

RESPIRATORY BLOCK

PNEUMONIA

Dr. Maha Arafah & Prof. Ammar Rikabi

Respiratory block
2020

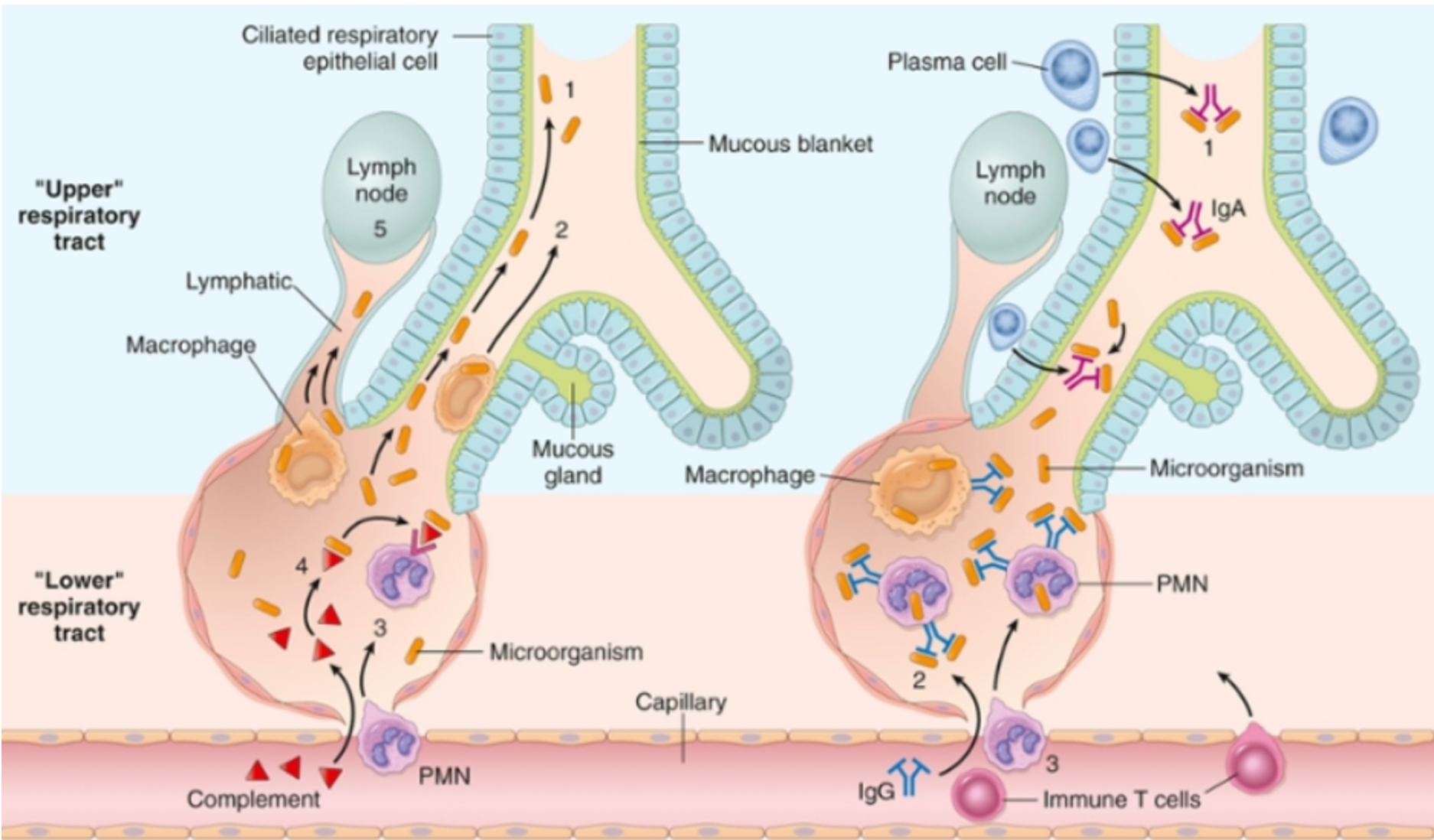
Objectives

- Define pneumonia
- List predisposing factors
- Know the pathogenesis of pneumonia
- Identify the clinical settings in which the infection occurs and its causes
- Recognize the anatomic classification of pneumonia
- Describe the four stages of morphological changes in bacterial pneumonia
- Know the clinical features and complication of pneumonia
- Know the features and causes 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



A INNATE IMMUNE DEFENSES

B ADAPTIVE IMMUNE DEFENSES

Pulmonary infections: Predisposing factors

- **Loss or suppression of the cough reflex:** as a result of 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 settings in which the infection occurs:

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

1. Community-Acquired Bacterial Pneumonia

- Can follow URT infection
- It can be lobar or bronchopneumonia

Clinical features: Sudden onset of high fever, chills, pleuritic chest pain and productive cough, may be with hemoptysis

Reduced air entry and dullness by percussion

Cause:

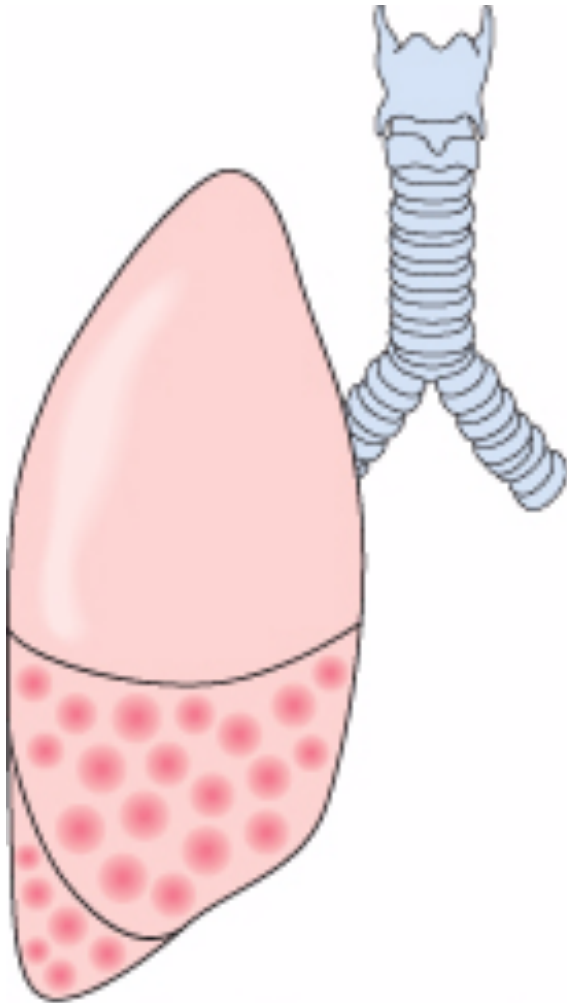
- The most common cause is ***Streptococcus pneumoniae***
- **Other common causes:** *Haemophilus influenzae*, *Moraxella catarrhalis*, *Staphylococcus aureus*, *Legionella pneumophila*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* spp. , *Mycoplasma pneumoniae*, *Chlamydia pneumoniae* and *Coxiella burnetii* (Q fever)
 - **In intravenous drug abuser:** *Staphylococcus aureus*

It is more common in:

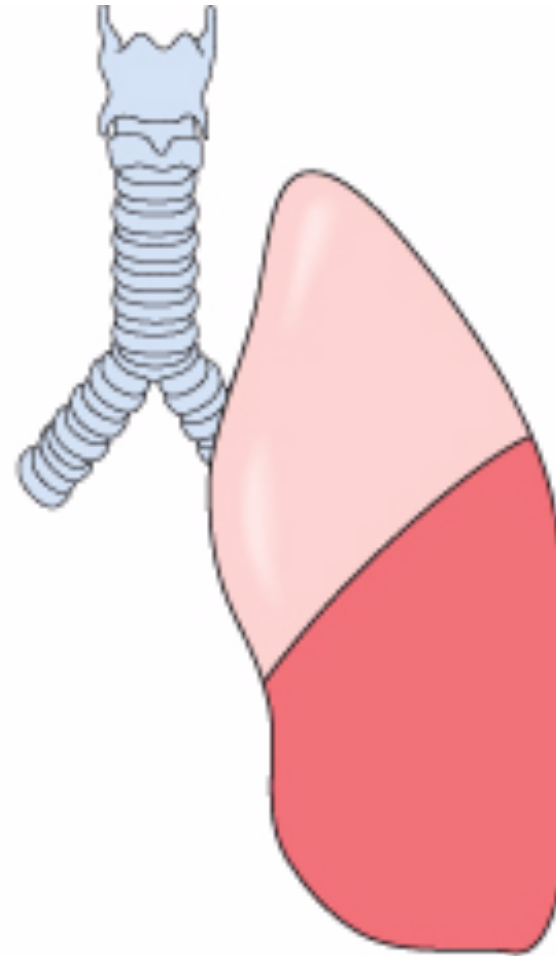
1. Underlying chronic disease e.g. DM, COPD, and congestive heart failure
2. Congenital or acquired immune deficiency
3. Decreased or absent splenic function

1. Community-Acquired Bacterial Pneumonia

Anatomic classification of pneumonia

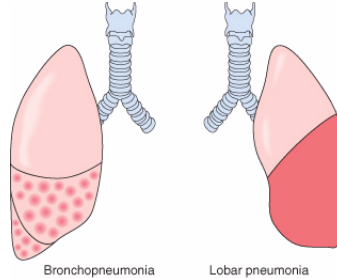


Bronchopneumonia



Lobar pneumonia

1. Community-Acquired Bacterial Pneumonia



Bronchopneumonia

– most common agents are:

- *Streptococcus pneumoniae*,
- *Haemophilus Influenza* in COPD
- *Pseudomonas Aeroginosa* in CF
- coliform bacteria
- Staphylococci (secondary bacterial pneumonia in children and healthy adults after viral respiratory illnesses)

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*

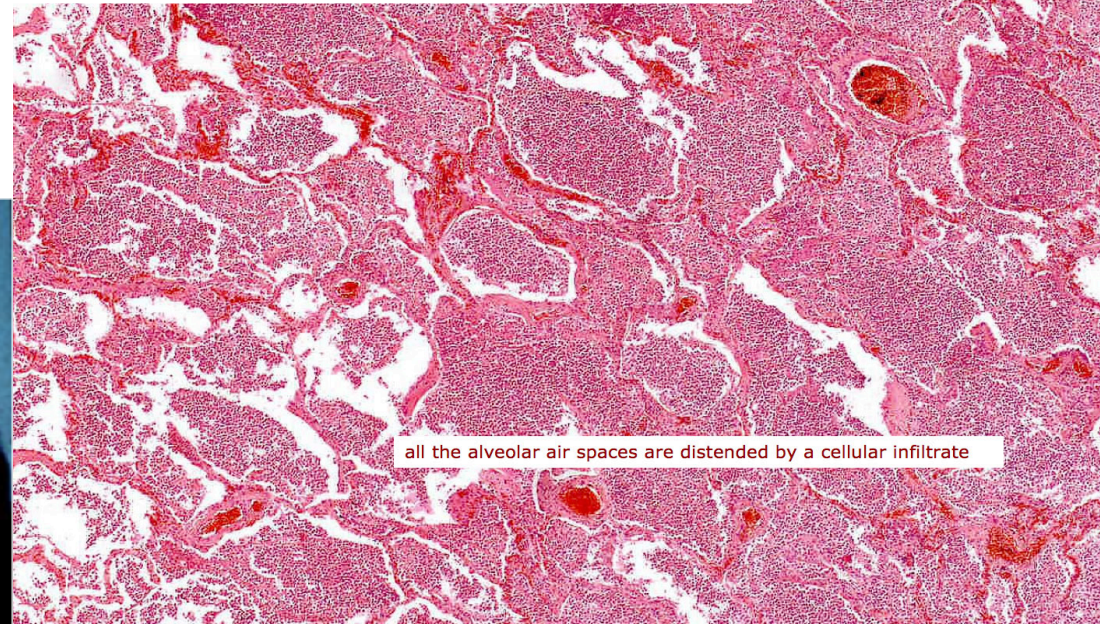
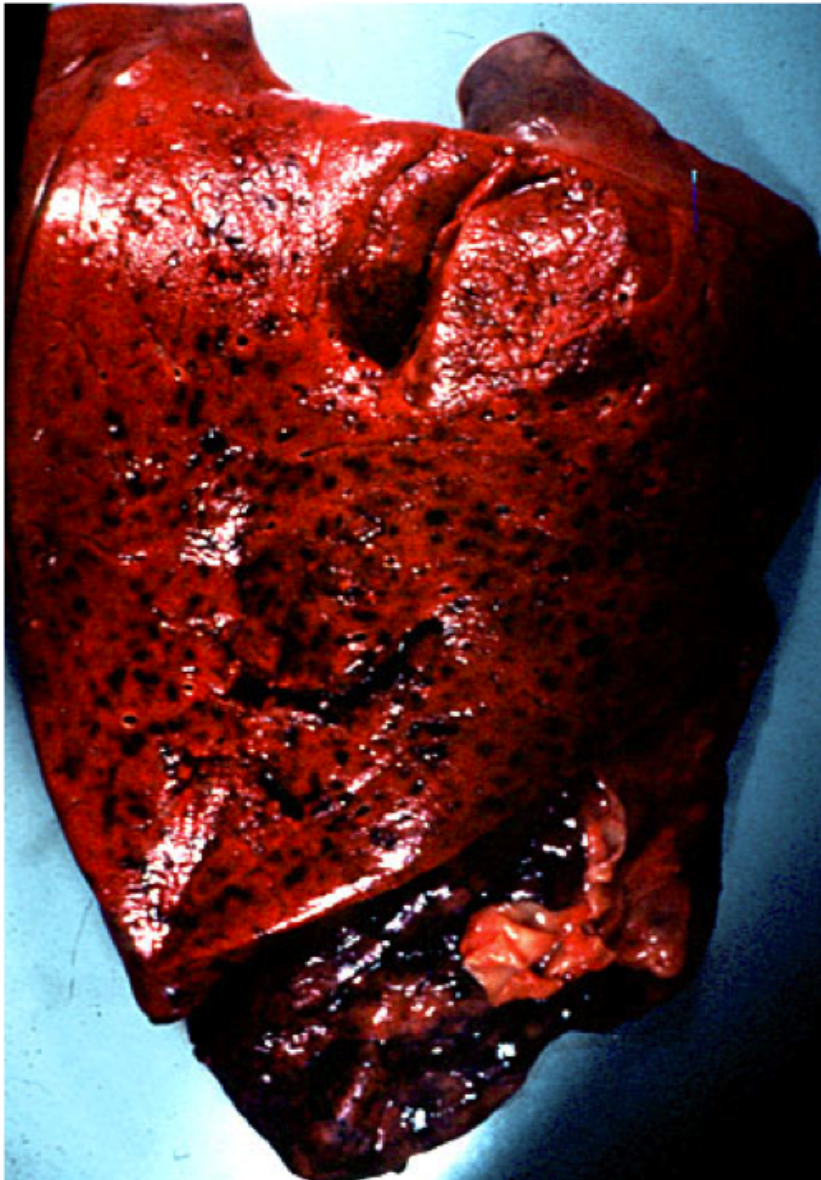
1. Community-Acquired Bacterial Pneumonia

Lobar pneumonia

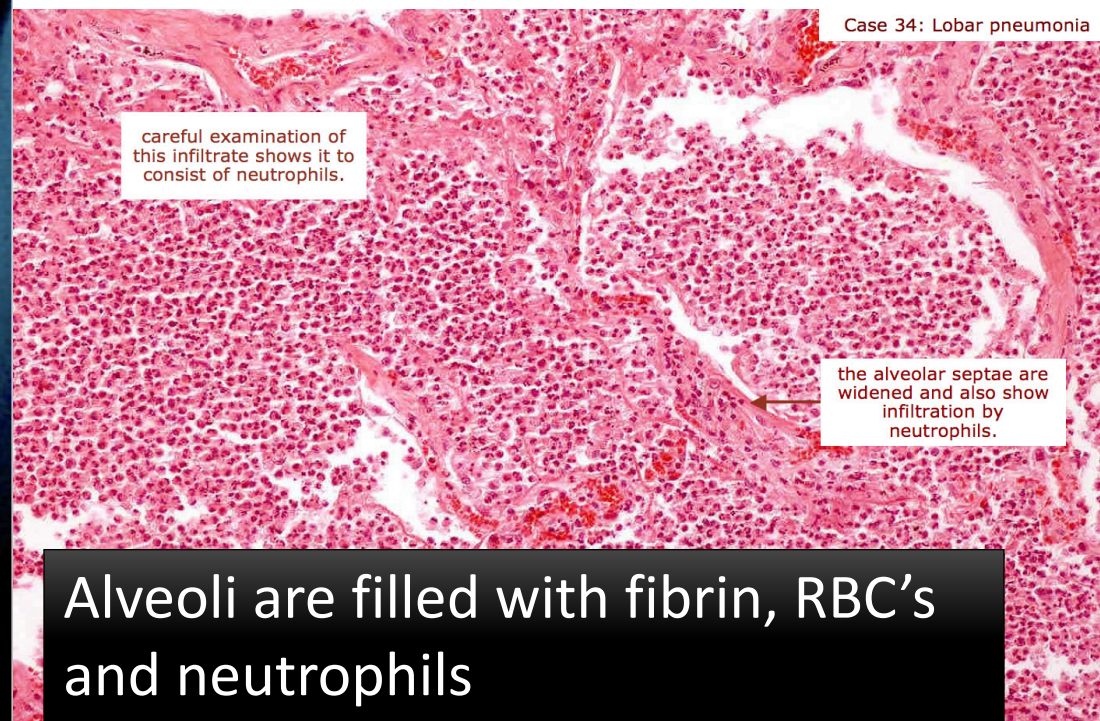
- It is widespread involvement of a large area and even an entire lobe of lung (widespread fibrinosuppurative consolidation).
- There are 4 stages:
 - i. **Stage I: Congestion:** lung is heavy, boggy and red. The intra-alveolar space is filled with fluid, few scattered neutrophils and numerous bacteria.
 - 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 Bacterial Pneumonia

Red hepatization



all the alveolar air spaces are distended by a cellular infiltrate



Case 34: Lobar pneumonia

Careful examination of this infiltrate shows it to consist of neutrophils.

the alveolar septae are widened and also show infiltration by neutrophils.

Alveoli are filled with fibrin, RBC's and neutrophils

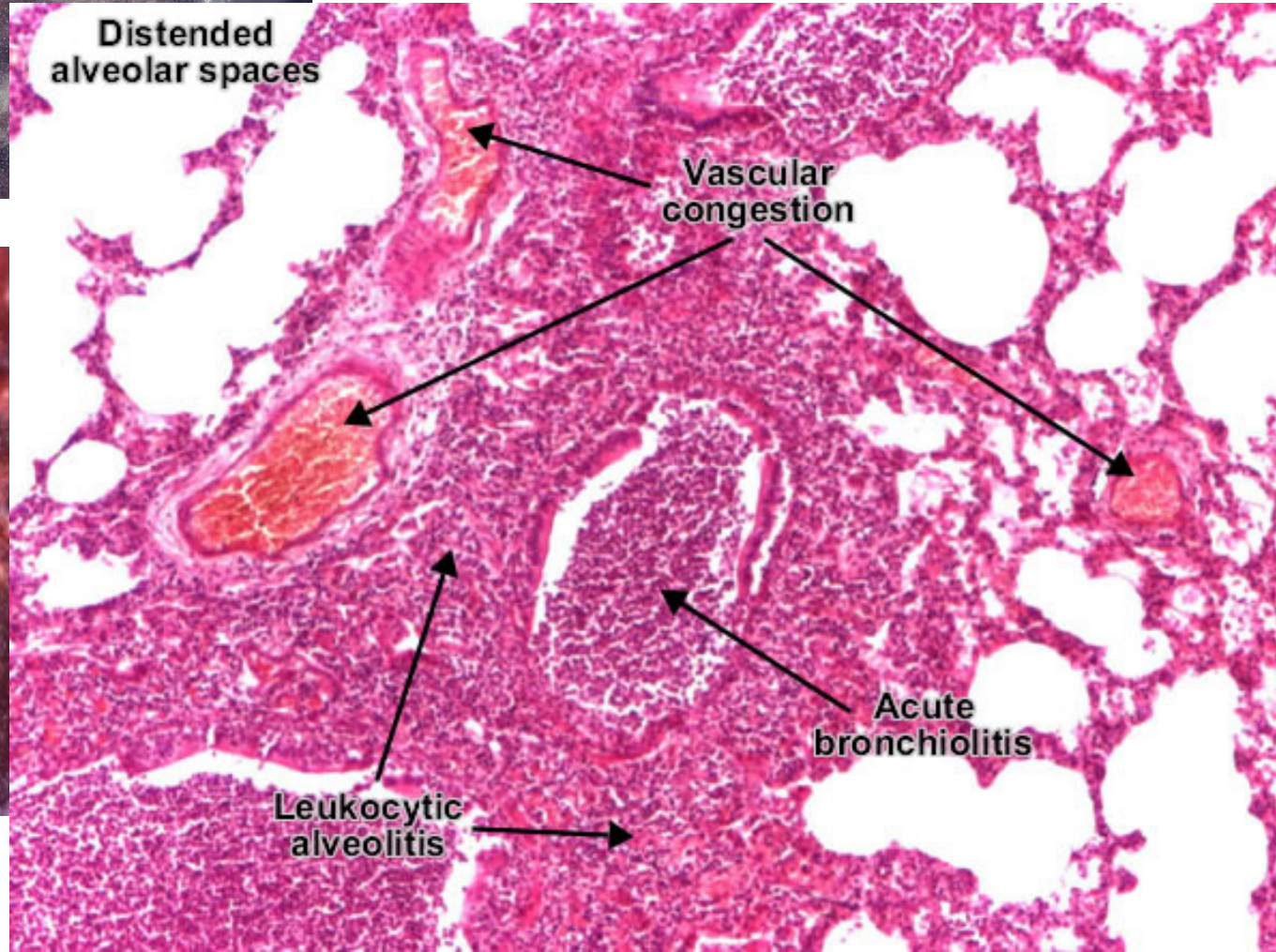
1. Community-Acquired Bacterial Pneumonia

Bronchopneumonia

- Are focal/patchy areas of consolidated acute suppurative inflammation in one or more lobes.
- Usually it involves lower lobes (basal) bilaterally 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.

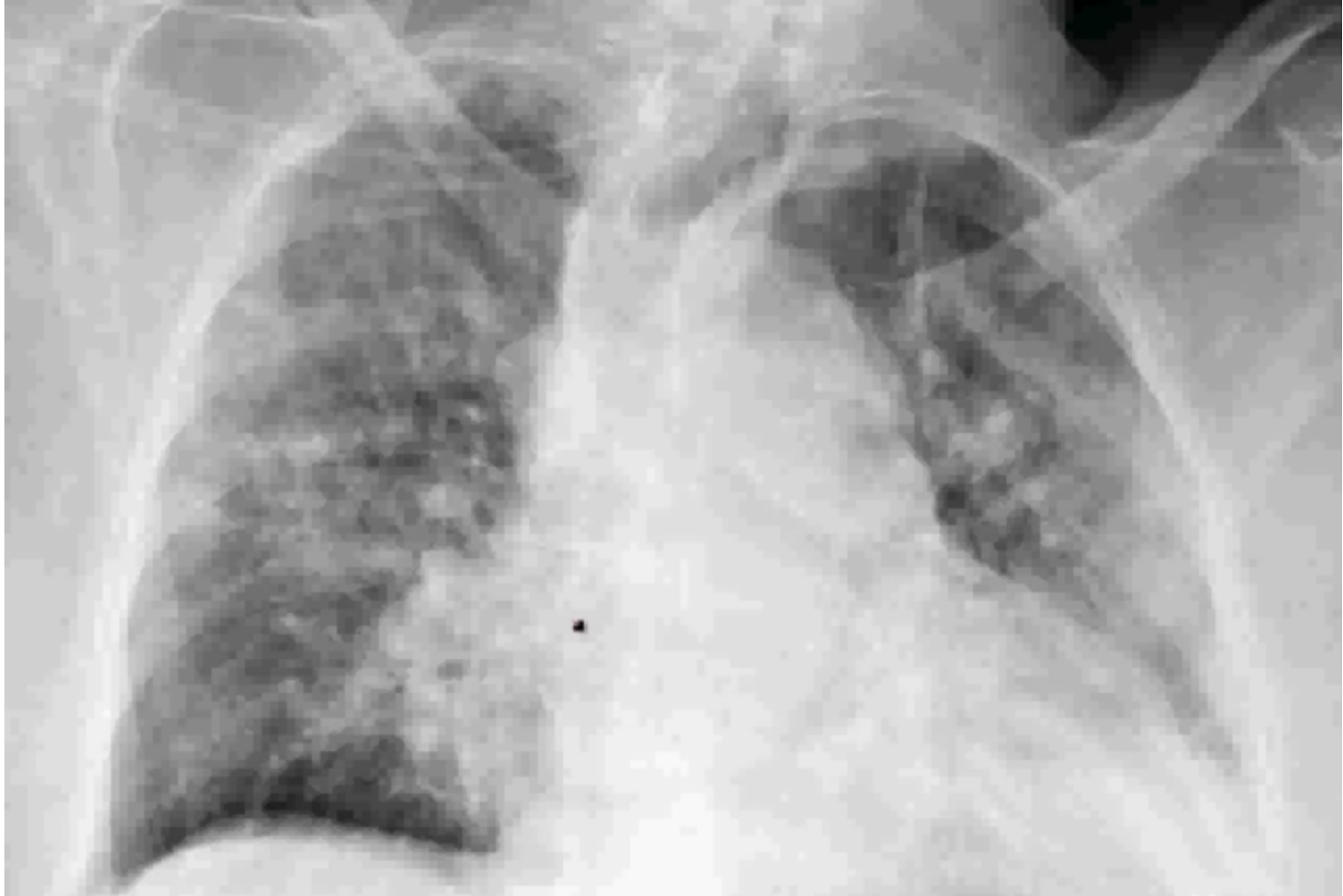
1. Community-Acquired Bacterial Pneumonia

Bronchopneumonia



1. Community-Acquired Bacterial Pneumonia

Bronchopneumonia



multiple small opacities (consolidation)

1. Community-Acquired Bacterial Pneumonia

Clinical features

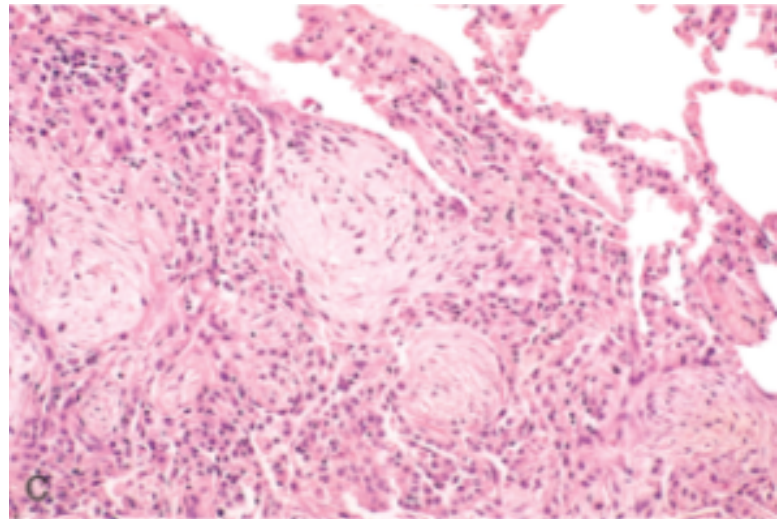
- Abrupt onset of
 - high fever
 - shaking chills
 - cough productive of mucopurulent sputum occasional patients may have hemoptysis.
- When fibrinosuppurative pleuritis is present, it is accompanied by pleuritic pain and pleural friction rub
- Radiology:
 - in lobar pneumonia there is a radio opaque (consolidation) well circumscribed lobe
 - in bronchopneumonia there are multiple small opacities usually basal and bilateral.

1. Community-Acquired Bacterial Pneumonia : atypical

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)

Advanced organizing pneumonia, featuring transformation of exudates to fibromyxoid masses richly infiltrated by macrophages and fibroblasts.



1. Community-Acquired Bacterial Pneumonia : atypical

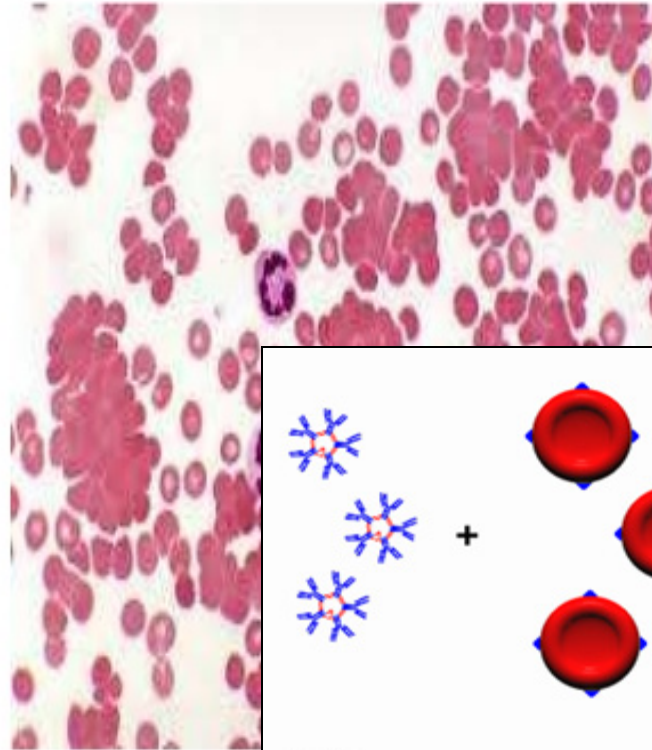
- Characterized by patchy inflammation in the lungs confined to the alveolar septae and pulmonary interstitium and therefore it is called **interstitial pnemonitis**.
- It is also called **atypical pneumonia** because it not the typical pneumonia in which the inflammation is primarily in the alveolar spaces.
- It is caused by many organisms
 - the most common is ***Mycoplasma pneumonia***
 - *Others include:*
 - ***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

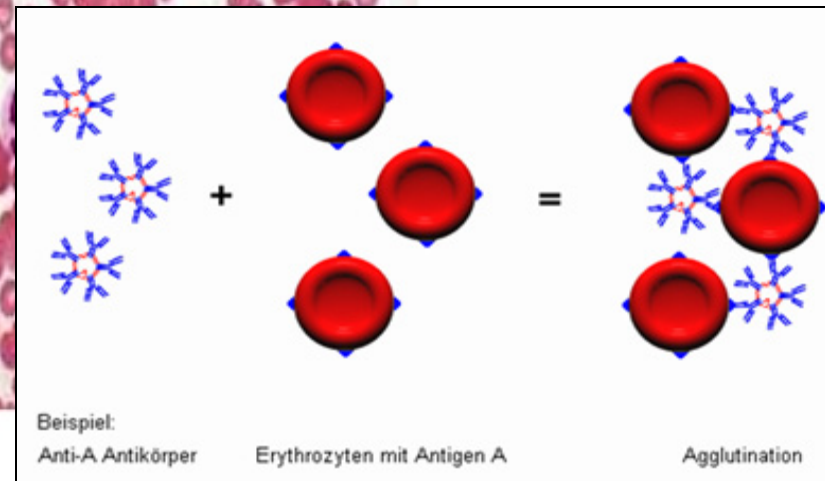
1) Community Acquired Bacterial Pneumonia : atypical

Test for *Mycoplasma pneumoniae*: **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



Dr.TV.Rao MD



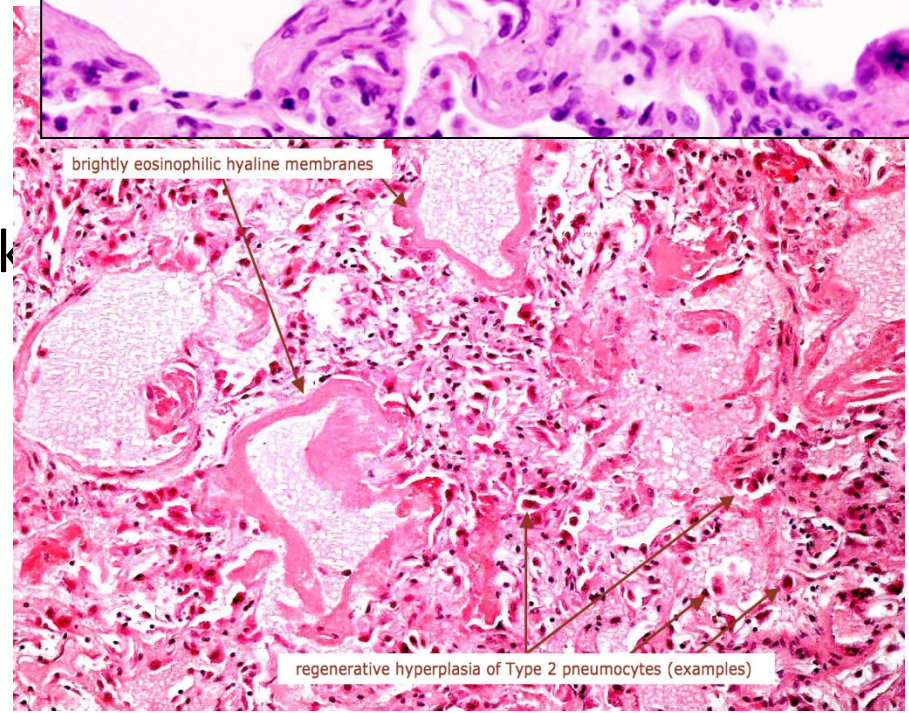
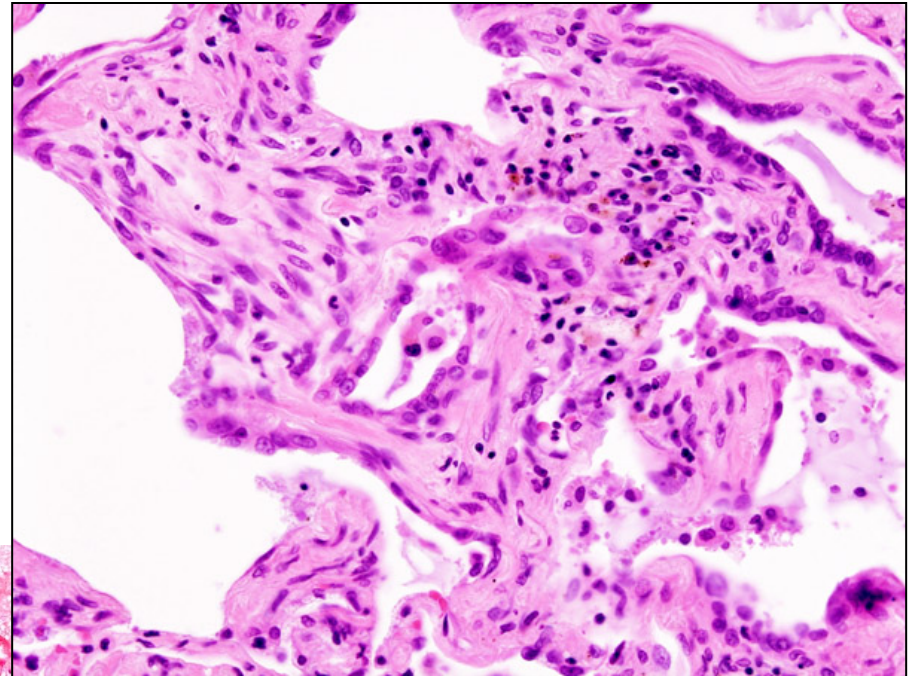
serological assays, and polymerase chain reaction (PCR) are used for diagnosis

1) Community Acquired Bacterial Pneumonia: atypical

Primary atypical pneumonia/interstitial pneumonitis

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)
- Severe cases: Intra-alveolar proteinaceous material with pink hyaline membrane lining the alveolar walls (diffuse alveolar damage)



brightly eosinophilic hyaline membranes

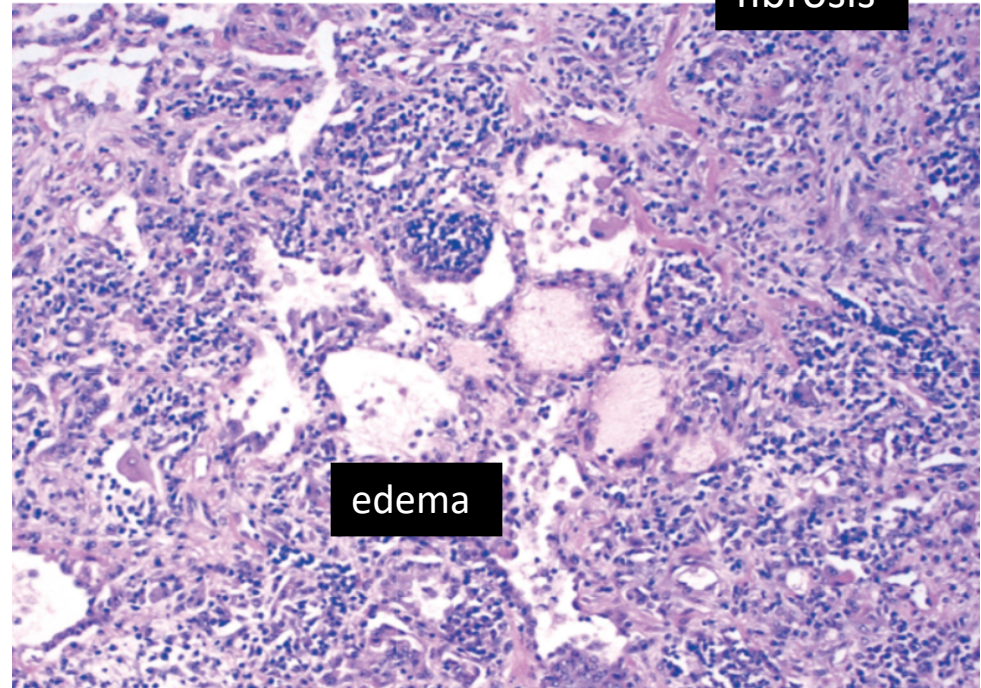
regenerative hyperplasia of Type 2 pneumocytes (examples)

2) Community Acquired Viral Pneumonia

- Most common causes of community-acquired viral pneumonias:
 - **influenza types A and B, the respiratory syncytial viruses, human metapneumovirus, adenovirus, rhinoviruses, rubeola virus, and varicella virus** (all of these agents also cause upper-respiratory tract infections)
- The virus damage respiratory epithelium, producing an inflammatory response. The process may extends to alveoli (interstitial inflammation), but some outpouring of fluid into alveolar spaces may also occur.
- so that on chest films the changes may mimic those of bacterial pneumonia
- Epithelial damage inhibits mucociliary clearance and predisposes to secondary bacterial infections. The most likely organism which cause secondary bronchopneumonia is *Staphylococcus aureus*.
- complications of viral infection are more likely in infants, older adults, malnourished patients, alcoholics, and immunosuppressed individuals.

2) Community Acquired Viral Pneumonia

Morphology:
The thickened alveolar walls are infiltrated with lymphocytes and some plasma cells, which are spilling over into alveolar spaces.



In severe cases full-blown diffuse alveolar damage with hyaline membranes may develop

The clinical course of viral pneumonia is extremely varied. It may appear as a severe upper-respiratory tract infection with respiratory distress, or manifest as a fulminant, life-threatening infection (in immunocompromised patients)

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

And

methicillin resistant *Stahylococcus aureus*.

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

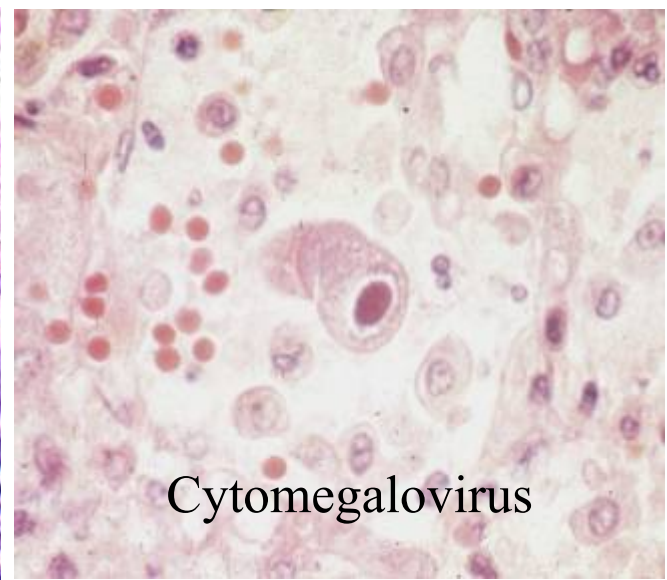
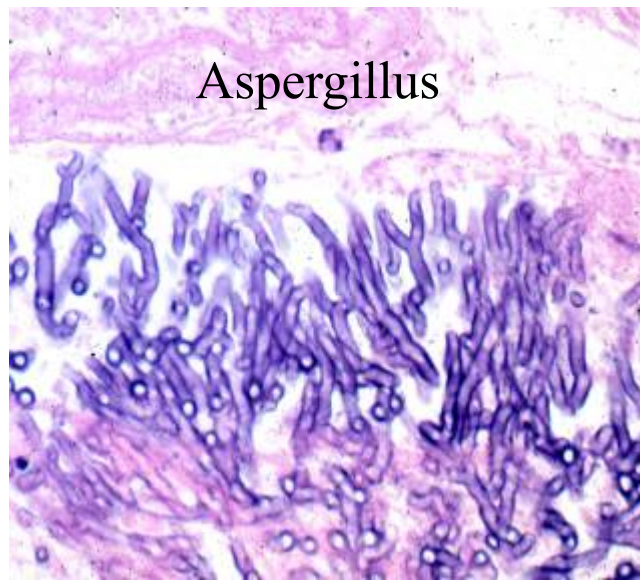
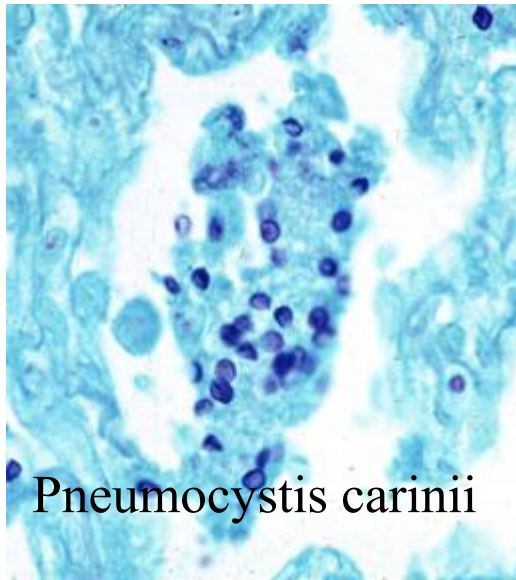
- ❖ is most often a localized lesion in an immunocompetent person, with or without regional lymph node involvement.
- ❖ There is typically granulomatous inflammation, Which may be due to bacteria (e.g., *M. tuberculosis*) or fungi (*Histoplasma capsulatum*, *Coccidioides immitis*, *Blastomyces*)
- ❖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

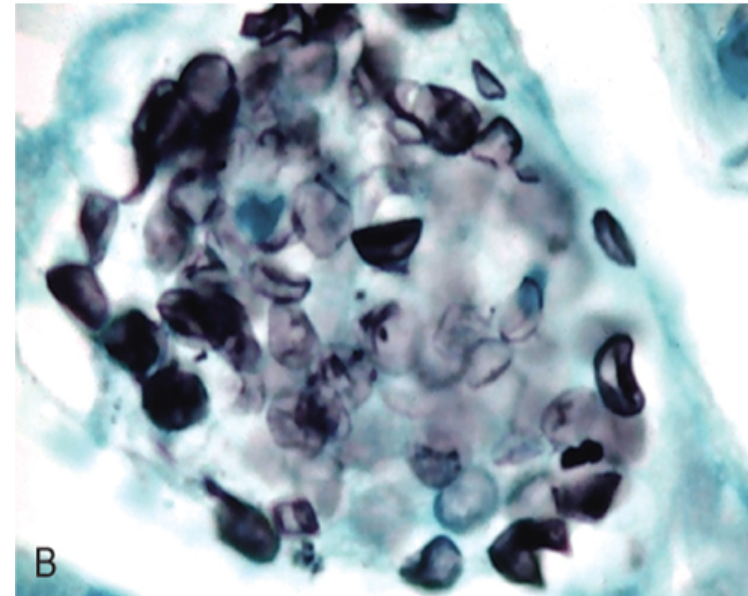
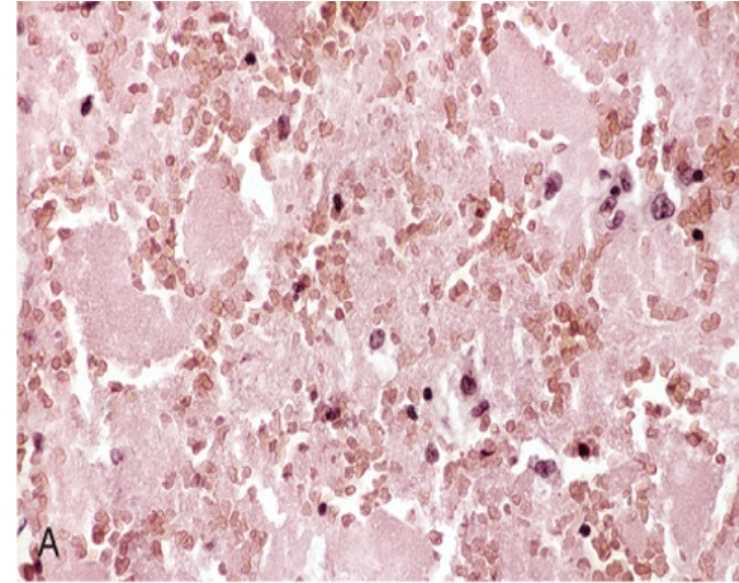
- Cytomegalovirus
- *Pneumocystis jiroveci*
- *Mycobacterium avium-intracellulare*
- Invasive aspergillosis
- Invasive candidiasis
- "Usual" bacterial, viral, and fungal organisms



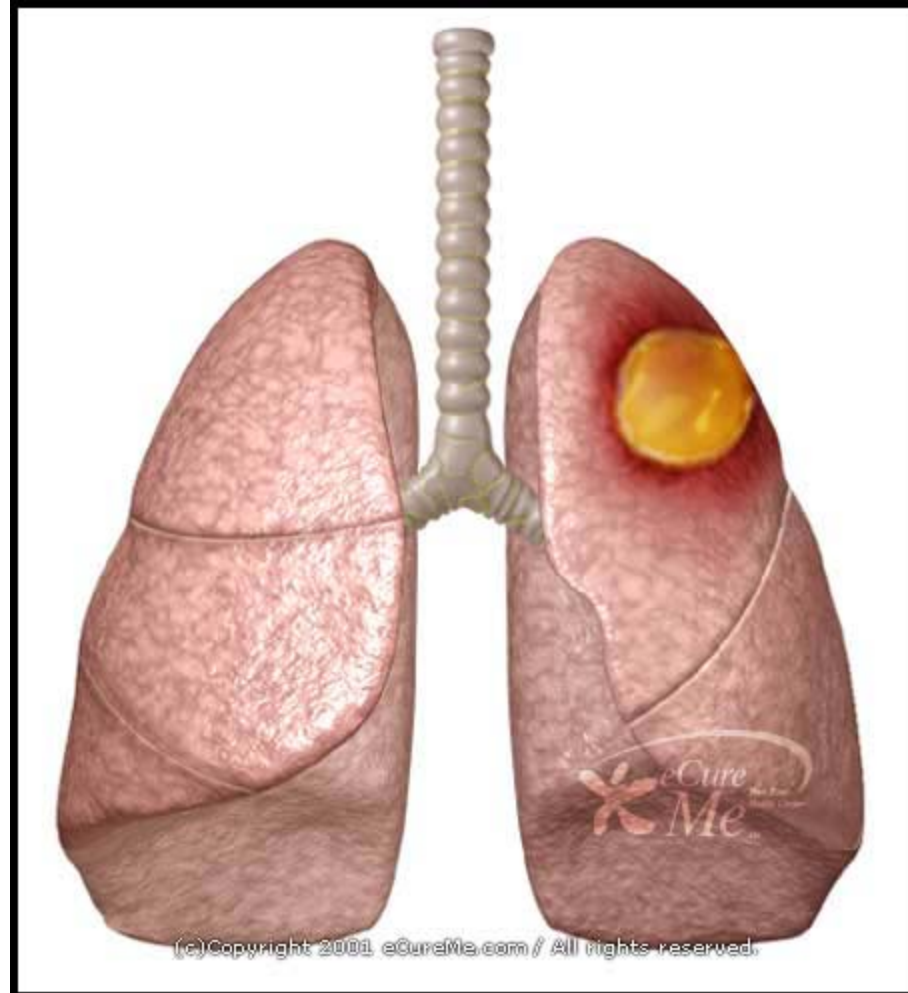
6) Opportunistic pneumonias

Pneumocystis Pneumonia

- *P. jiroveci* (formerly *P. carinii*) is an opportunistic infectious agent considered as a fungus.
- Seen in immunocompromised individuals especially AIDS.
- 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.
- Microscopically:
 - characteristic **intra-alveolar foamy, pink-staining exudate** on H&E stains (A).
 - organism is trapped in the foamy material and can be seen on silver stain as oval cup shaped structures (B)

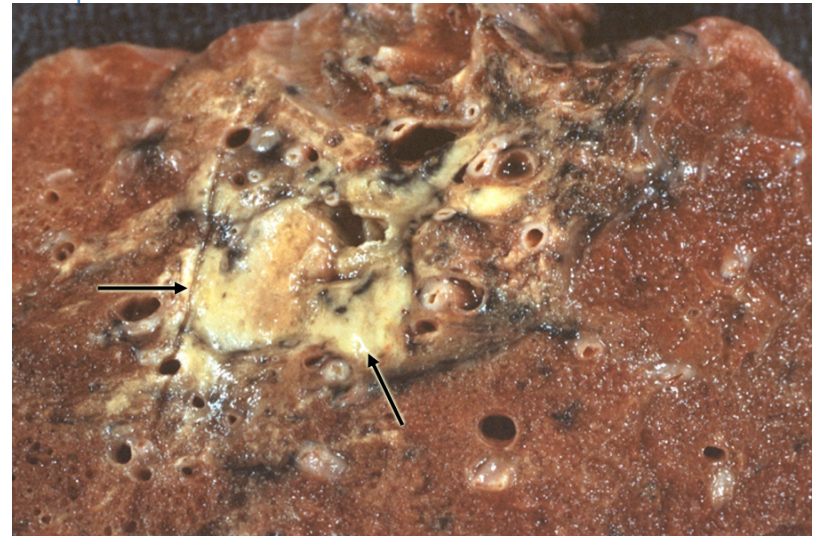
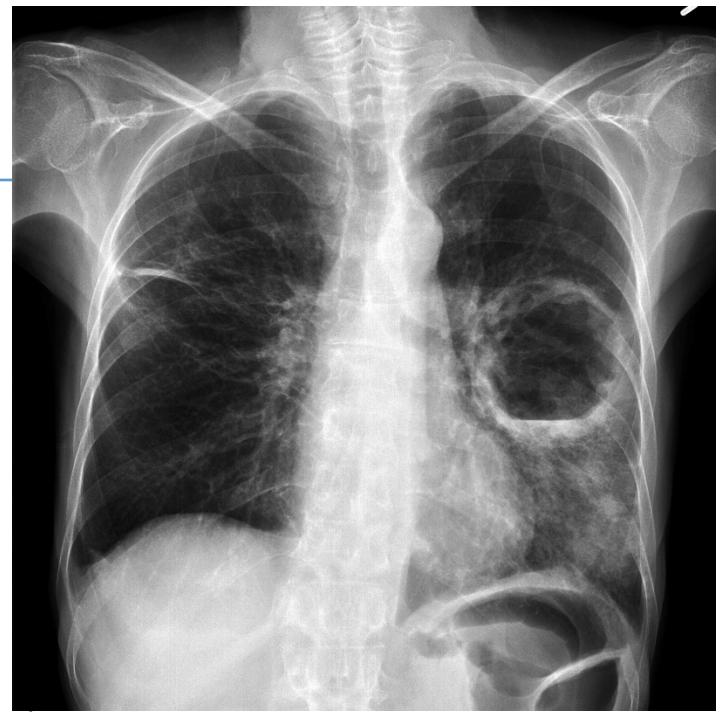


Lung abscess



Lung abscess

- Is localized suppurative necrotic process within the pulmonary parenchyma
- **Features:** tissue necrosis and marked acute inflammation. Abscess is filled with necrotic suppurative debris
 - ▣ **Organisms:**
 - Staphylococci
 - Streptococci
 - Gram-negative organisms
 - Anaerobes
 - ▣ **Pathogenesis:**
 - Can follow aspiration
 - As a complication of pneumonia
 - 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