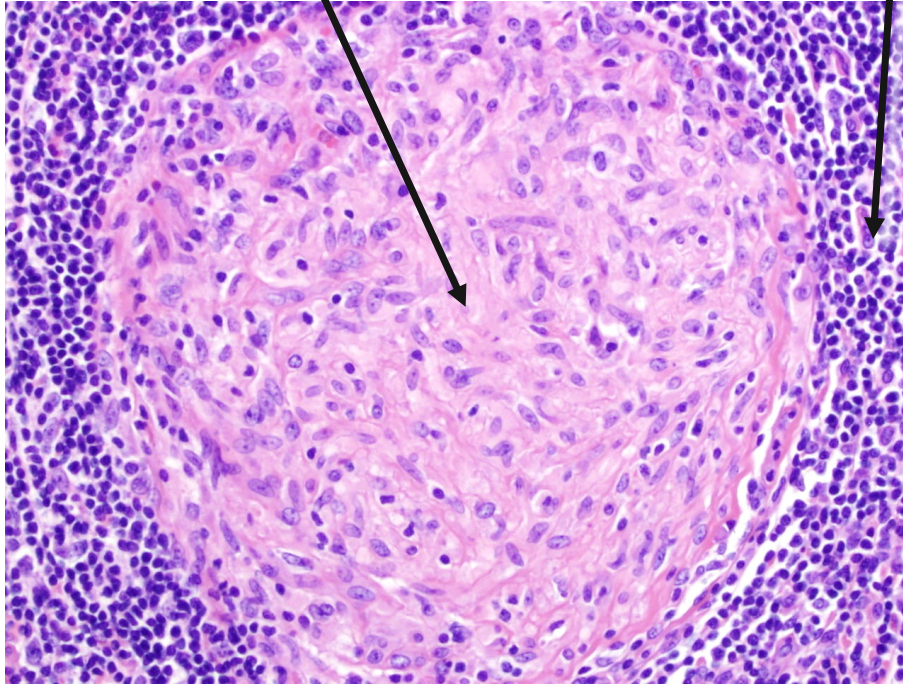
Lung abscess

Tuberculosis

- Cause: *Mycobacterium tuberculosis*
- Chronic, granulomatous disease that can involve any organ but often involves lungs
- Spread by respiratory droplet
- Primary (initial) TB: Ghon complex.
- Secondary (reactivation) TB: Cavitating granulomas.

just macrophages
(no necrotic debris)

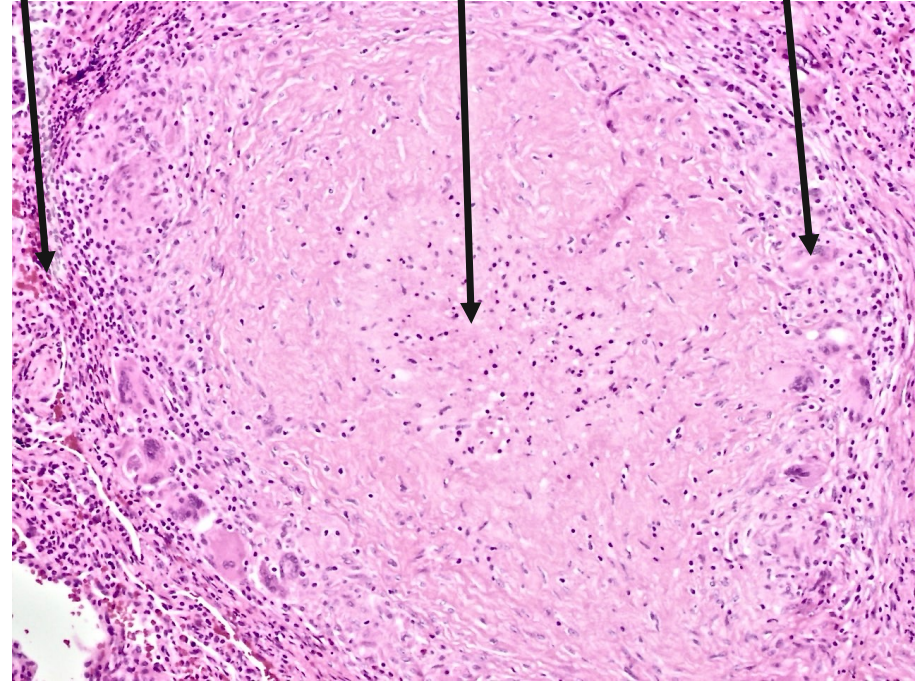
lymphocytes



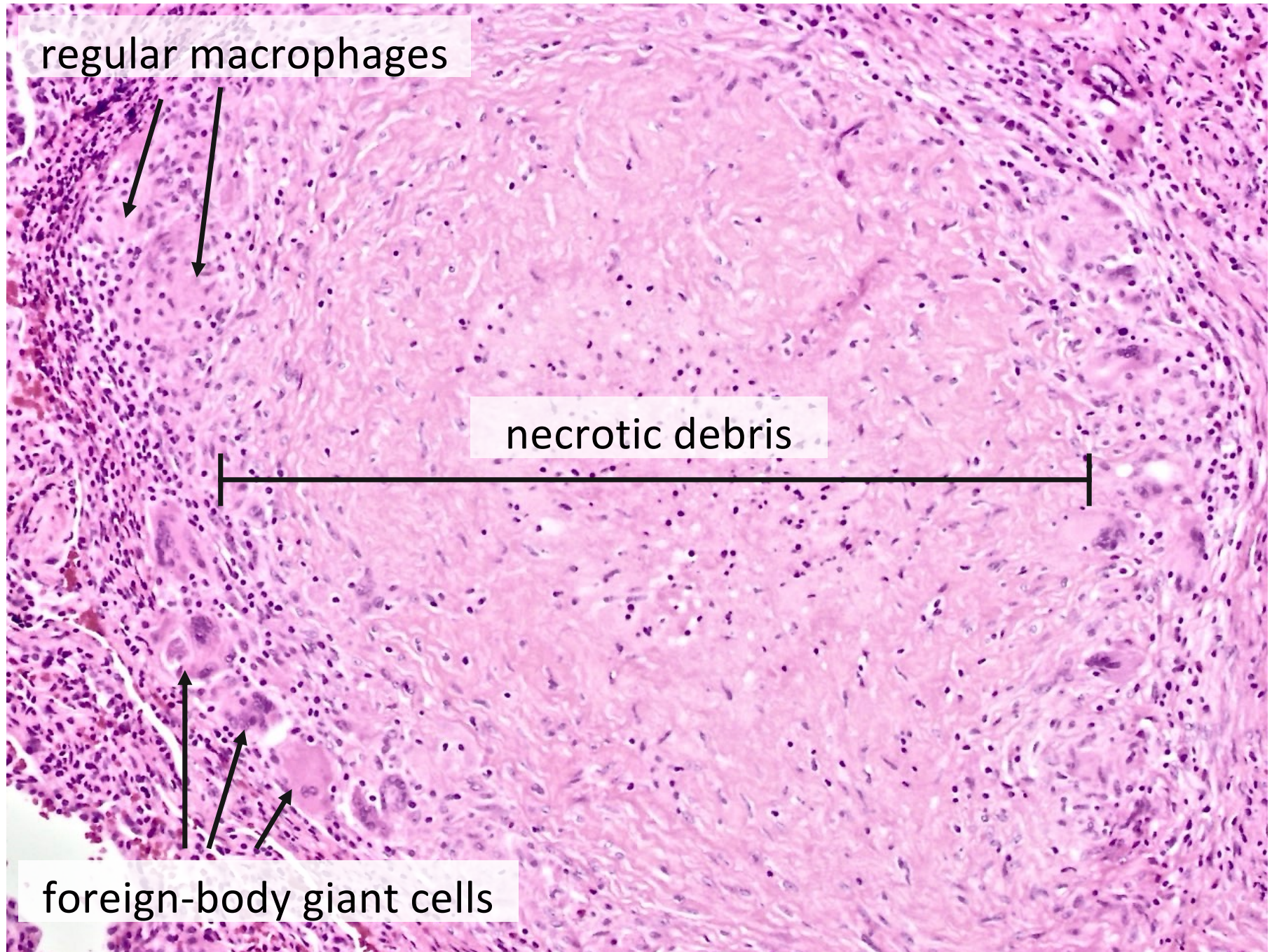
Regular (non-caseating)
granuloma

necrotic debris

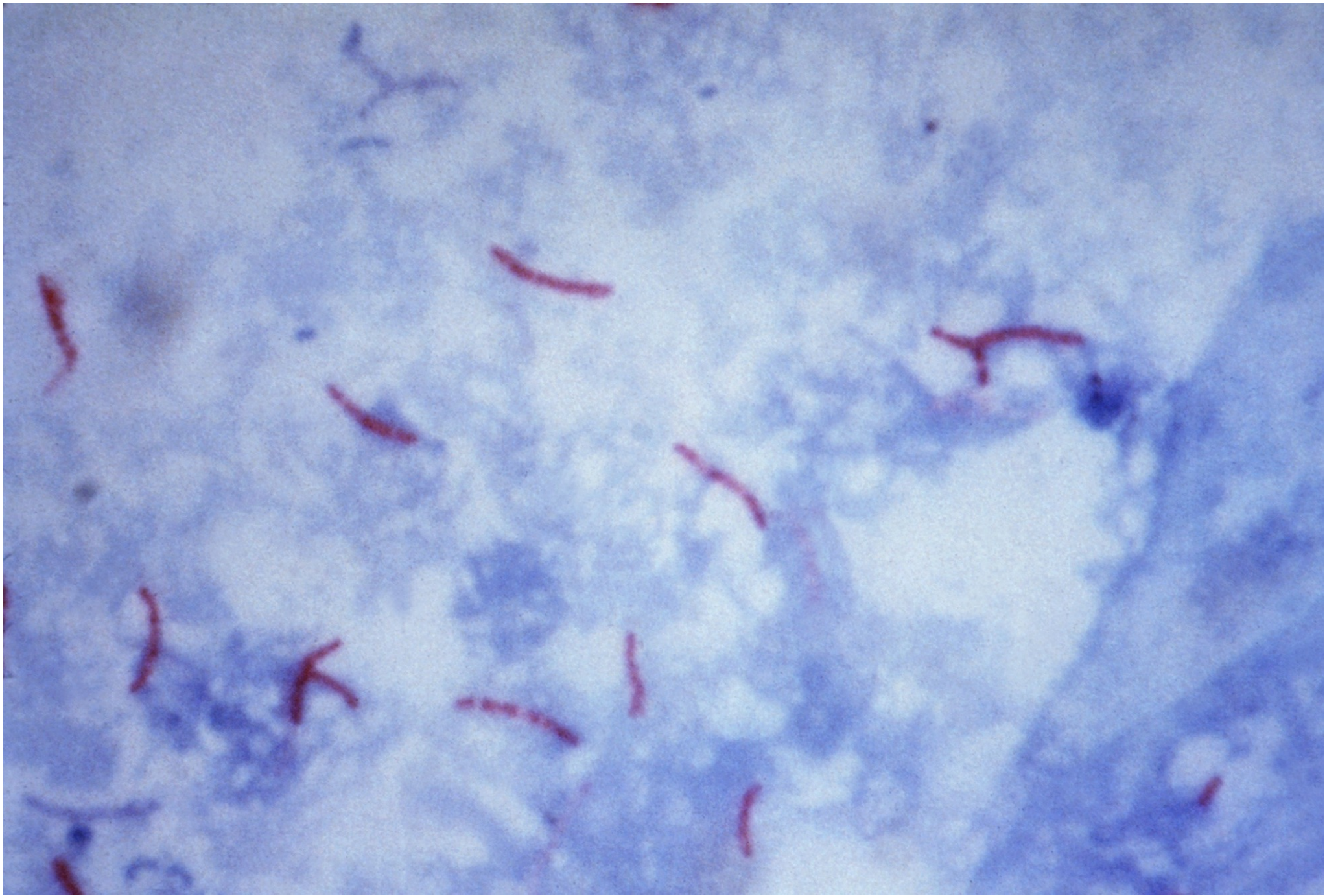
macrophages



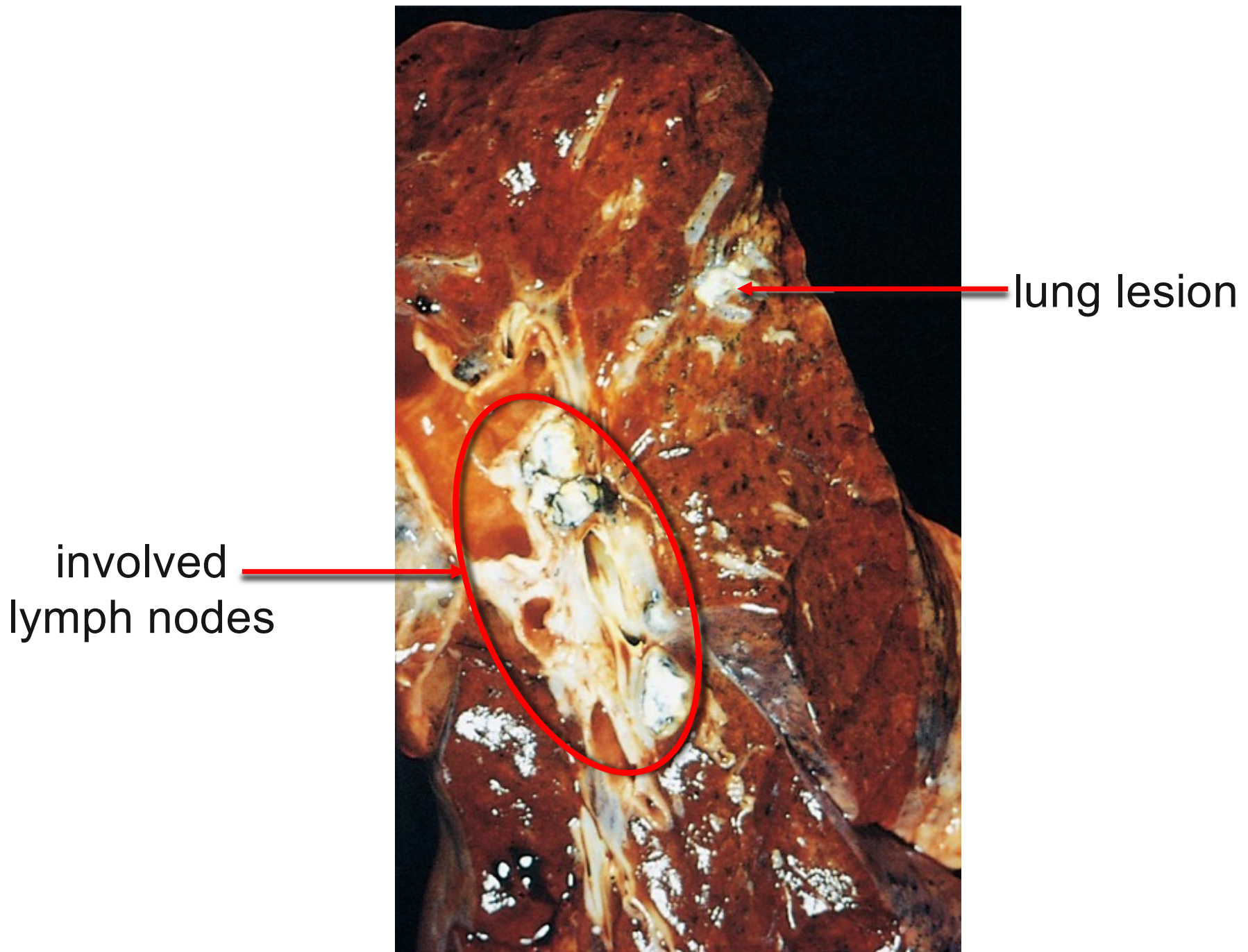
Caseating granuloma



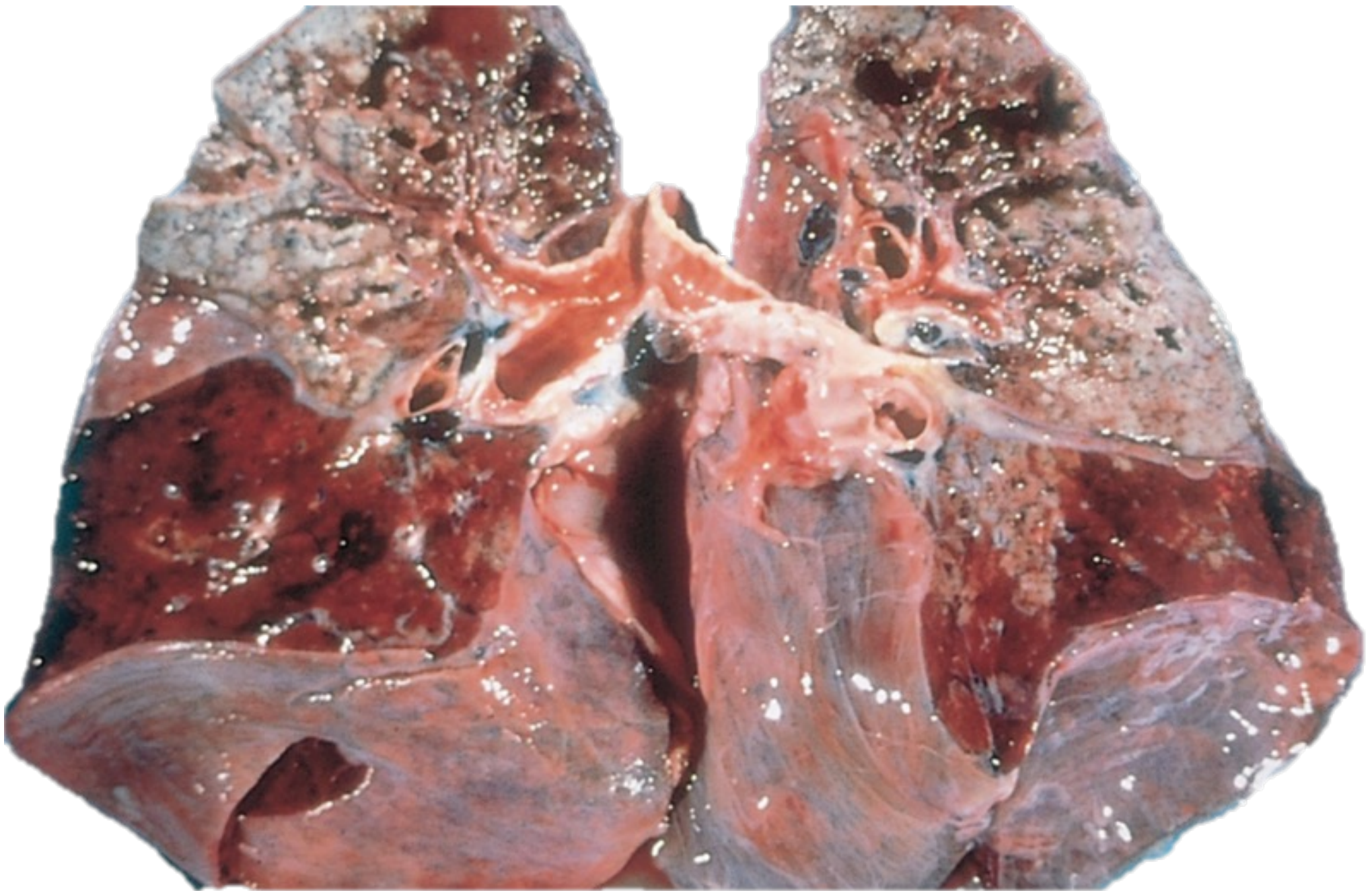
Caseating granuloma



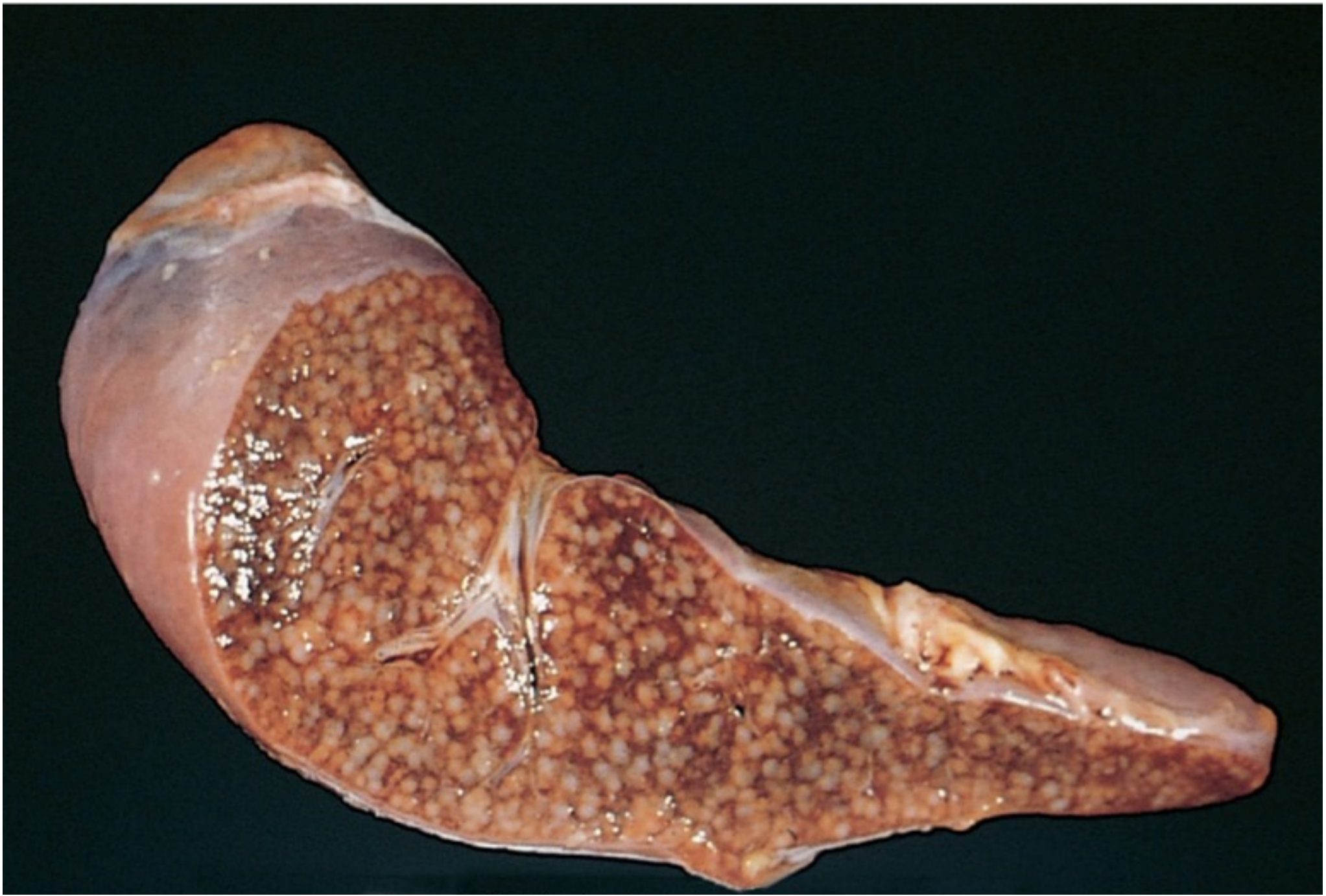
TB organisms (acid-fast stain)



Ghon complex: lung lesion + involved nodes



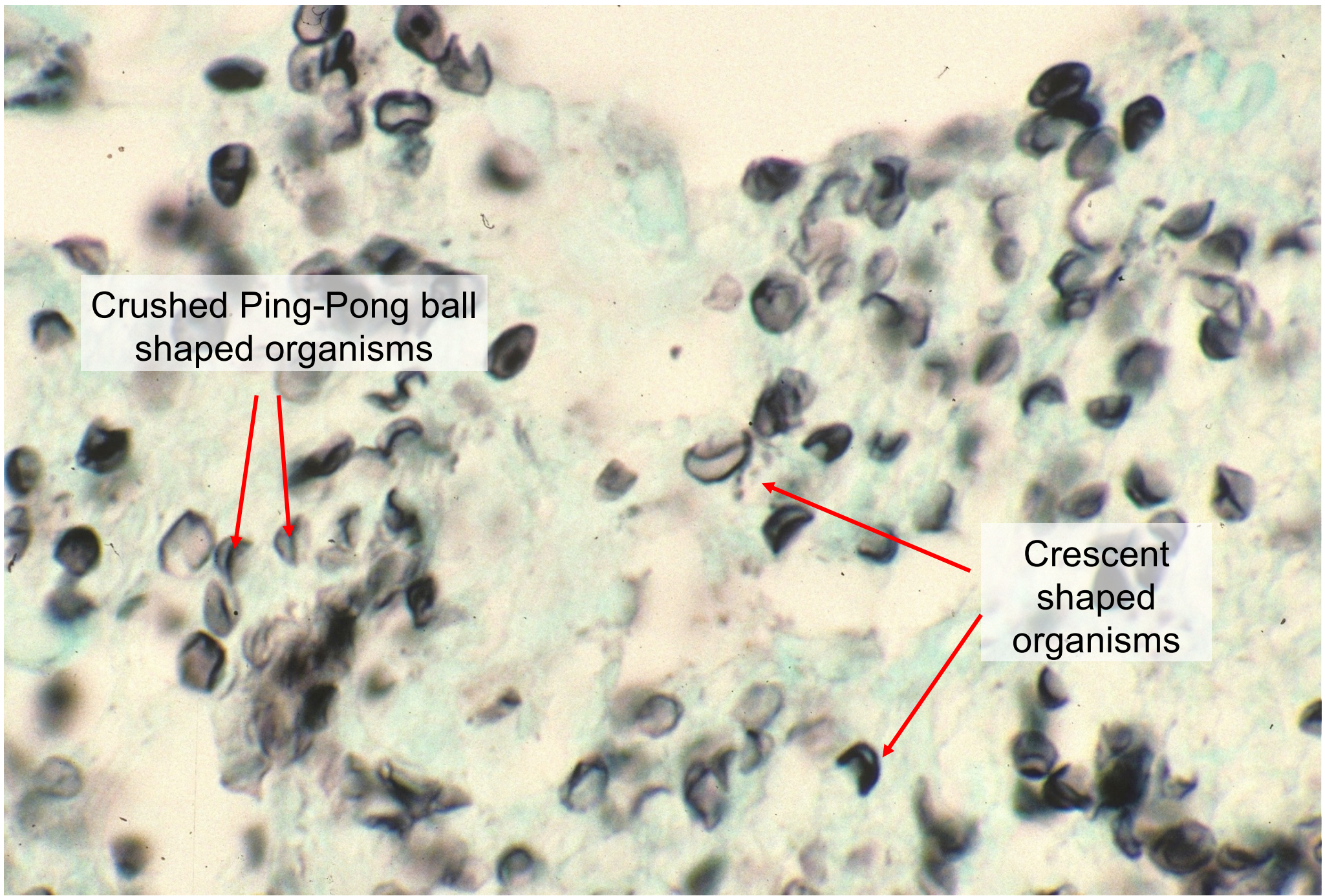
Secondary TB: tons of caseating, cavitating necrosis



Spleen: miliary TB

Opportunistic pneumonias

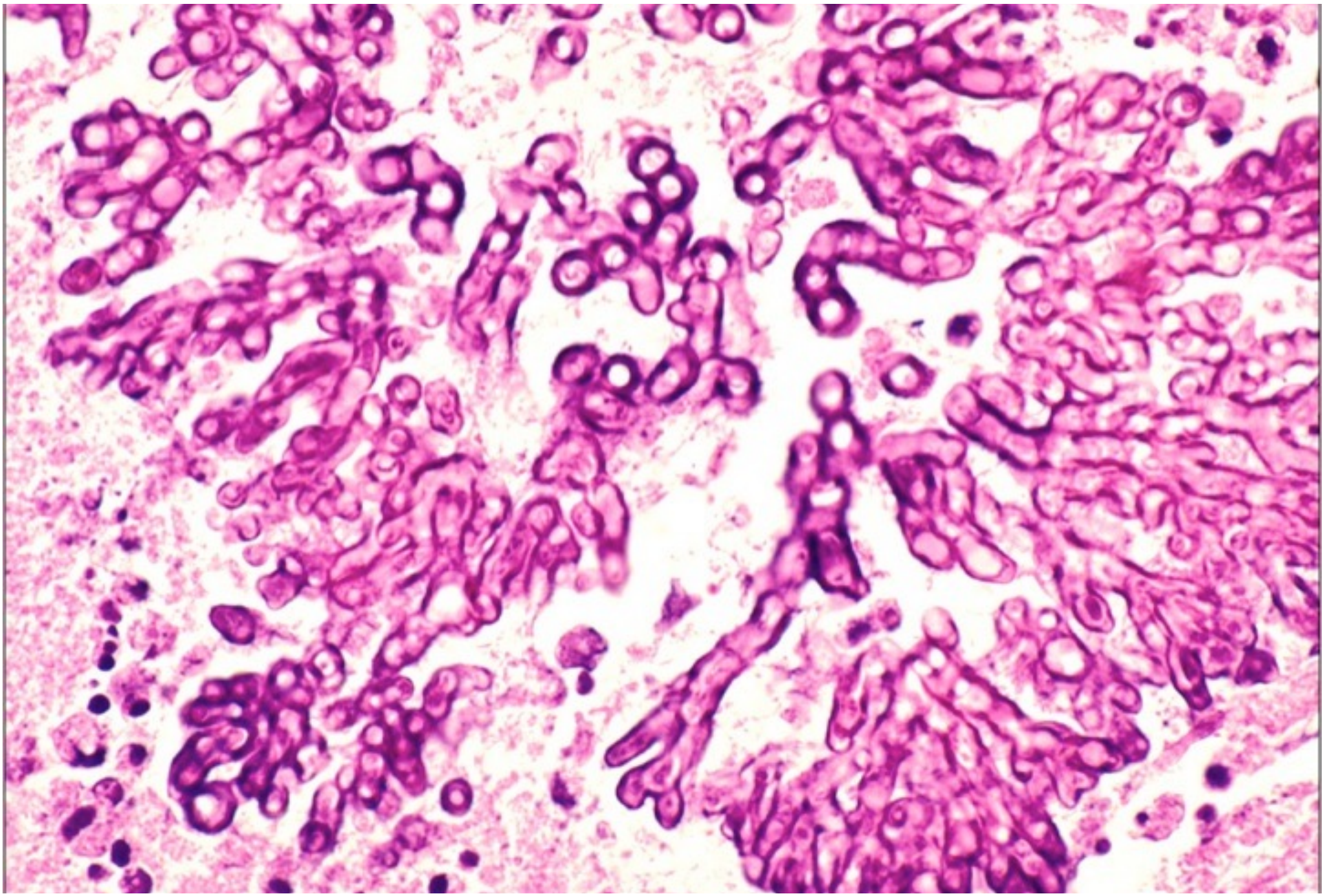
- Affect immunosuppressed patients (patients with AIDS, cancer, post-transplant)
- Unusual organisms:
 - *Pneumocystis jiroveci*
 - *Aspergillus*
 - *Cytomegalovirus*



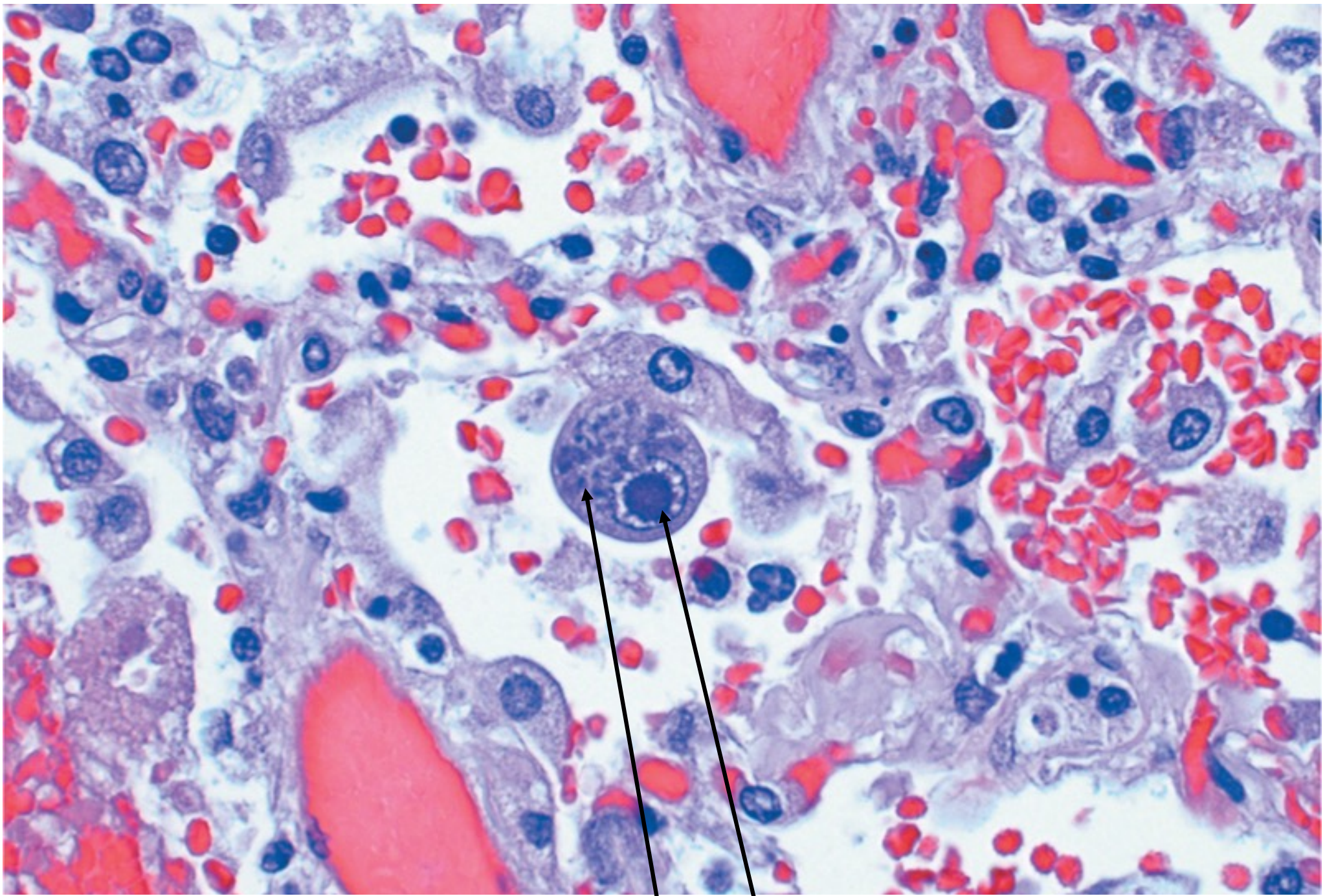
Crushed Ping-Pong ball
shaped organisms

Crescent
shaped
organisms

Pneumocystis



Aspergillus

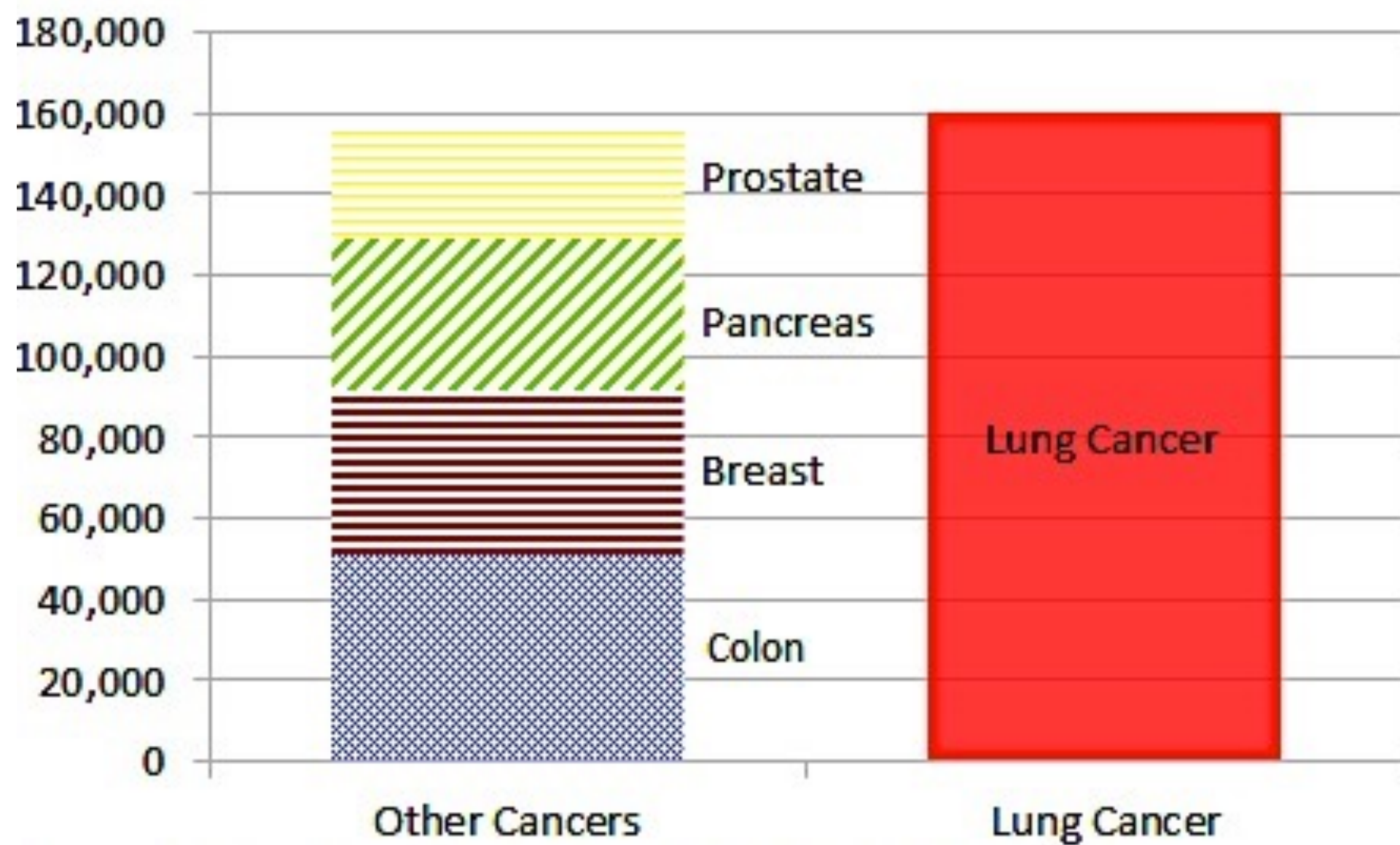


Cytomegalovirus (two kinds of inclusions)

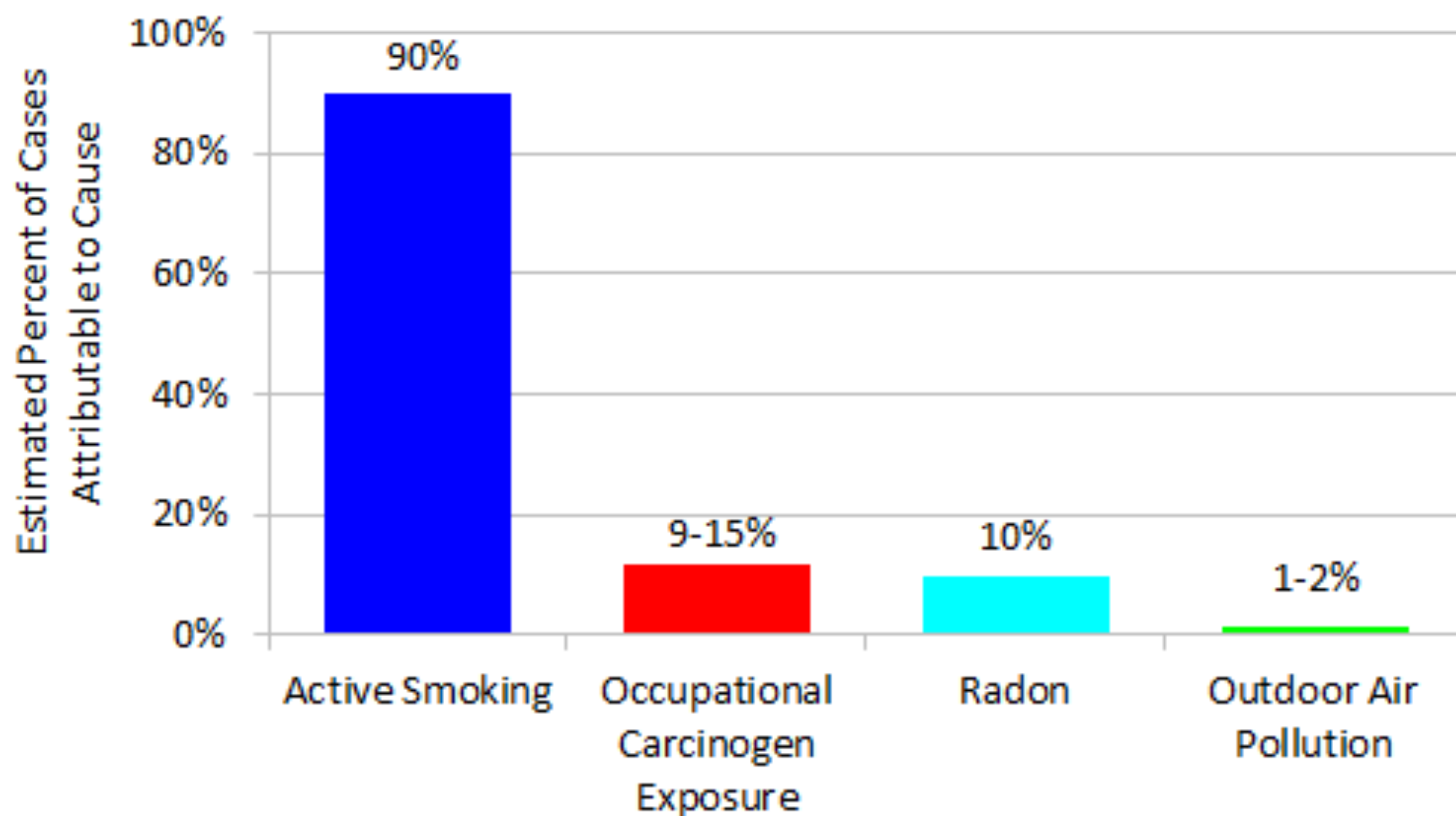
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Estimated Cancer Deaths by Site, 2012



Estimated Attributable Portion of Lung Cancer Cases by Cause



Types of lung cancer

Adenocarcinoma

Squamous cell carcinoma

Large cell carcinoma

Small cell carcinoma

Types of lung cancer

NSCLC →

Adenocarcinoma

Squamous cell carcinoma

Large cell carcinoma

SCLC →

Small cell carcinoma

Presenting symptoms

Potentially curable

- asymptomatic
- cough
- hemoptysis

Usually incurable

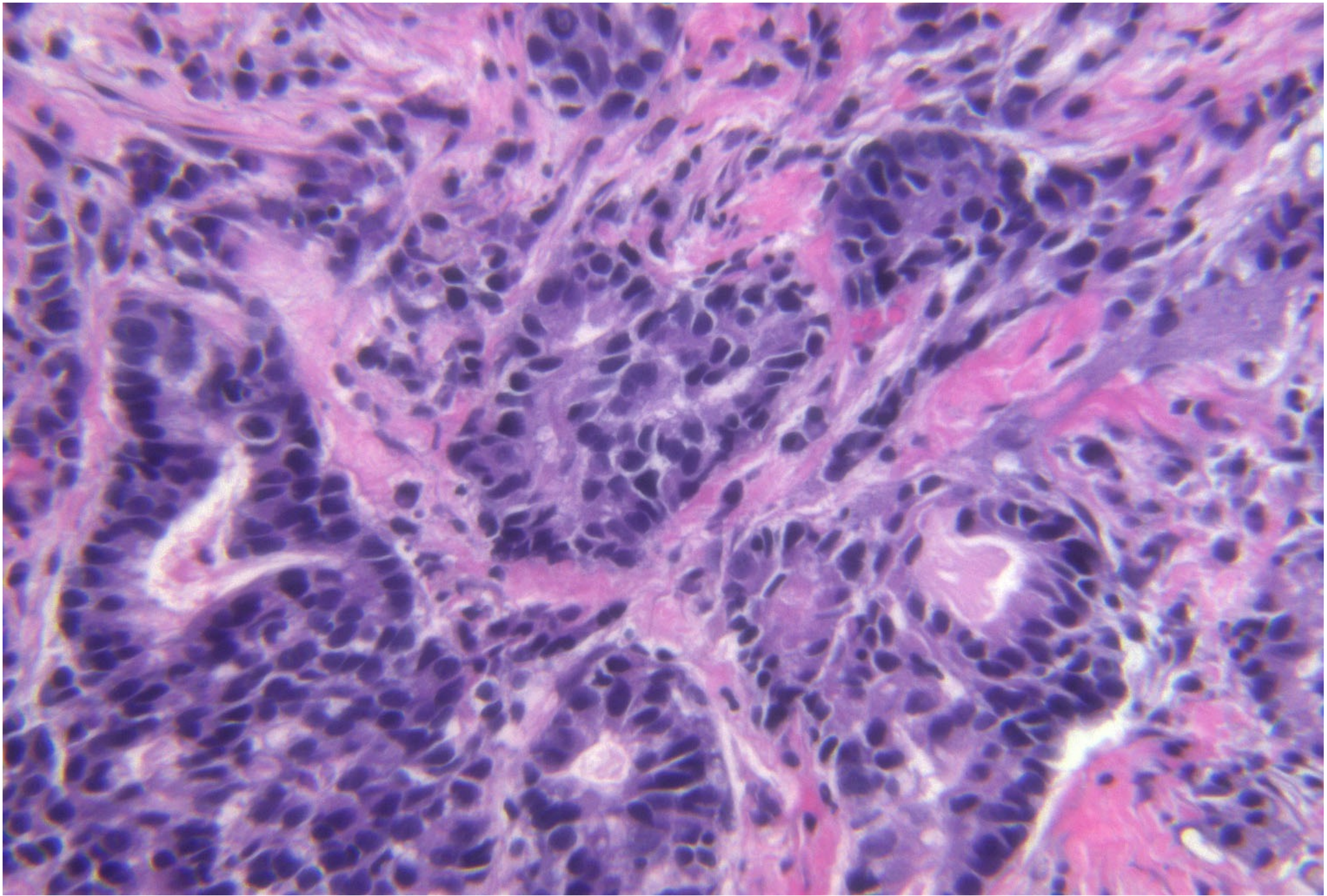
- dyspnea
- chest pain
- anorexia & weight loss
- hoarseness
- bone pain

Survival statistics...bad.

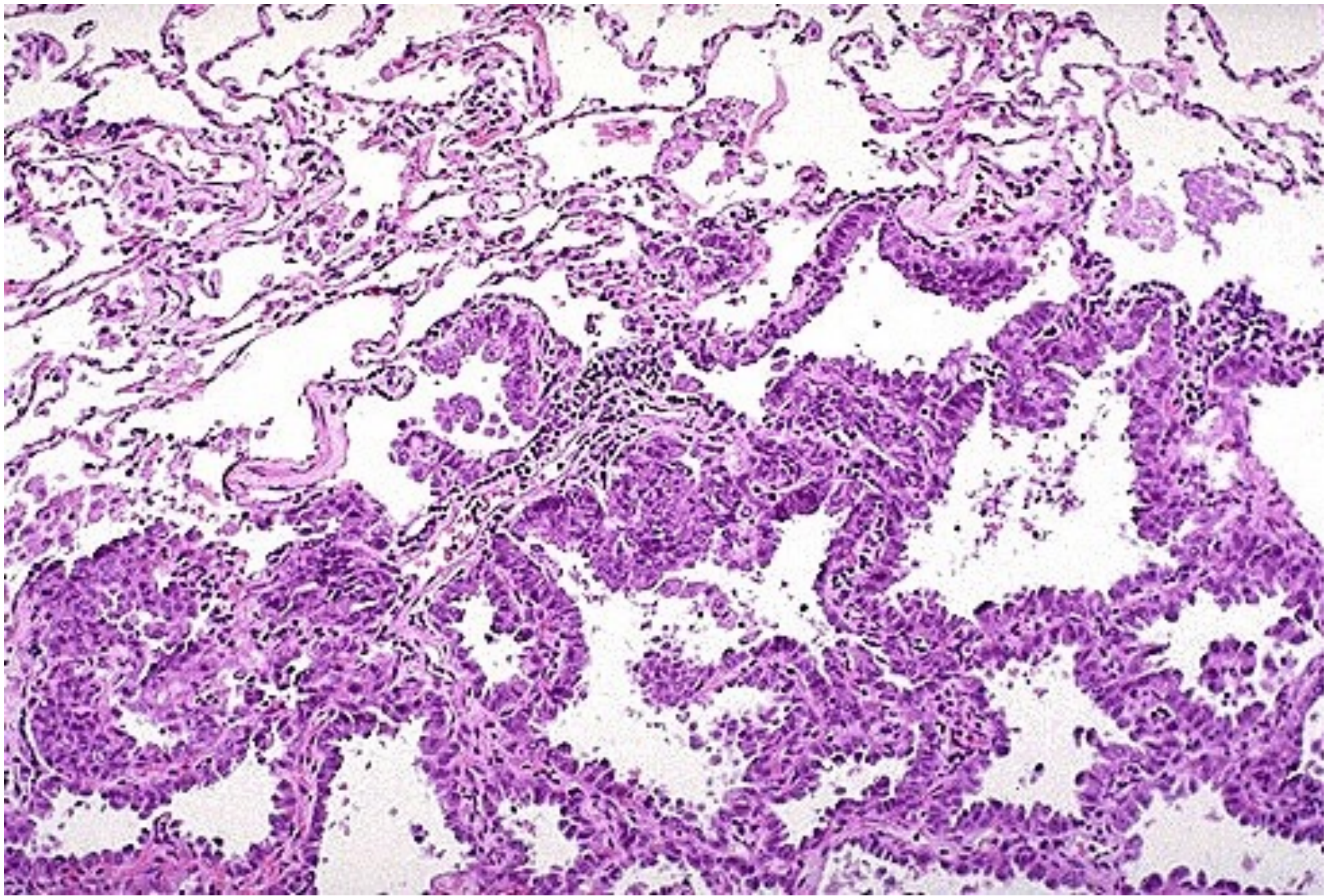
- At diagnosis, >50% have metastases
- Overall (all stages) 5ys = 16%
- Localized disease 5ys = 45%

Adenocarcinoma

- Most common type, especially in women and non-smokers
- Usually peripherally located
- Adenocarcinoma in situ is a rare form of adenocarcinoma with a better prognosis (5ys = 40%)



Adenocarcinoma



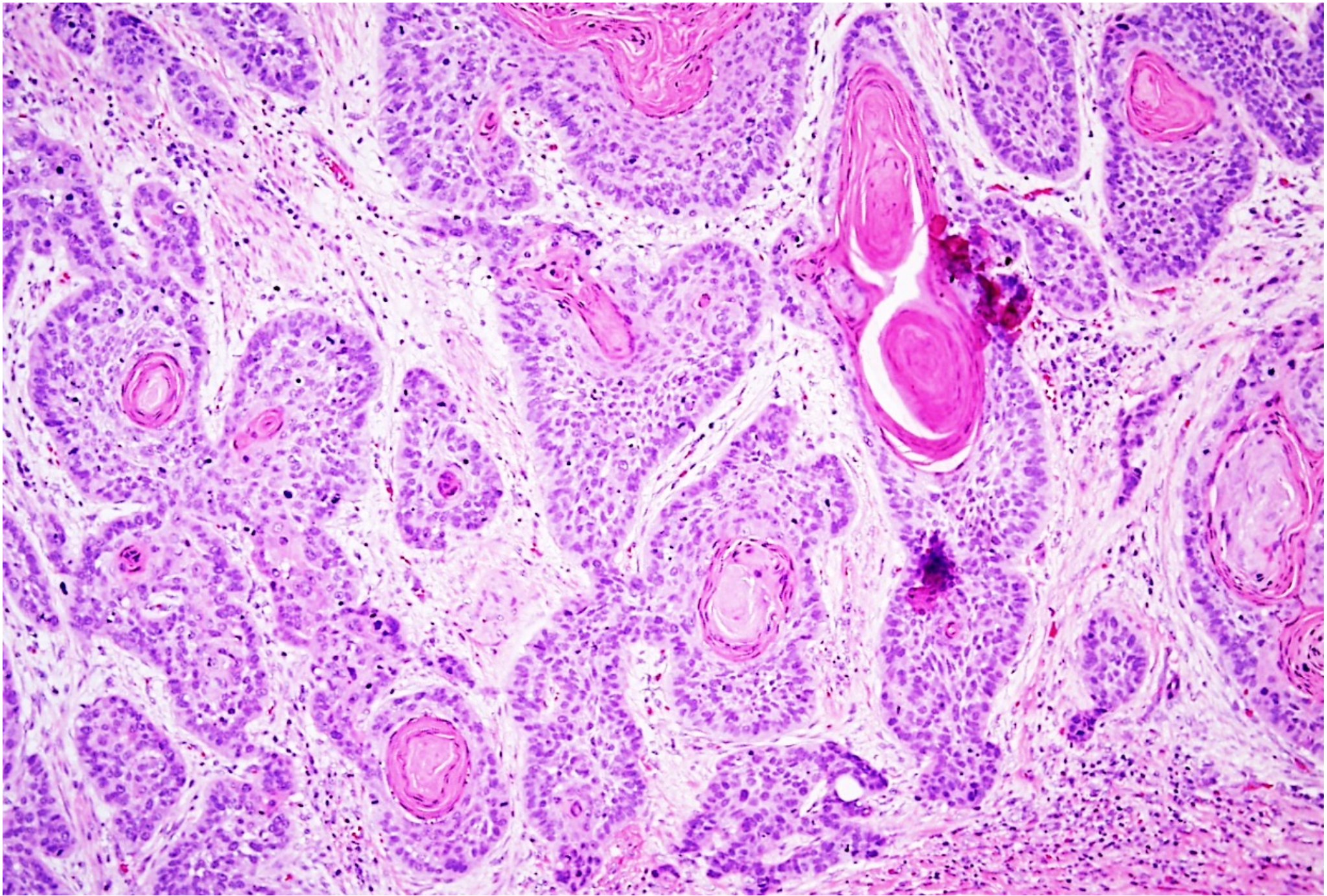
Adenocarcinoma in situ

Squamous cell carcinoma

- Malignant tumor of squamous cells
- Usually centrally located
- Usually preceded by distinct lesions

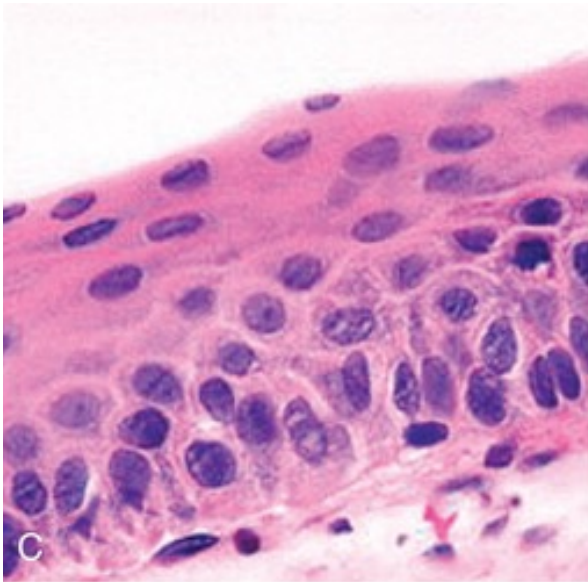


Squamous cell carcinoma

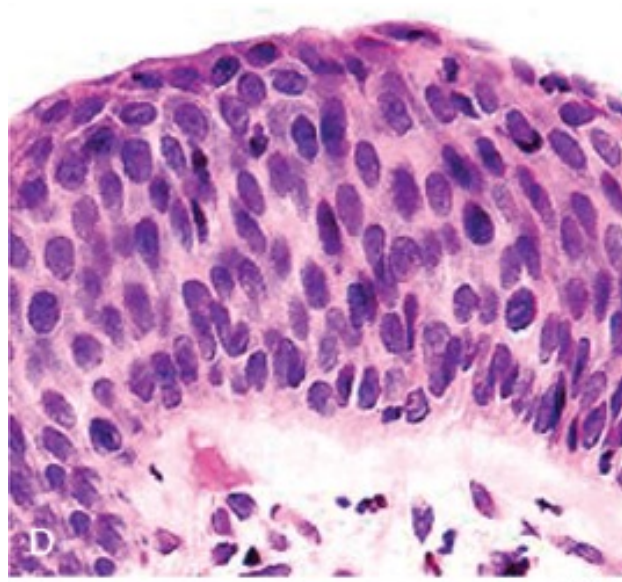


Squamous cell carcinoma

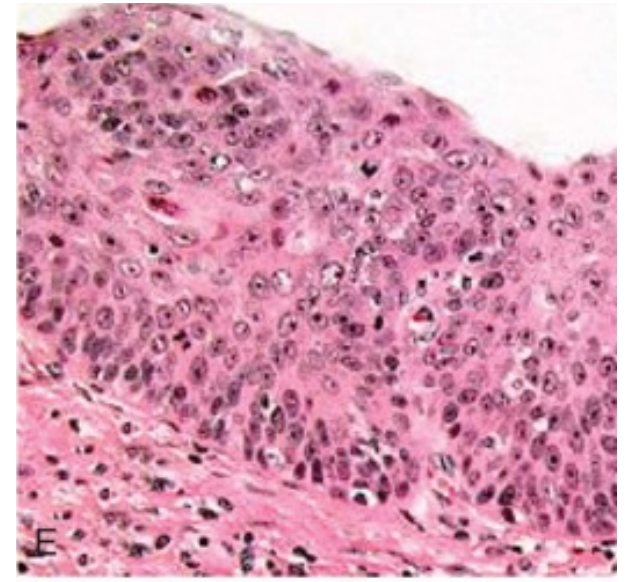
Squamous cell carcinoma precursor lesions



squamous metaplasia



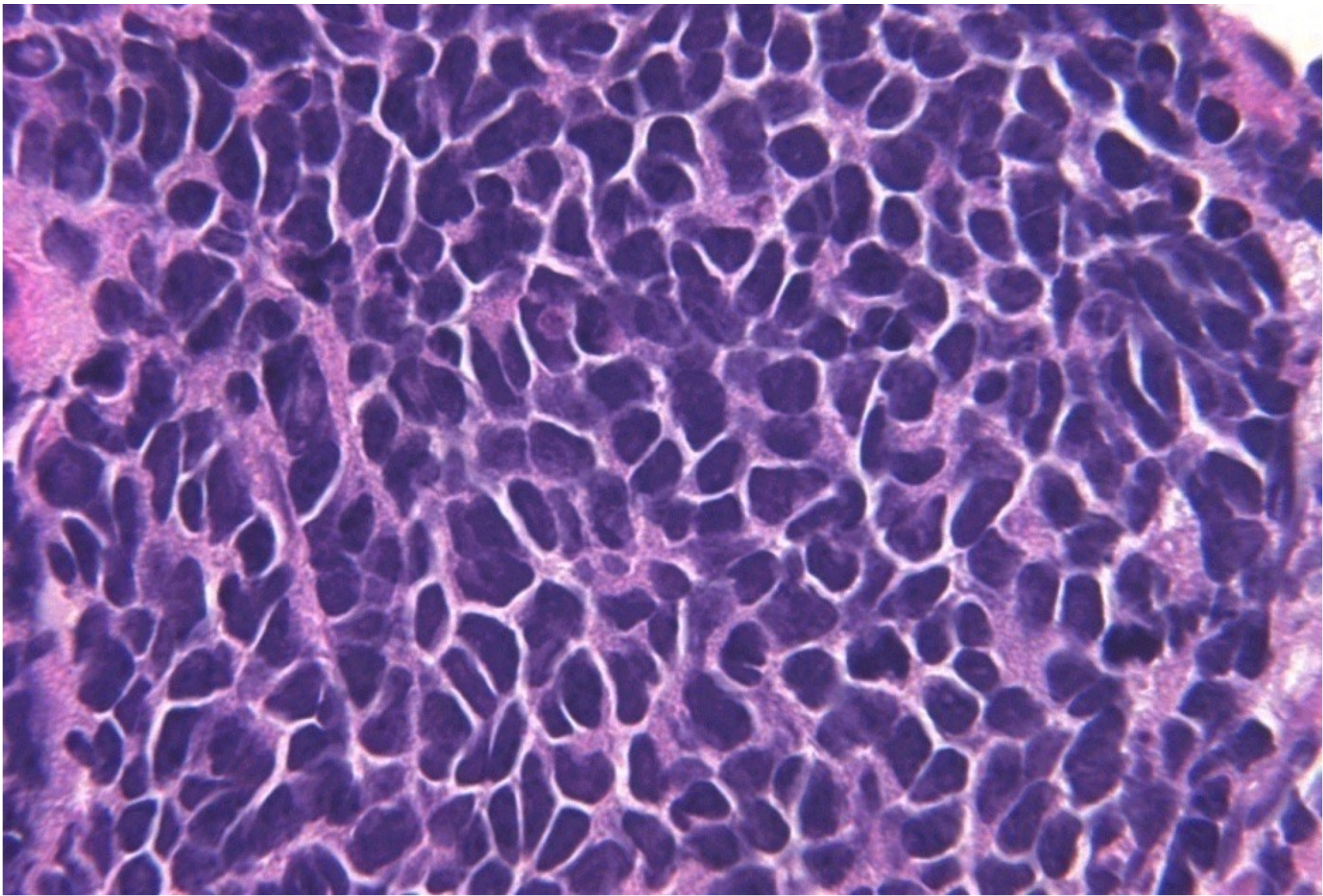
dysplasia



carcinoma in situ

Small cell carcinoma

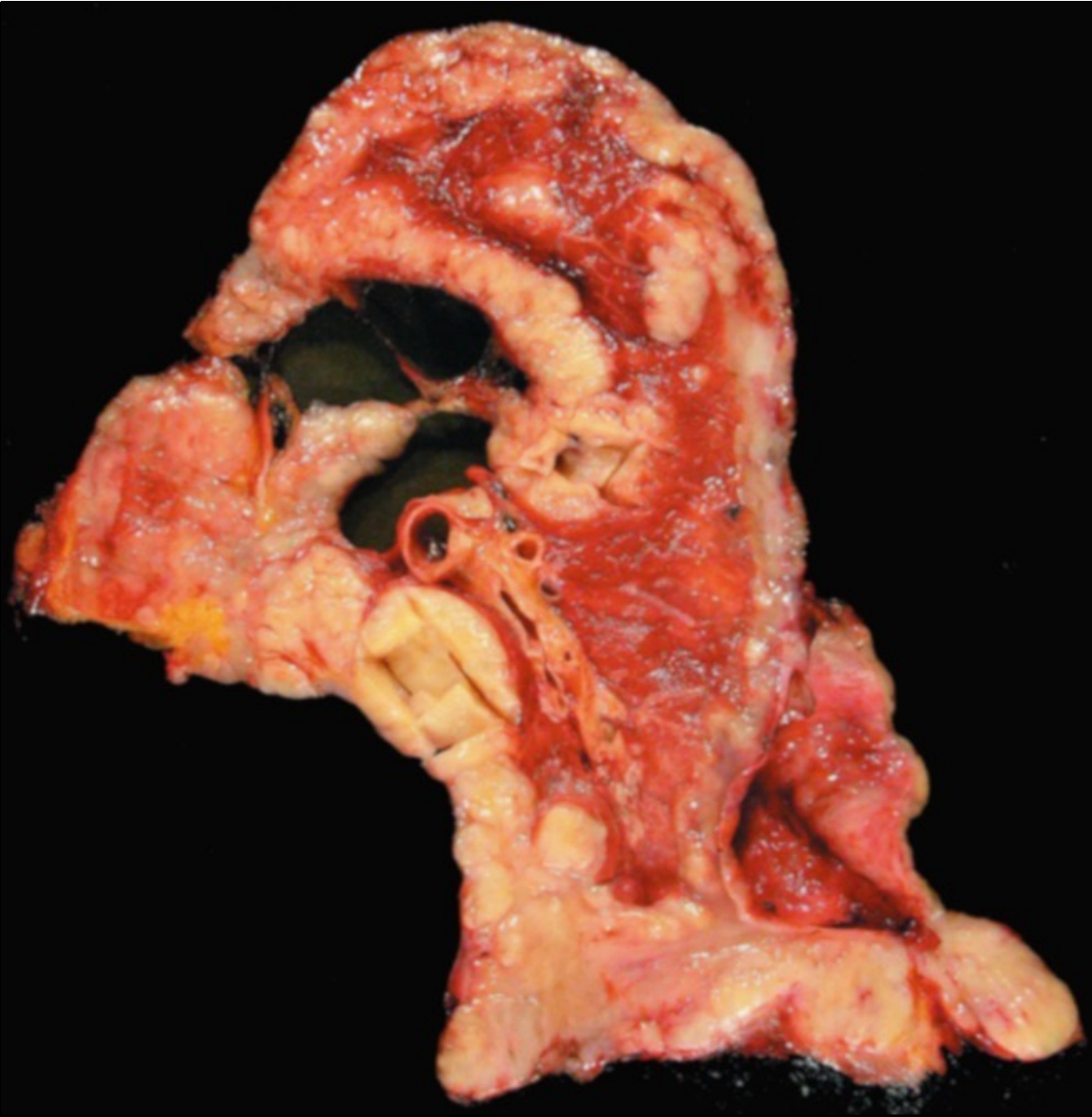
- VERY high mortality
- Small cells, minimal cytoplasm, “molding”
- High growth fraction yet treatment ineffective
- Median survival (with treatment) = 1 year



Small cell carcinoma

Mesothelioma

- Malignant tumor of mesothelial cells
- Most patients have had asbestos exposure
- Not related to smoking
- Highly malignant; short survival.



Mesothelioma