RESPIRATORY BLOCK

PNEUMONIA

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Objectives

- Understand that pneumonia is an inflammatory condition of the lung characterized by consolidation (solidification) of the pulmonary tissue.
- Is aware of the pathogenesis of pneumonia
- Know the classification of pneumonia.
- Is able to appreciate the aetiology and pathogenesis of lung abscess.

Pulmonary infections

- Pneumonia /pulmonary infection can be very broadly defined as any infection in the lung

- Respiratory tract infections are more frequent than infections of any other organ. Why?

–The epithelium of the lung is exposed to liters of contaminated air

– Nasopharyngeal flora are aspirated during sleep

–Underlying lung diseases render the lung parenchyma vulnerable to virulent organism

Pulmonary infections: Predisposing factors

Other causes:

- **Loss or suppression of the cough reflex:** coma, anesthesia, neuromuscular disorders, drugs, or chest pain.
- **Injury to the mucociliary apparatus:** by either impairment of ciliary function or destruction of ciliated epithelium e.g. cigarette smoke, inhalation of hot or corrosive gases, viral diseases, chronic diseases or genetic disturbances
- **Decreased function of alveolar macrophages:** by alcohol, tobacco smoke, anoxia, or oxygen intoxication
- **Pulmonary congestion and edema**
- **Retention and accumulation of secretions:** e.g. cystic fibrosis and bronchial obstruction
- **Immunologic deficiencies**, treatment with immunosuppressive agents, leukopenia
- **chronic diseases**

Pathogenesis of pneumonia

- **Portal of entry for most pneumonias** is
  - Inhalation of air droplets
  - Aspiration of infected secretions or objects
  - Hematogenous spread from one organ to other organs can occur.
- **Pneumonia can be acute or chronic**

Anatomic classification of pneumonia

Classification of pneumonia can be made according to causative agent or gross anatomic distribution of the disease.

- **1. Alveolar**
  - **Bronchopneumonia:** (*Streptococcus pneumoniae, Haemophilus influenza, Staphylococcus aureus*) Represent an extension from preexisting bronchitis or bronchiolitis. Extremely common tends to occur in two extremes of life.
  - **Lobar pneumonia:** (*Streptococcus pneumoniae*) Acute bacterial infection of a large portion of a lobe or entire lobe.Classic lobar pneumonia is now infrequent.

Note: Overlap of the two patterns often occur

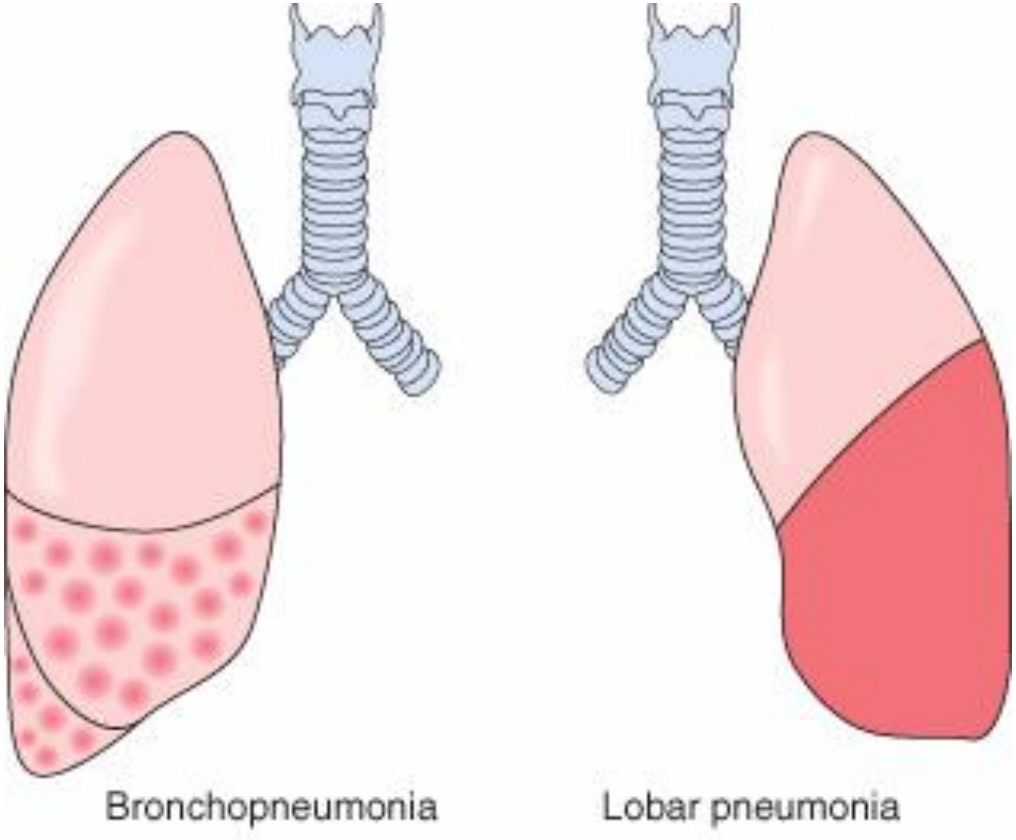
- **2. Interstitial:** Influenza virus (children), *Mycoplasma pneumoniae*

The clinical types of pneumonia

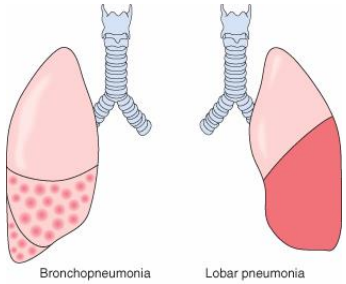
1. **Community-Acquired Acute Pneumonia**
2. **Community-Acquired Atypical Pneumonia**
3. **Nosocomial Pneumonia**
4. **Aspiration Pneumonia**
5. **Chronic Pneumonia**
6. **Opportunistic pneumonias/Pneumonia in the Immunocompromised Host**

1. Community-Acquired Acute Pneumonia

- **Usually Bacterial**
- **Can follow URT infection**
- **It can be lobar or bronchopneumonia**



1. Community-Acquired Acute Pneumonia



Bronchopneumonia

– most common agents are:

Streptococcus pneumoniae,

Haemophilus Influenza, in COPD

Pseudomonas Aeroginosa in CF

coliform bacteria

Staphylococci

Lobar pneumonia

- 90-95% are caused by pneumococci (*Streptococcus pneumoniae* type 1,3,7 & 2)
- Rare agents: *K. pneumoniae*

Staphylococci - Streptococci

H. influenzae - Pseudomonas and Proteus

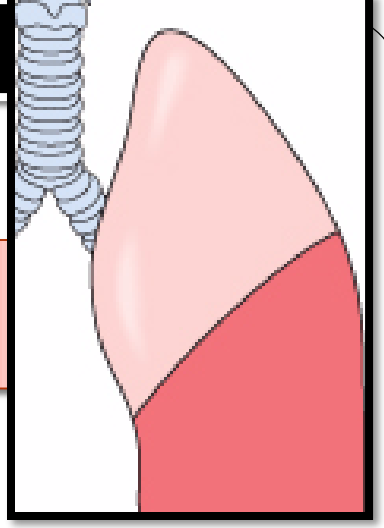
Cause of pneumonia:

- **The most common cause** of Community-Acquired Acute Pneumonia is ***Streptococcus pneumoniae***
- **Other common causes:** *Haemophilus influenzae, Moraxella catarrhalis, Staphylococcus aureus, Legionella pneumophila, Klebsiella pneumoniae and Pseudomonas aeruginosa spp.*
- **In intraveinous drug abuser:** *Staphylococcus aureus*

It is more common in:

1. Underlying chronic disease e.g. DM, COPD, and congestive heart failure
2. Congenital or acquired immune deficiency
3. Decreased or absent splenic function

Lobar pneumonia



It is widespread involvement of the entire lobe (widespread fibrinosuppurative consolidation).

- There are 4 stages:

I. **Stage I: Congestion**: lung is heavy, boggy and red. The intra-alveolar space is filled with fluid, few scattered neutrophils and numerous bacteria.

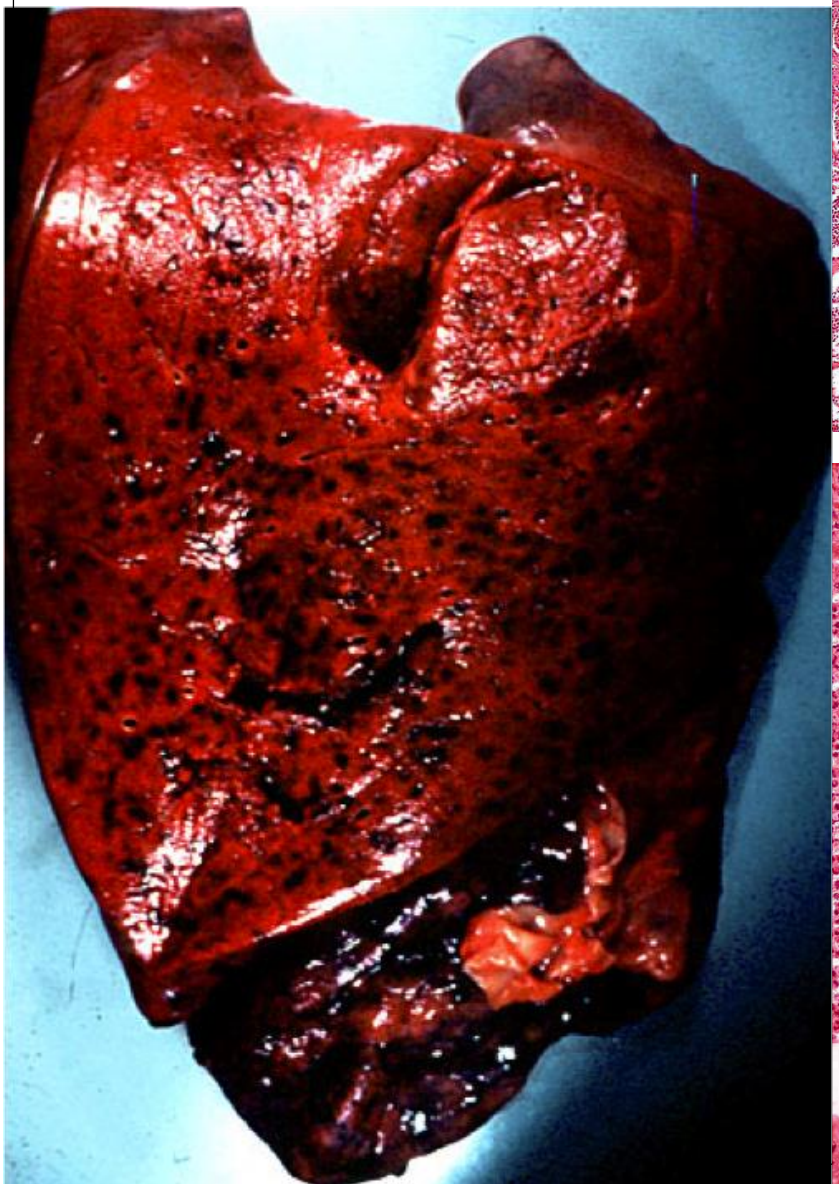
II. **Stage II: Red hepatization (solidification):** alveolar spaces are filled with neutrophils, red cells (congestion) and fibrin. Grossly the lung is firm/solid red and liver-like.

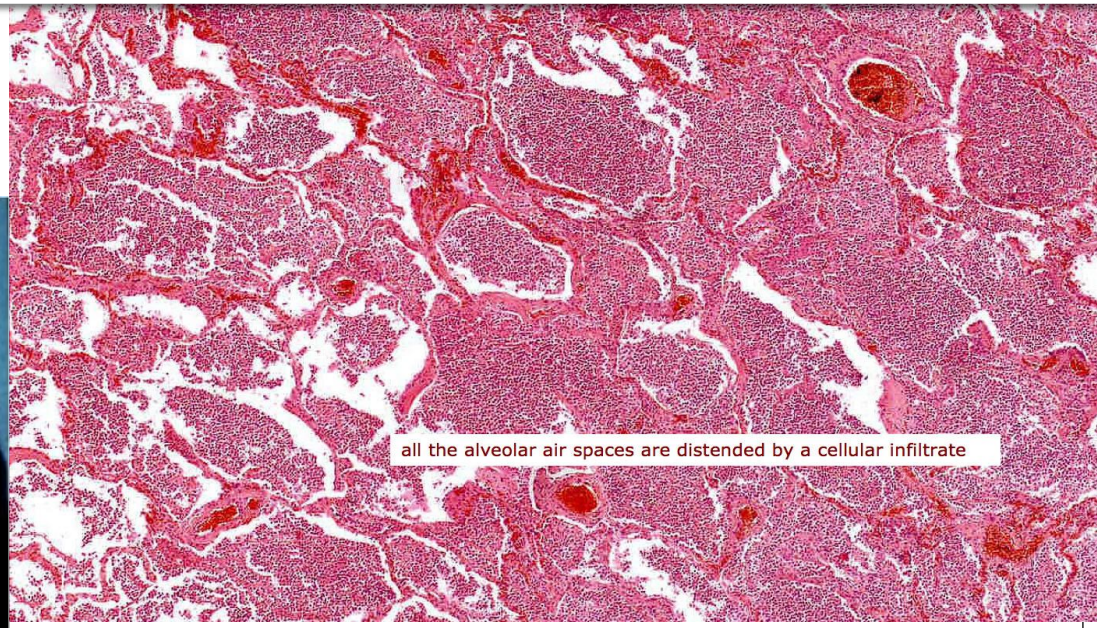
III. **Stage III: Gray hepatization:** here the red cells are reduced but neutrophils and fibrin(fibrinopurulent/suppurative exudate) are still present. Grossly the lung is still firm/solid and liver-like but grey.

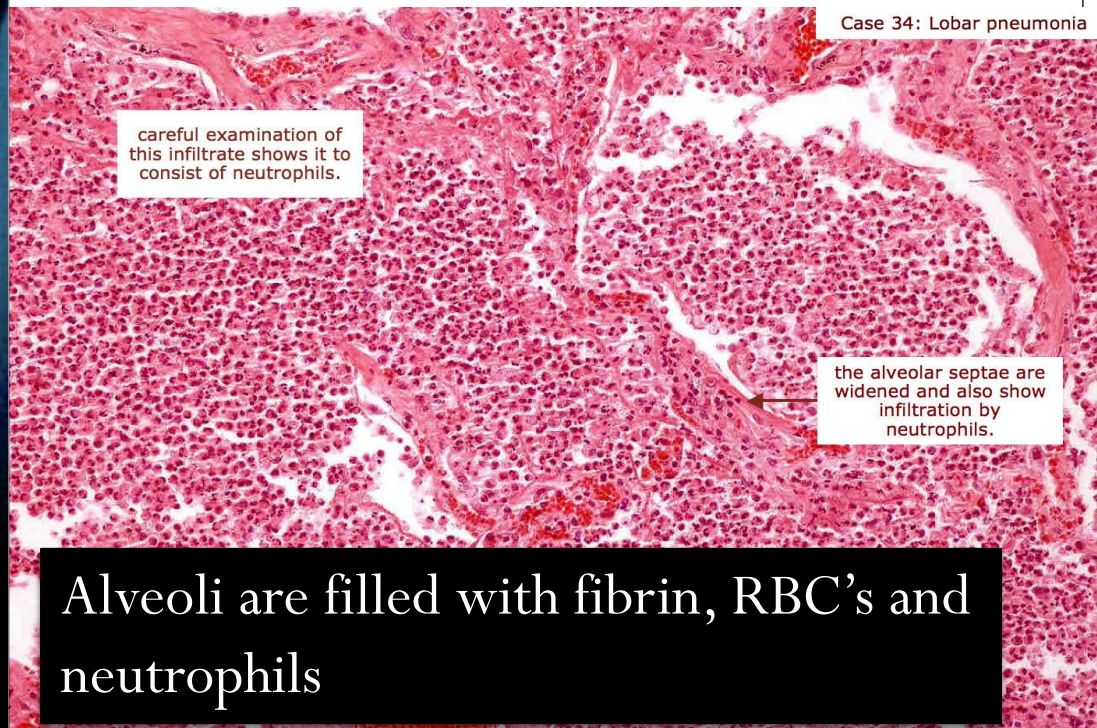
IV. **Stage IV: Resolution:** exudates within the alveoli are being enzymatically digested, resorbed, ingested by macrophages or coughed up.

1. Community-Acquired Acute Pneumonia

Red hepatization



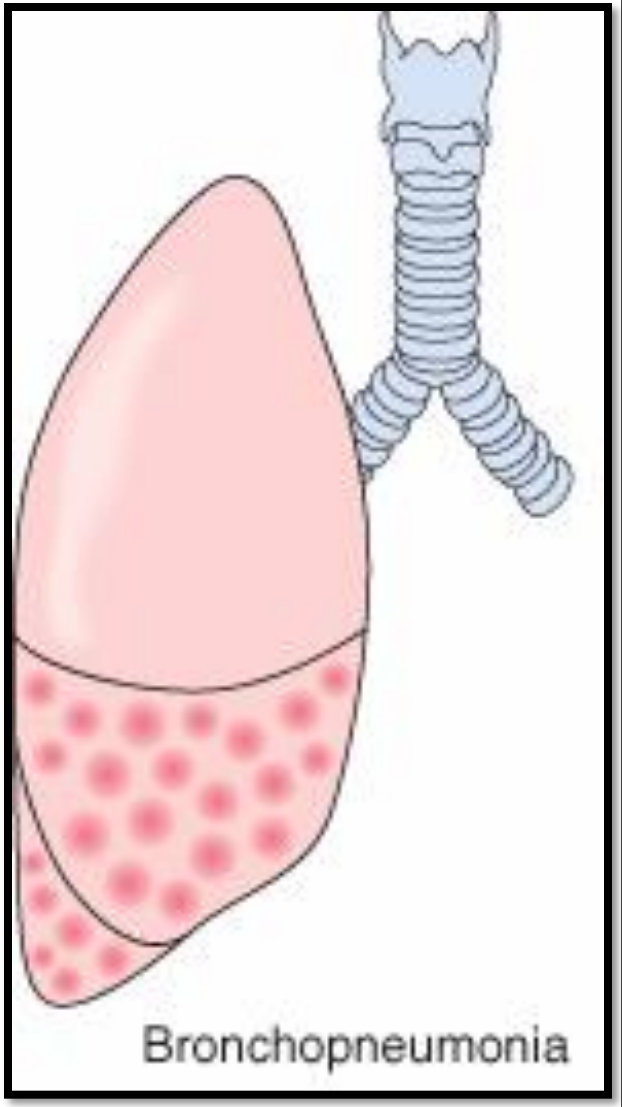




Alveoli are filled with fibrin, RBC's and neutrophils

Bronchopneumonia

- Are focal/patchy areas of consolidated acute suppurative inflammation in one or more lobes.
- Usually it involves lower lobes (basal) because there is a tendency of the secretions to gravitate into the lower lobes.
- Well developed lesions are 3 to 4 cm dry grey red ill defined nodules.
- Microscopy: neutrophil rich exudate filling the bronchi, bronchioles and adjacent alveolar spaces.



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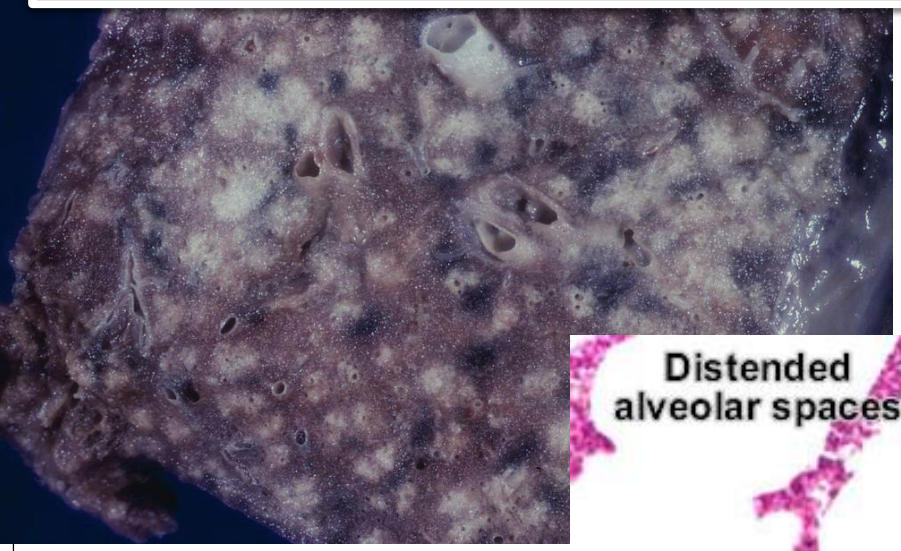
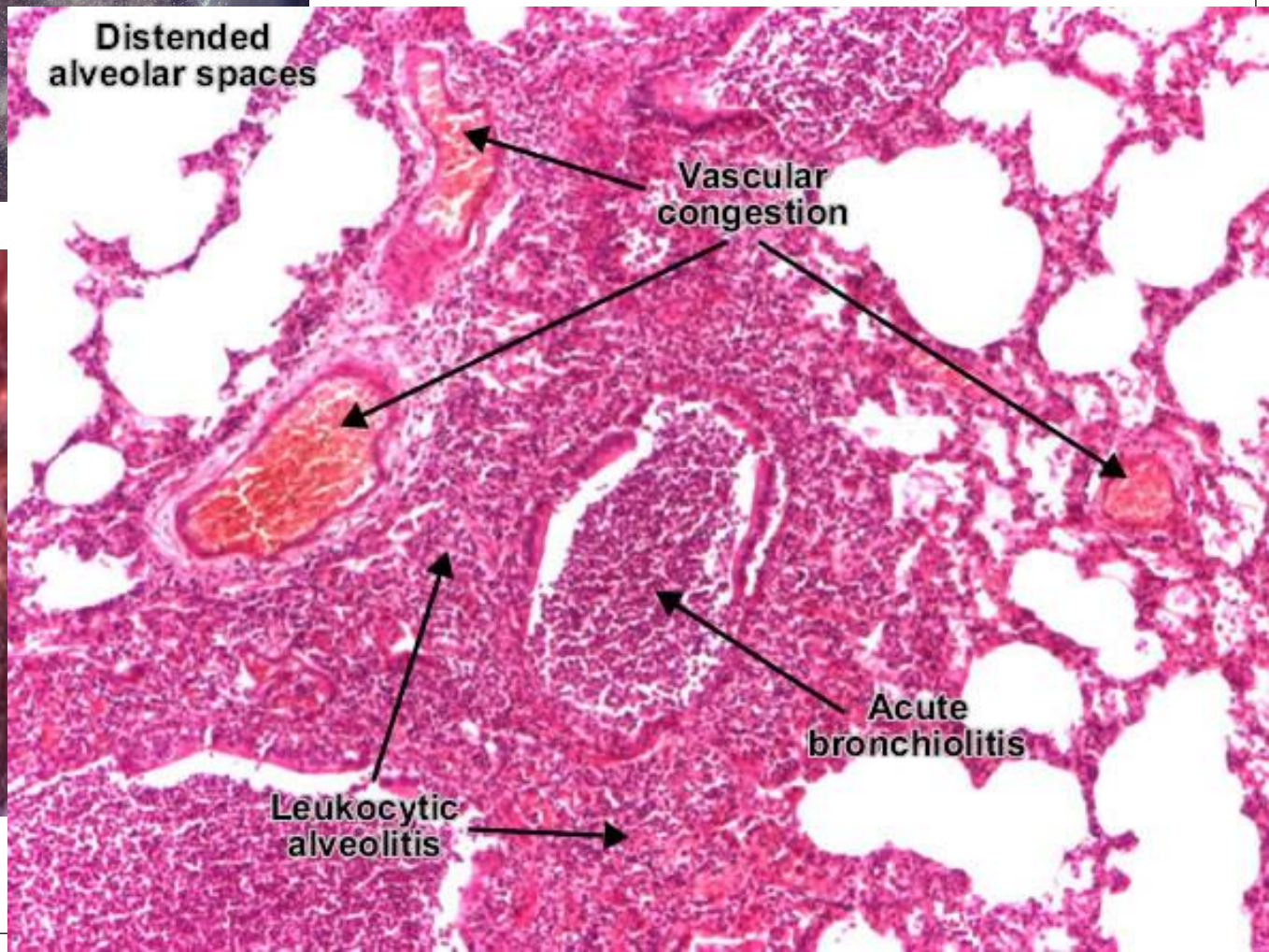
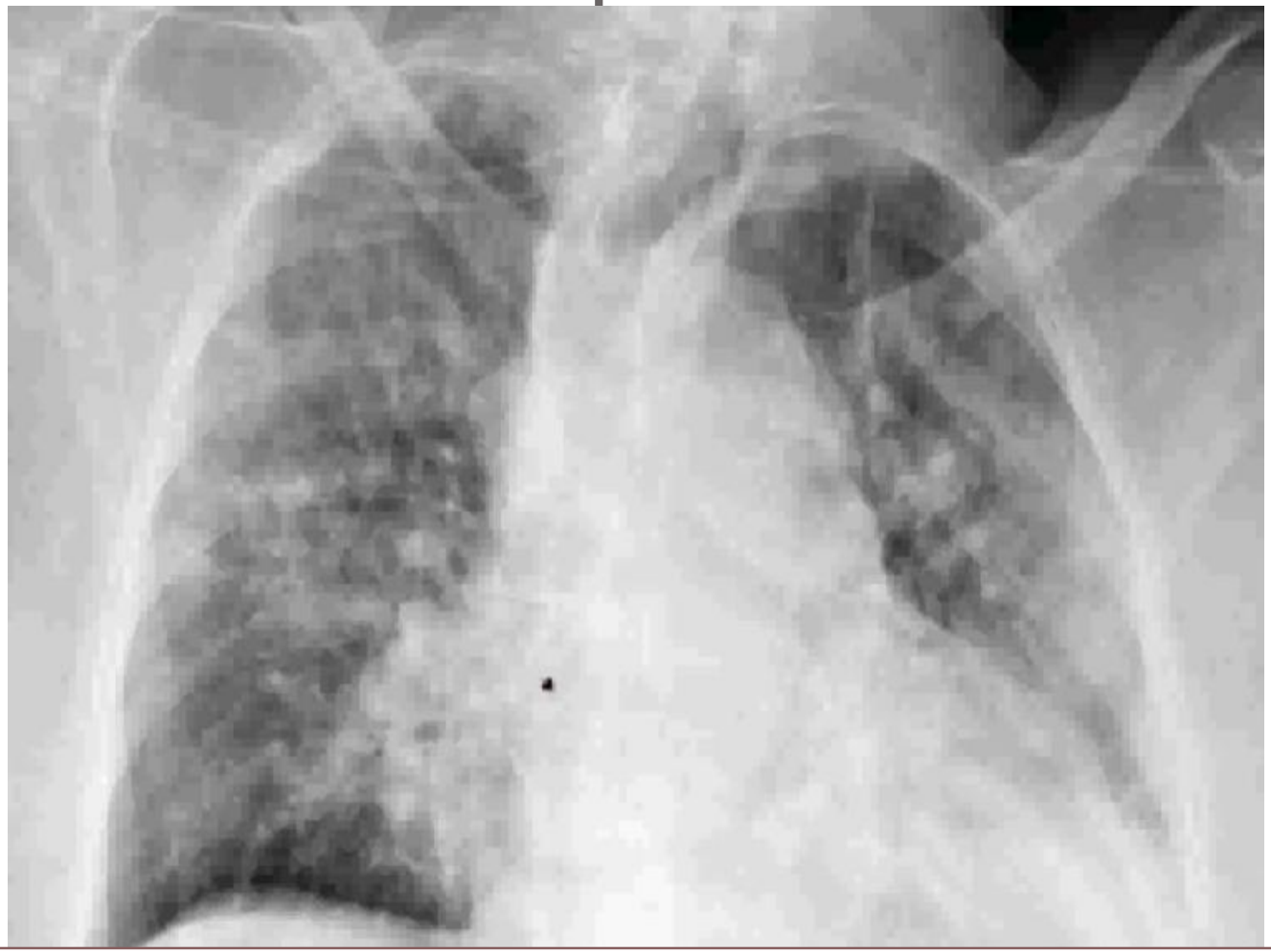


Bronchopneumonia



1. Community-Acquired Acute Pneumonia

Bronchopneumonia



multiple small opacities (consolidation)

Clinical features:

Sudden onset of high fever, chills, pleuritic chest pain and productive cough (mucopurulent sputum), may be with hemoptysis

Reduced air entry and dullness by percussion

- When fibrinosuppurative pleuritis is present, it is accompanied by pleuritic pain and pleural friction rub
- Radiology:
  - in lobar pneumonia there is a radio opaque (consolidation) well circumscribed lobe
  - in bronchopneumonia there are multiple small opacities usually basal and bilateral

1. Community-Acquired Acute Pneumonia

Complications

- Tissue destruction and necrosis (abscess).
- Spread of infection to the pleura leading to empyema.
- Organization of the exudate which converts the lung into solid tissue.
- Bacteremic dissemination to heart valves (infective endocarditis), pericardium, brain (meningitis), kidneys, spleen or joints (arthritis)

2) Community Acquired Atypical Pneumonia

Primary atypical pneumonia/interstitial pnemonitis

- Characterized by patchy inflammation in the lungs confined to the alveolar septae and pulmonary interstitium and therefore it is called interstitial pnemonitis.
- It is also called atypical pneumonia because it not the typical pneumonia in which the inflammation is primarily in the alveolar spaces.

2) Community Acquired Atypical Pneumonia

Primary atypical pneumonia/interstitial pnemonitis

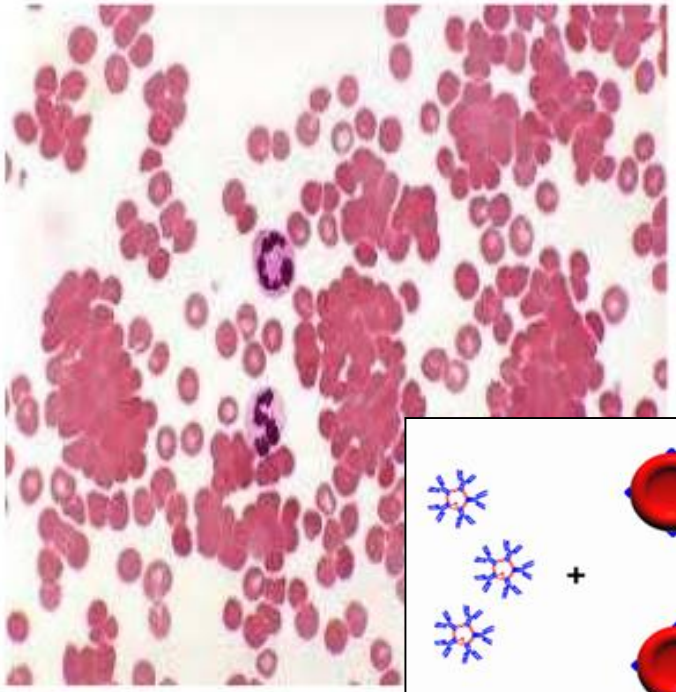
- caused by many organisms
  - the most common is ***Mycoplasma pneumonia***
  - *Others include:*
    - **Viruses** e.g. respiratory syncytial virus, influenza virus (children), influenza A and B (adults); adenovirus and SARS virus
    - ***Chlamydia*** spp. (*C. pneumonia etc.*) and *Coxiella burnetti* (Q fever). Chlamydia is transmitted by inhalation of dried excreta of infected birds and causes ornithosis/psittacosis.

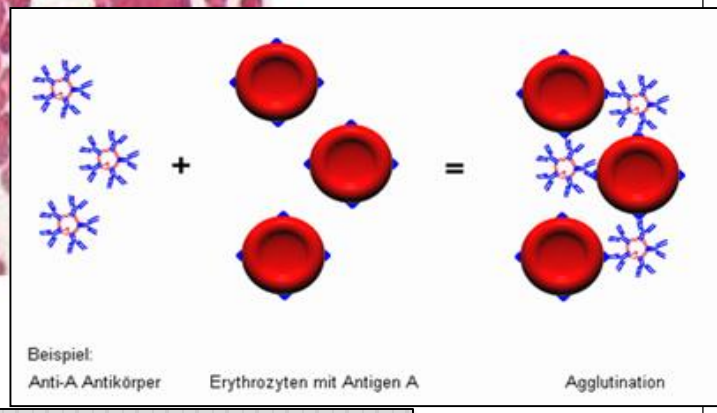
Predisposing factors: malnutrition, alcoholism and any underlying debilitating disease

Test for *Mycoplasma pneumonea:*

Cold Agglutination test

- Positive in Mycoplasma (Primary Atypical) Pneumonia
- The patients sera agglutinated human O group erythrocytes at 4 o c the agglutination being reversible at 37 0 c





Serological assays, and polymerase chain reaction (PCR) are used for diagnosis

2) Community Acquired Atypical Pneumonia

Primary atypical pneumonia/interstitial pnemonitis

Clinical course:

- Extremely variable course. Patient usually present with flulike symptoms which may progress to life-threatening situations.
- Identification of the organism is difficult.
- Prognosis in uncomplicated pt. is good

Gross:

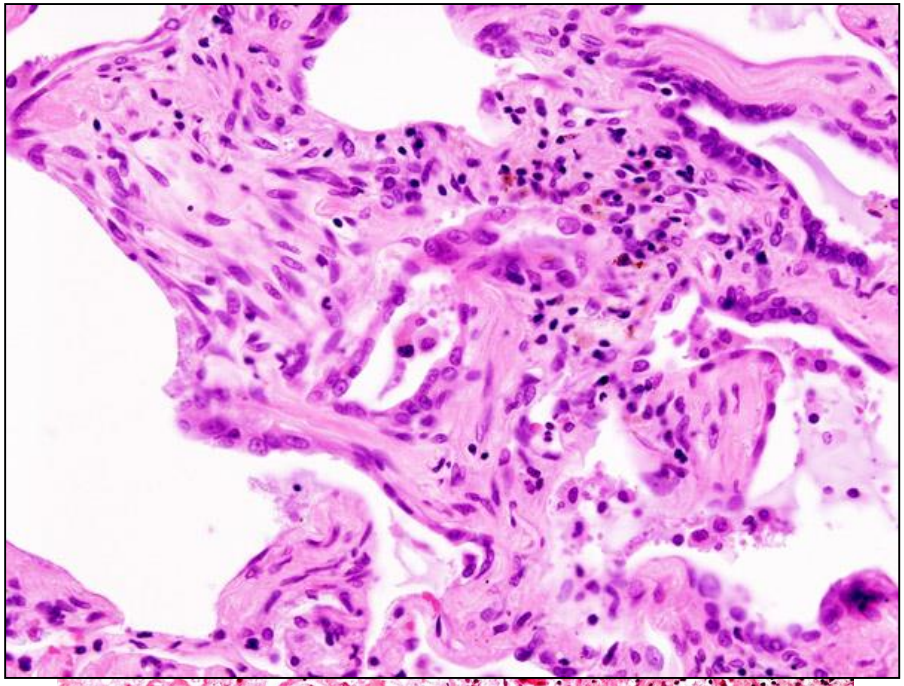
- Pneumonic involvement may be patchy, or involve whole lobes bilaterally or unilaterally.
- Affected areas are red-blue congested.

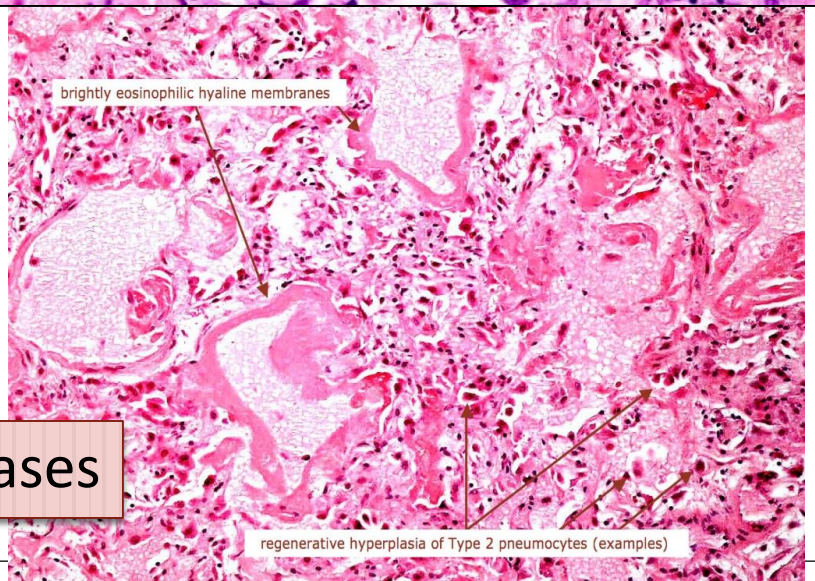
2) Community Acquired Atypical Pneumonia

Primary atypical pneumonia/interstitial pnemonitis

Micro:

- Predominantly there is inflammation in the interstitium/alveolar wall.
- Alveolar septa are widened and edematous with mononuclear inflammatory infiltrate (and neutrophils in acute cases only)
- Sever cases: Intra-alveolar proteinaceous material with pink hyaline membrane lining the alveolar walls (diffuse alveolar damage)





Sever cases

3) Nosocomial Pneumonia:

- Hospital acquired Pneumonia.
- Acquire terminal pneumonias while hospitalized (nosocomial infection)

Predisposing factor: sever underlying conditions e.g. immunosuppression, prolonged antibiotic therapy, intravascular catheter and pt. with mechanical ventilator

Cause: Gram-negative organisms like Klebsiella, Pseudomonas aeruginosa and E. coli

4) Aspiration pneumonia

- Occur in debilitated patients, comatose, alcoholic, or those who aspirated gastric contents
- Chemical injury due gastric acid and bacterial infection (anaerobic bacteria admixed with aerobic bacteria, e.g. *Bacteroides, Fusobacterium and Peptococcus*)
- A necrotizing pneumonia with fulminant clinical course, common complication (abscess) and frequent cause of death.

5) Chronic pneumonia

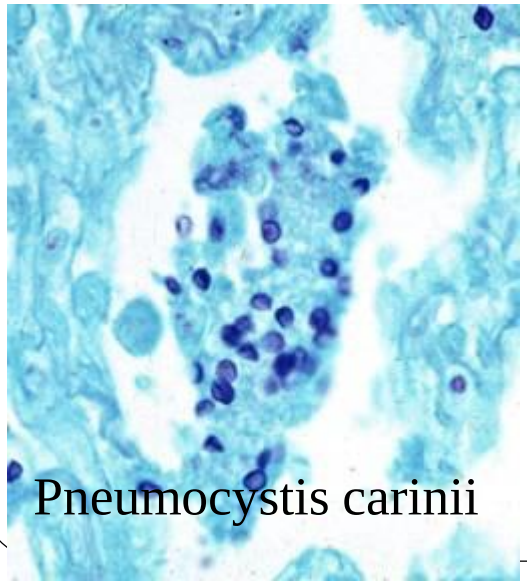
- is most often a localized lesion in an immunocompetent person, with or without regional lymph node involvement.
- There is typically granulomatous inflammation,
  Which may be due to bacteria (e.g., *M. tuberculosis*) or fungi (*Histoplasma capsulatum, Coccidioides immitis, Blastomyces)*
- In the immunocompromised, there is usually systemic dissemination of the causative organism, accompanied by widespread disease.
- Tuberculosis is the most important entity within the spectrum of chronic pneumonias.

6) Opportunistic pneumonias

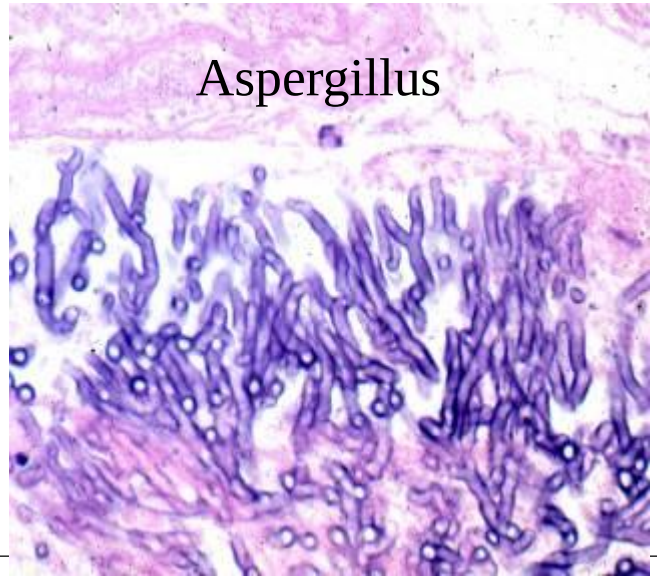
- Infections that affect immunosuppressed patients (AIDS, cancer patients and transplant recipients)

Causative organisms:

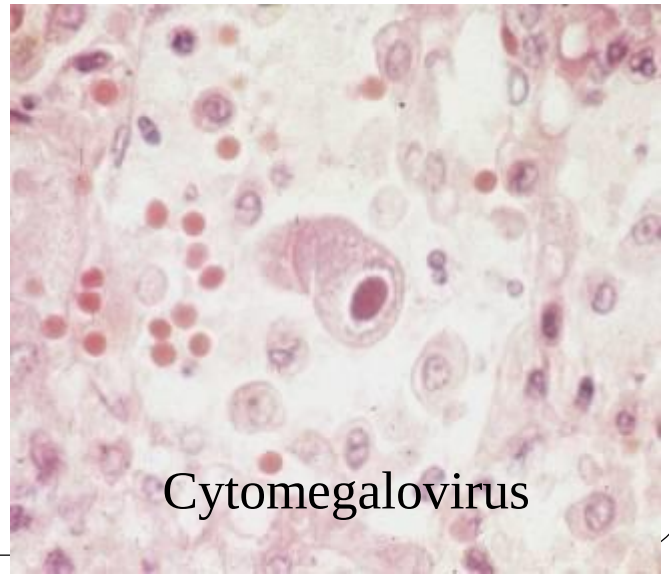
- Cytomegalovirus
- *Pneumocystis jiroveci (carinii)*
- *Mycobacterium avium-intracellulare*
- Invasive aspergillosis
- Invasive candidiasis
- "Usual" bacterial, viral, and fungal organisms



Pneumocystis carinii



Aspergillus



Cytomegalovirus

Pneumocystis Pneumonia

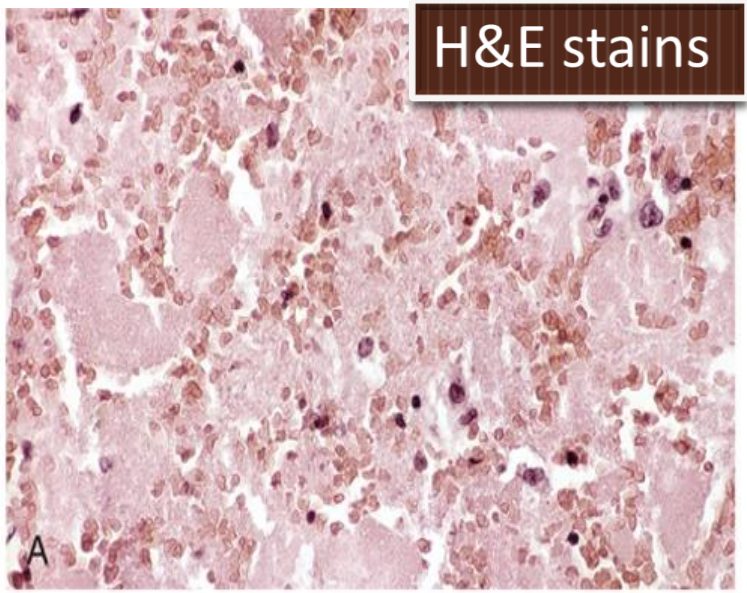
- *P. jiroveci* (formerly *P. carinii*) is an opportunistic infectious agent (a fungus)
- Seen in immunocompromised individuals especially AIDS.
- *Pneumocystis* infection is confined to the lung, produces an interstitial pneumonitis.
- Effective methods of diagnosis are:
  - identify the organism in bronchoalveolar lavage fluids or in a transbronchial biopsy specimen.
  - immunofluorescence antibody kits and PCR-based assays.

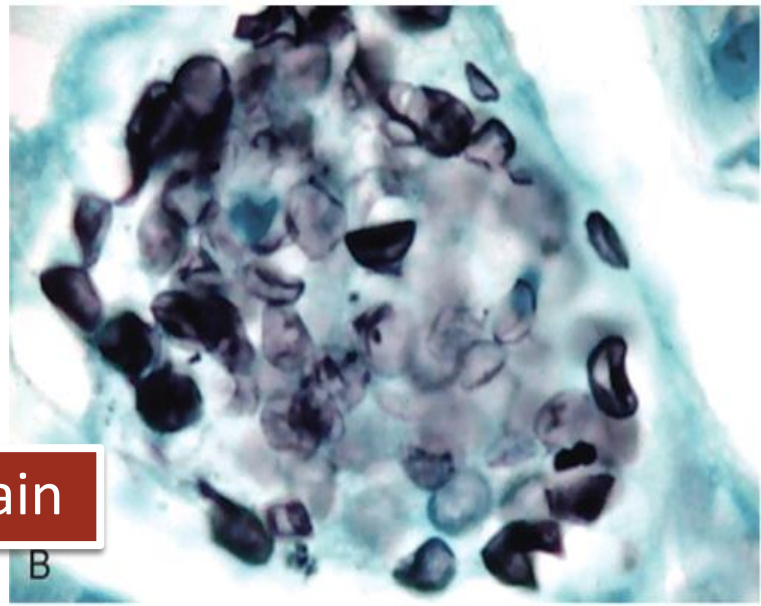
Pneumocystis Pneumonia

- Microscopically:

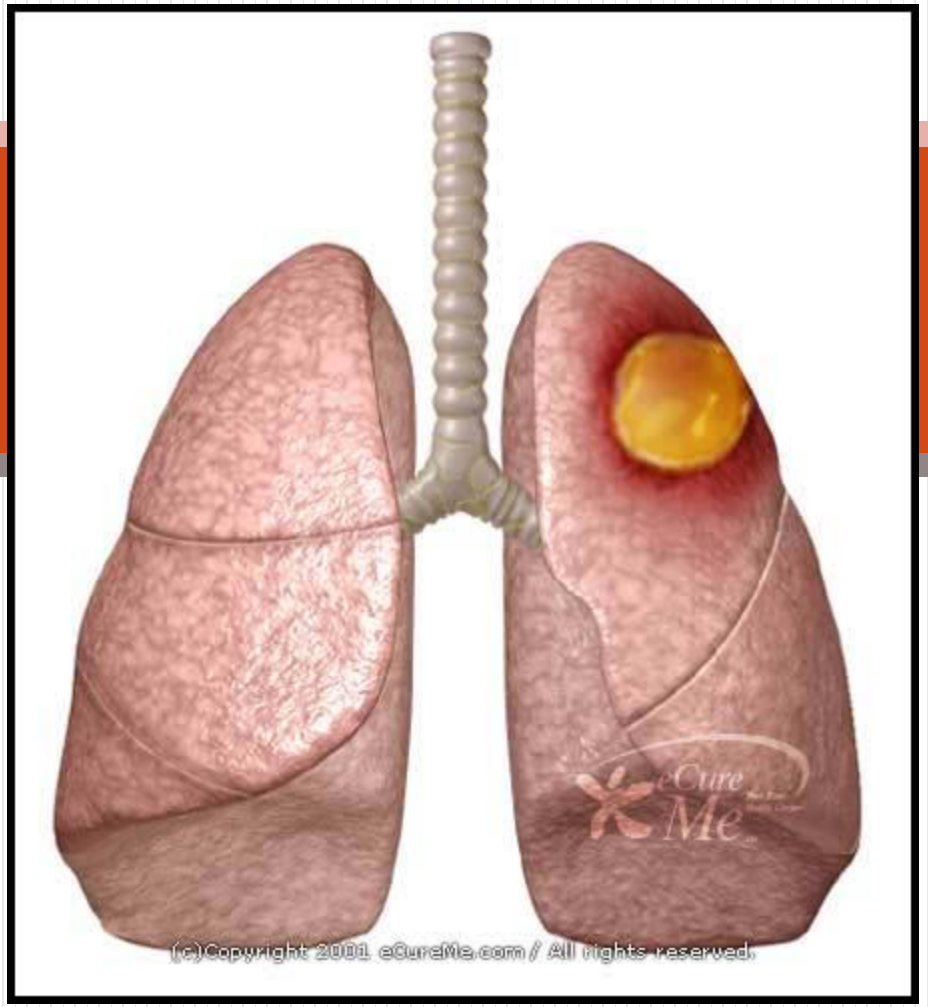
- characteristic **intra-alveolar foamy, pink-staining exudate** on H&E stains

- organism is trapped in the foamy material and can be seen on silver stain as oval cup shaped structures



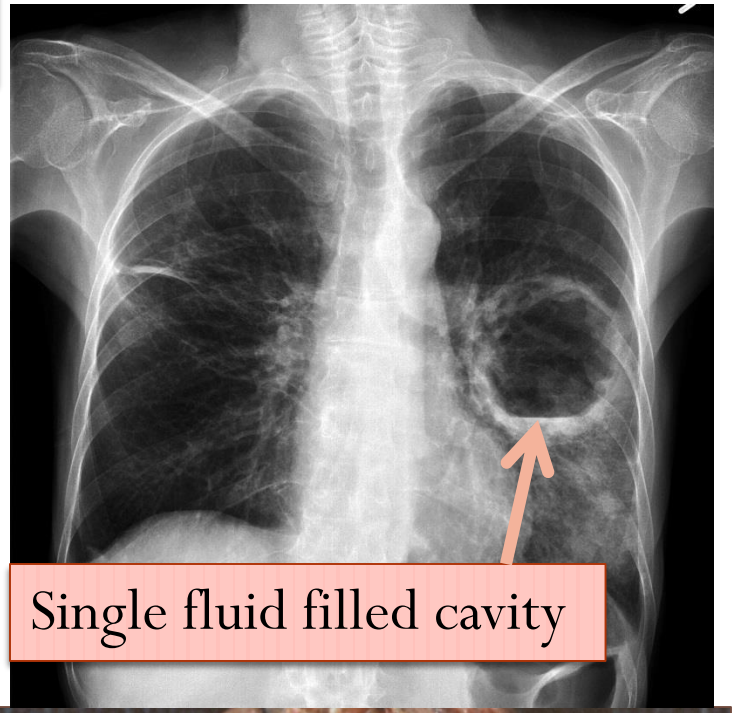


Lung abscess



Lung abscess

- Is localized suppurative necrotic process within the pulmonary parenchyma
- **Features:** tissue necrosis and marked acute inflammation.
  - **Organisms**:
    - Staphylococci
    - Streptococci
    - Gram-negative organisms
    - Anaerobes
  - **Pathogenesis:**
    - Can follow aspiration
    - As a complication of bronchopneumonia
    - Septic emboli
    - Tumors
    - Direct infection



Lung abscess

Clinical features

- Prominent cough producing copious amount of foul smelling and bad-tasting purulent sputum
- Change in position evoke paroxysm of cough
- Fever malaise and clubbing of fingers
- Radiology shows fluid filled cavity

Lung abscess

Complications

- Bronchopleural fistula and pleural involvement resulting in empyema
- Massive hemoptysis, spontaneous rupture into uninvolved lung segments
- Non-resolution of abscess cavity
- Bacteremia could result in brain abscess and meningitis

Prognosis:

with antibiotic therapy, 75% of abscess resolve