

RSM-2

PULMONARY INFECTIONS

Dr. Eman Kreishan, M.D

13-10-2022

PULMONARY INFECTIONS

- ▶ Pneumonia can be broadly defined as any infection in the lung.
- ▶ The vulnerability of the lung to infection is high because:
 - (1) Many microbes are airborne and readily inhaled into the lungs.
 - (2) Nasopharyngeal flora are regularly aspirated during sleep, even by healthy individuals.
 - (3) Lung diseases often lower local immune defenses.

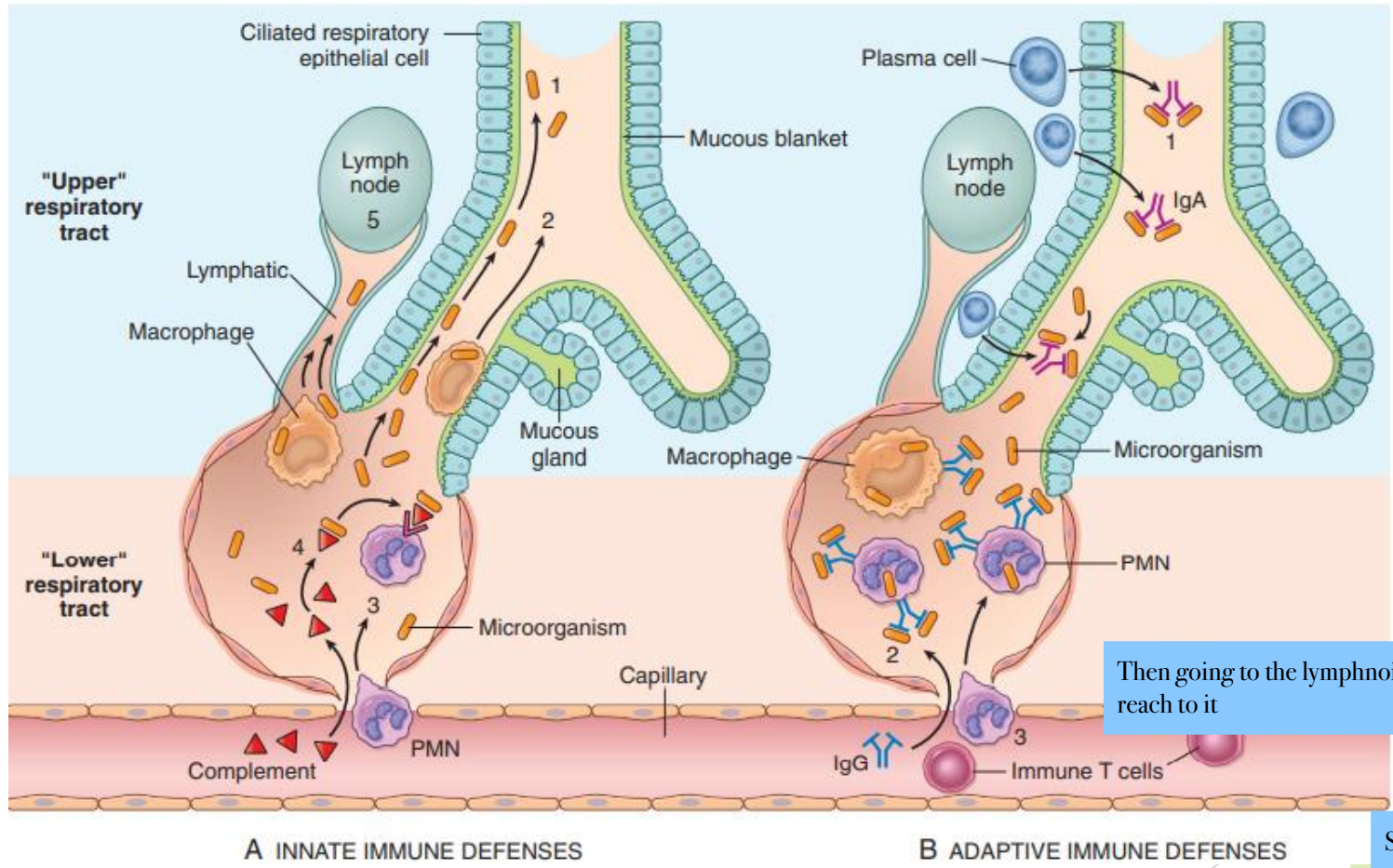


Normally, the lung parenchyma remains sterile because of a number of highly effective immune and non-immune defense mechanisms that extend throughout the respiratory system from the nasopharynx to the alveolar air spaces

LUNG DEFENSE

Innate >> cilia that will remove the microbes outside
Then macrophages

➤ mutations in MYD88, a protein required for signaling by Toll-like receptors, lead to severe necrotizing pneumococcal infections



Then going to the lymphnodes that will become active when the microbe reach to it

Serum: igm iga : for recognition and engulfment

➤ congenital defects in IgA production can increased risk for pneumonias caused by encapsulated organisms such as pneumococcus and H. influenzae.

So any patients with inherited or acquired defects in:

- ▶ Innate immunity (including neutrophil and complement defects).
- ▶ Adaptive immunity (e.g., humoral immunodeficiency).

increased incidence of
infections with
pyogenic bacteria .

STOP SMOKING.....



- ▶ Lifestyle choices interfere with host immune defense mechanisms and facilitate infections.
- ▶ For example:
 - ❖ Cigarette smoke compromises mucociliary clearance and pulmonary macrophage activity.
 - ❖ Alcohol impairs neutrophils function as well as cough and epiglottic reflex

Table 13.5 The Pneumonia Syndromes and Implicated Pathogens

Community-Acquired Bacterial Pneumonia
<i>Streptococcus pneumoniae</i> <i>Haemophilus influenzae</i> <i>Moraxella catarrhalis</i> <i>Staphylococcus aureus</i> <i>Legionella pneumophila</i> Enterobacteriaceae (<i>Klebsiella pneumoniae</i>) and <i>Pseudomonas</i> spp. <i>Mycoplasma pneumoniae</i> <i>Chlamydia pneumoniae</i> <i>Coxiella burnetii</i> (Q fever)
Community-Acquired Viral Pneumonia
Respiratory syncytial virus, human metapneumovirus, parainfluenza virus (children); influenza A and B (adults); adenovirus (military recruits)
Nosocomial Pneumonia
Gram-negative rods belonging to Enterobacteriaceae (<i>Klebsiella</i> spp., <i>Serratia marcescens</i> , <i>Escherichia coli</i>) and <i>Pseudomonas</i> spp. <i>S. aureus</i> (usually methicillin-resistant)
Aspiration Pneumonia
Anaerobic oral flora (<i>Bacteroides</i> , <i>Prevotella</i> , <i>Fusobacterium</i> , <i>Peptostreptococcus</i>), admixed with aerobic bacteria (<i>S. pneumoniae</i> , <i>S. aureus</i> , <i>H. influenzae</i> , and <i>Pseudomonas aeruginosa</i>)
Chronic Pneumonia
Nocardia Actinomyces Granulomatous: <i>Mycobacterium tuberculosis</i> and atypical mycobacteria, <i>Histoplasma capsulatum</i> , <i>Coccidioides immitis</i> , <i>Blastomyces dermatitidis</i>

بنحوف للابيات
انقراض

Classification of pneumonia

Necrotizing Pneumonia and Lung Abscess

Anaerobic bacteria (extremely common), with or without mixed aerobic infection
S. aureus, *K. pneumoniae*, *Streptococcus pyogenes*, and type 3 pneumococcus (uncommon)

Pneumonia in the Immunocompromised Host

Cytomegalovirus
Pneumocystis jiroveci
Mycobacterium avium complex (MAC)
Invasive aspergillosis
Invasive candidiasis
"Usual" bacterial, viral, and fungal organisms (listed above)

1. Community-Acquired Bacterial Pneumonias

▶ A. Streptococcus pneumonia:

▶ Is the most common cause of community-acquired acute pneumonia.

▶ Risk factors:

▶ (1) Chronic diseases such as CHF, COPD, or diabetes.

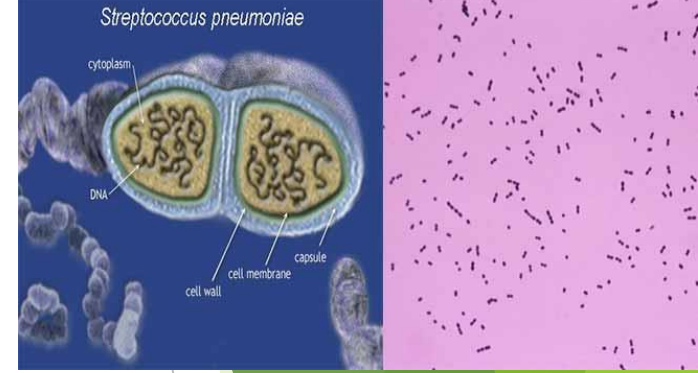
Chronic heart failure

▶ (2) Congenital or acquired defects in immunoglobulin production (e.g., acquired immune deficiency syndrome [AIDS]).

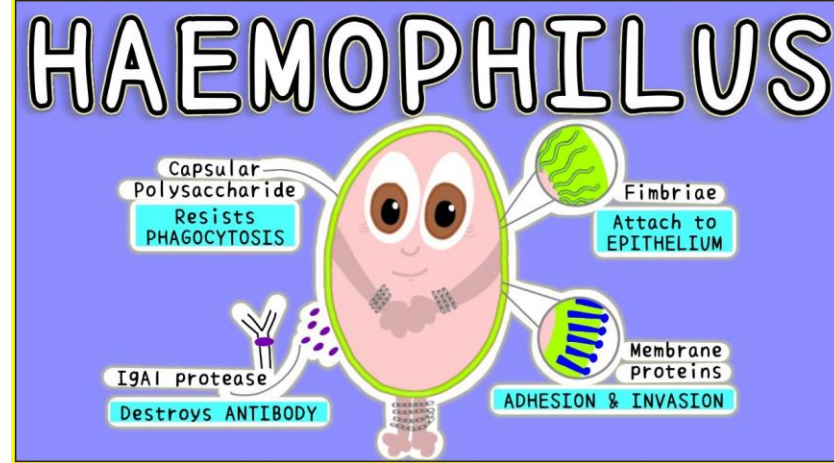
▶ (3) Decreased or absent splenic function (e.g., sickle cell disease or after splenectomy).

Rarely healthy patients gets the pneumonia

Diagnosis??



- ▶ Presence of numerous neutrophils in sputum containing the typical gram-positive, lancet-shaped diplococci supports the diagnosis of pneumococcal pneumonia, but????
- ▶ Isolation of pneumococci from blood cultures.
- ▶ Prevention:
- ▶ Pneumococcal vaccines containing capsular polysaccharides from the common serotypes are used in individuals at high risk for pneumococcal sepsis.



Bacterial cause

▶ B. Haemophilus influenzae:

- ▶ Both encapsulated and unencapsulated forms of H. influenzae are important causes of community-acquired pneumonia.
- ▶ Encapsulated: can cause life threatening pneumonia, epiglottitis and suppurative meningitis in children.
- ▶ Adults at risk for developing infections include those with chronic pulmonary diseases such as chronic bronchitis, cystic fibrosis, and bronchiectasis.
- ▶ H. influenzae is the most common bacterial cause of acute exacerbations of COPD.

C. Moraxella catarrhalis:

- ❑ It is the second most common bacterial cause of acute exacerbation of COPD in adults , especially in older adults.
- ❑ Is one of the three most frequent causes of otitis media.

D. Staphylococcus aureus:

- ❑ is an important cause of secondary bacterial pneumonia in children and healthy adults after viral respiratory illnesses (e.g., measles in children and influenza in both children and adults).
- ❑ associated with a high incidence of complications, such as :
 - lung abscess and empyema.
 - right-sided staphylococcal endocarditis.
 - nosocomial pneumonia.

E. Klebsiella pneumonia:

- ❑ is the most frequent cause of gram-negative bacterial pneumonia.
- ❑ frequently afflicts debilitated and malnourished individuals, particularly chronic alcoholics.
- ❑ Thick and gelatinous sputum is characteristic, because the organism produces an abundant viscid capsular polysaccharide.

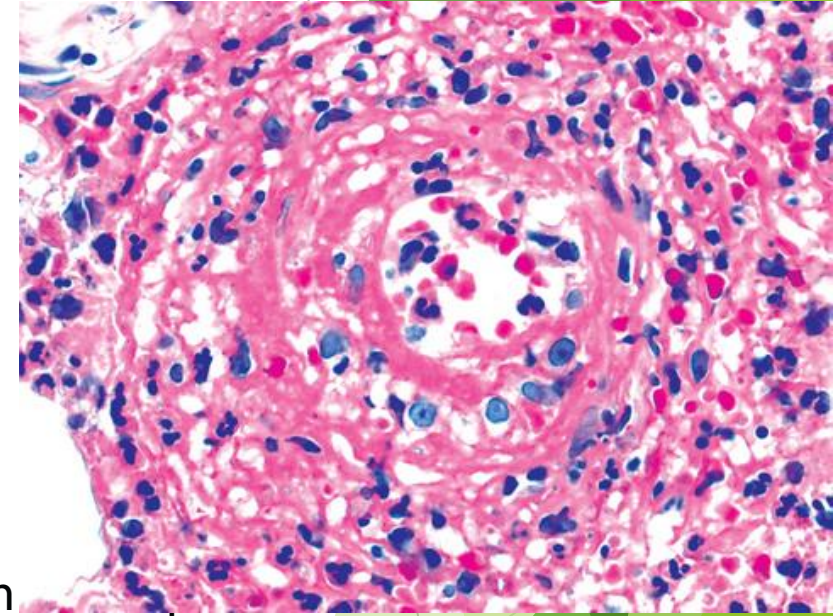
F. Mycoplasma pneumoniae :

- ❑ common among children and young adults.
They occur sporadically or as local epidemics in closed communities (schools, military camps, prisons).
- ❑ Tests for Mycoplasma antigens and polymerase chain reaction (PCR) testing for Mycoplasma DNA are available.

Not easy to culture thats why we use per

G. Pseudomonas aeruginosa:

- ▶ is most commonly seen in:
 - nosocomial settings.
 - cystic fibrosis
 - Neutropenic patient, usually secondary to chemotherapy. Immune deficiency
 - in victims of extensive burns.
 - in patients requiring mechanical ventilation.
- has a propensity to invade blood vessels at the site of infection, with extrapulmonary spread.
- Histologic examination: Pseudomonas vasculitis*



H. Legionella pneumophila

- ▶ is the agent of Legionnaire disease.
- ▶ flourishes in artificial aquatic environments.
- ▶ Mode of transmission : either inhalation of aerosolized organisms or aspiration of contaminated drinking water.
- ▶ Risk factor includes: condition such as cardiac, renal, immunologic, or hematologic disease

Form air conditioner



Legionella pneumophila



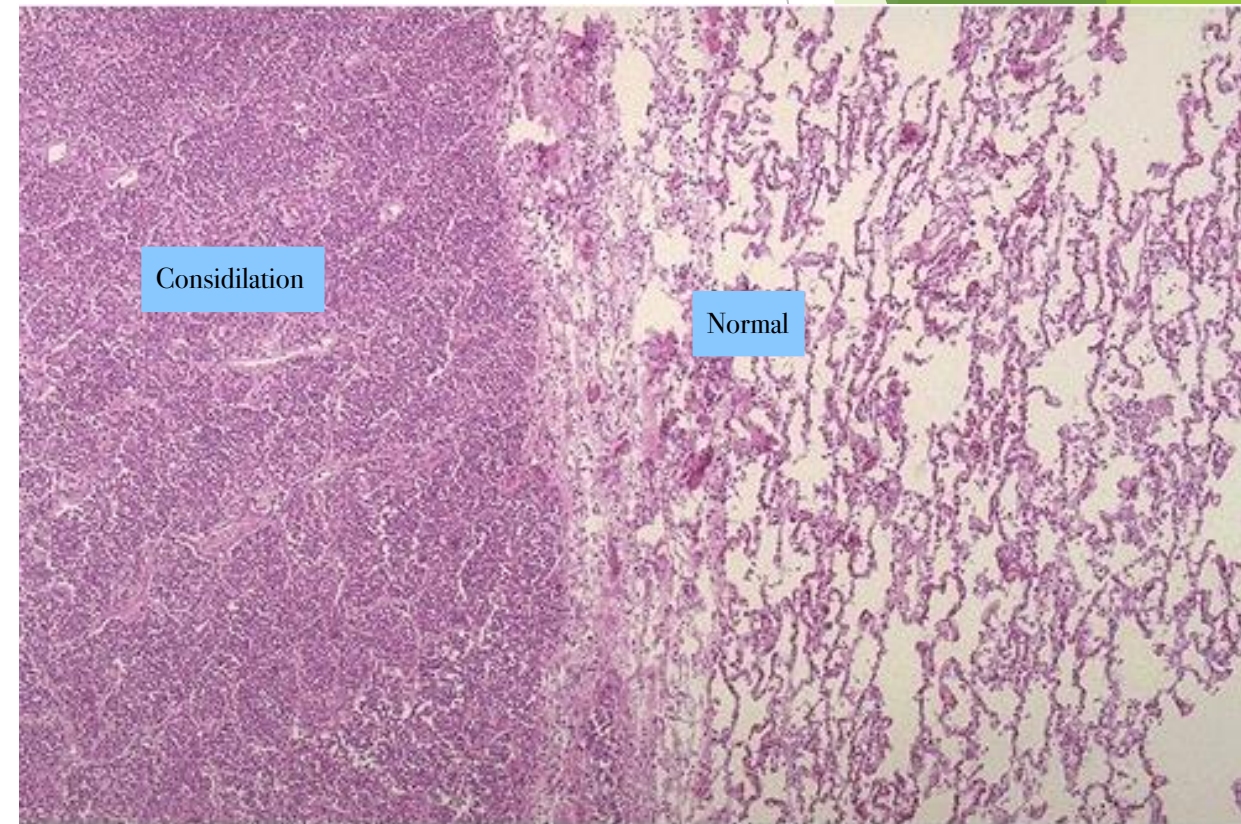
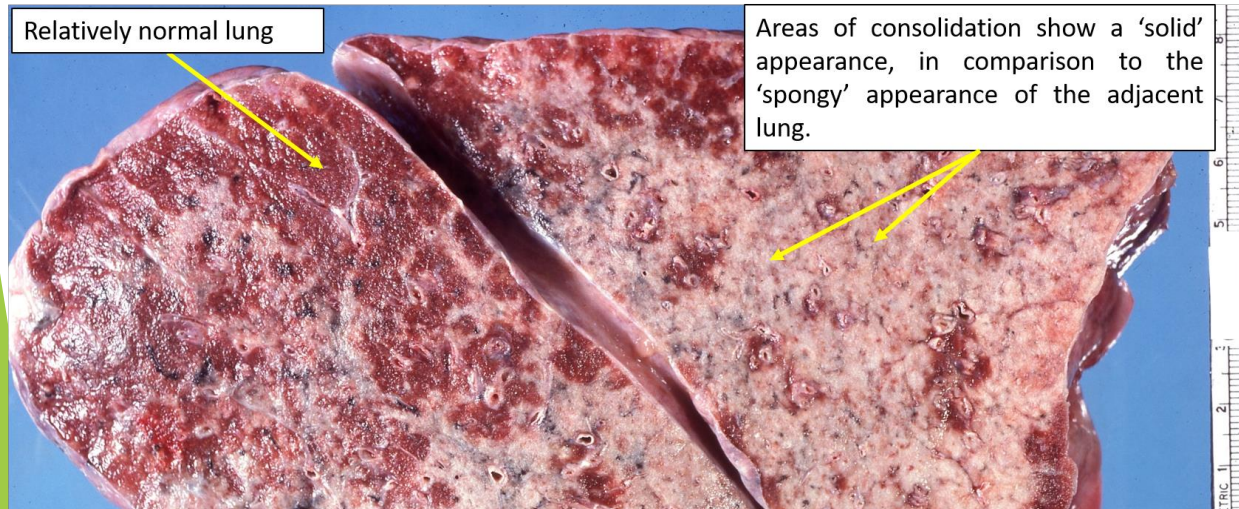
- ▶ Legionella pneumonia may be quite severe, frequently requiring hospitalization and producing a fatality rate of 30% to 50% in immunosuppressed individuals.
- ▶ Rapid diagnosis is facilitated by :
 - demonstration of Legionella antigens in the urine.
 - positive fluorescent antibody test on sputum samples.
 - But culture remains the standard diagnostic modality.
 - PCR-based tests can be used on bronchial secretions in atypical cases

Doctors and medial stuff wont get the disease it only affect immune def

MORPHOLOGY of pneumonia

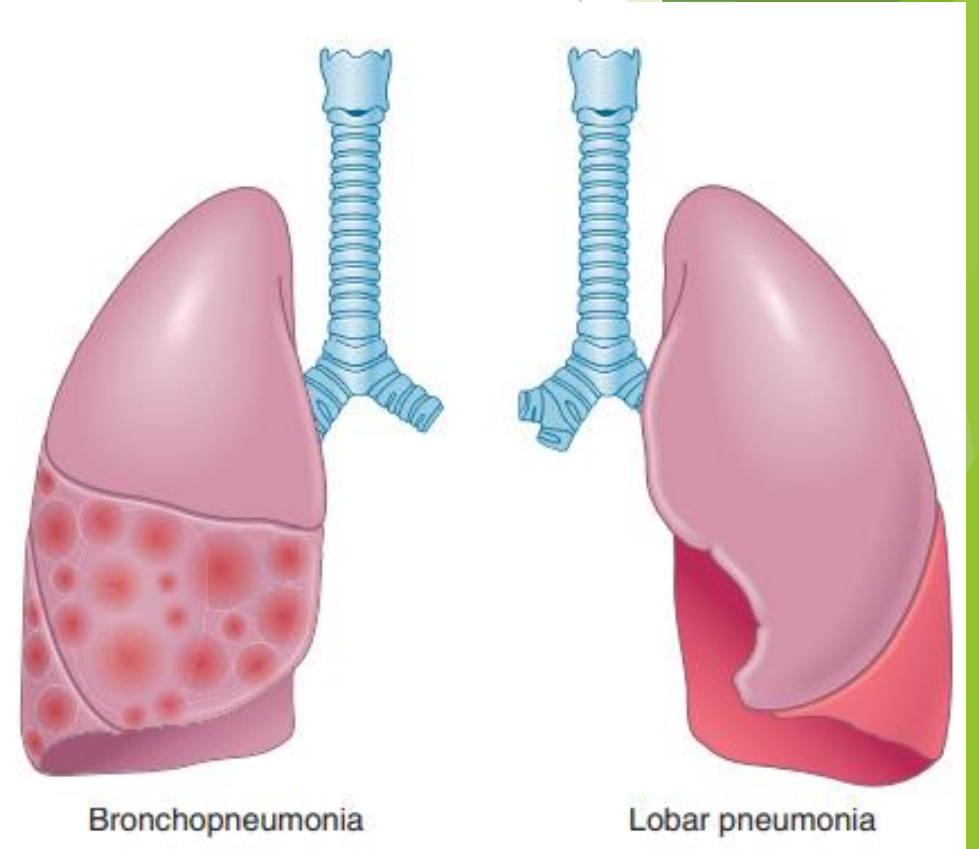
Bacterial pneumonia >> neutrophils
Viral >> lymphocytes

- consolidation,” refers to “solidification” of the lung due to replacement of the air by exudate in the alveoli



Bacterial pneumonia has two patterns of anatomic distribution:

- Lobular bronchopneumonia: Patchy consolidation.
- Lobar pneumonia: consolidation of a large portion of a lobe or of an entire lobe



Lobar pneumonia

▶ four stages of the inflammatory response have classically been described:

▶ A. **congestion:**

characterized by vascular engorgement, intraalveolar fluid with few neutrophils, and numerous bacteria.

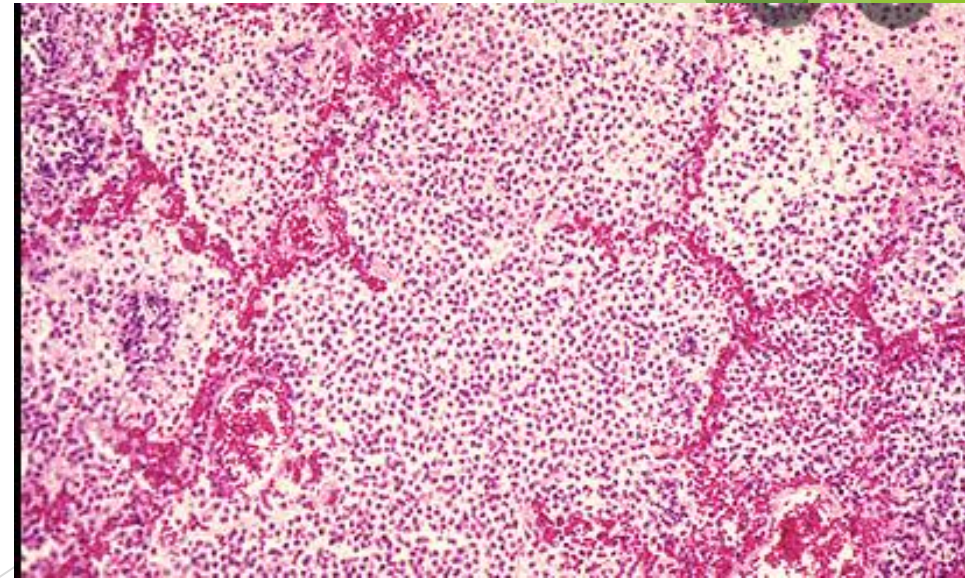
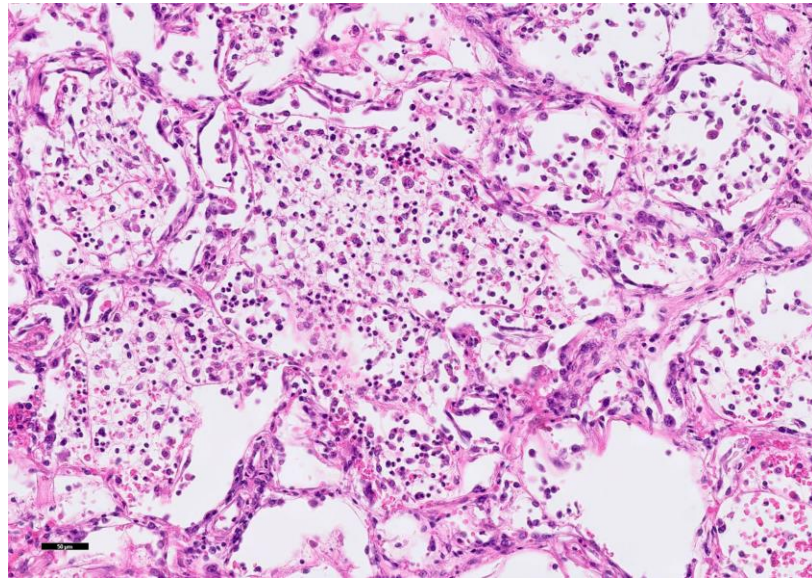
Increase permeability

▶ B. **Red hepatization:**

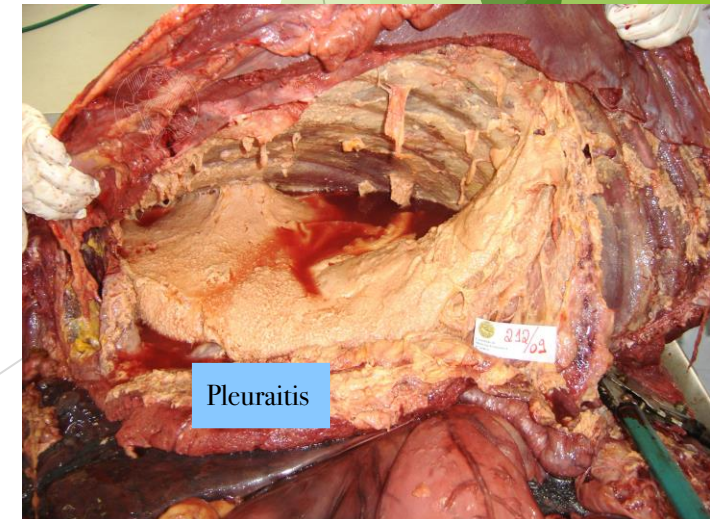
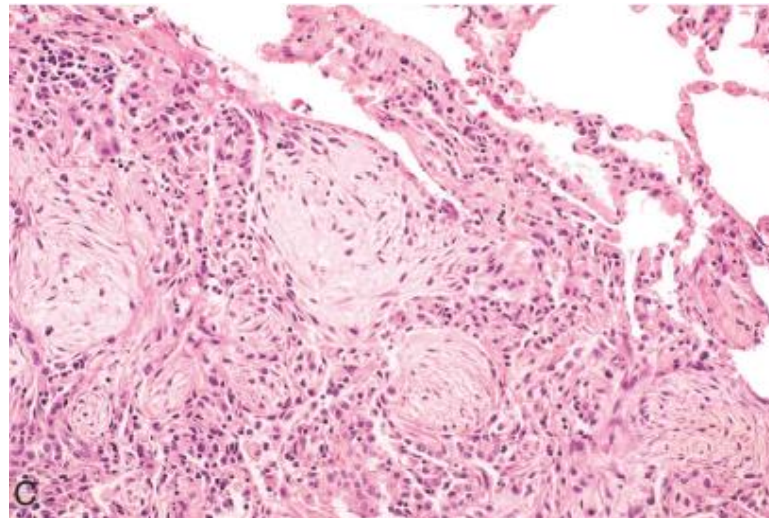
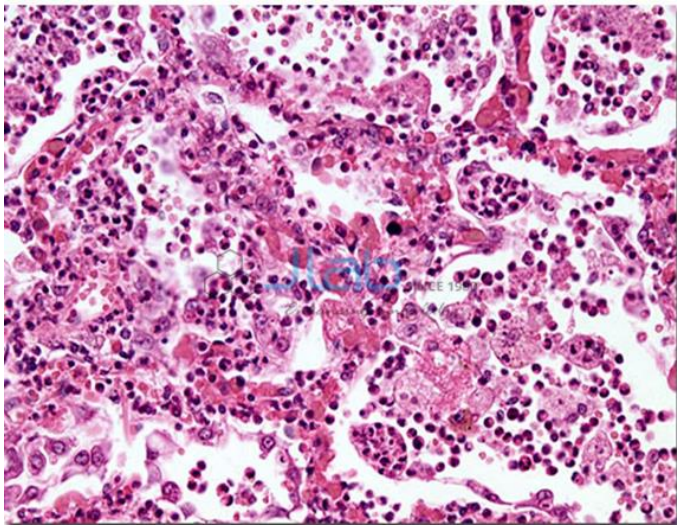
characterized by massive confluent exudation, as neutrophils, red cells, and fibrin fill the alveolar spaces.

Margination the exit neutrophils

Fibrin and pus



- ▶ **C. Gray hepatization :**
 - ▶ marked by progressive disintegration of red cells and the persistence of a fibrinosuppurative exudate.
 - ▶ **D. Resolution:**
 - ▶ the exudate within the alveolar spaces is broken down by enzymatic digestion to produce granular, semifluid debris that is resorbed, ingested by macrophages, or organized by fibroblasts growing into it.
- The area will end up with fibrosis
- ▶ **Pleuritis:**
 - ▶ Pleural fibrinous reaction to the underlying inflammation is often if the consolidation extends to the surface.
- No pus and neutrophils then there will be fibrotic and collagen
- Extend to the pleura

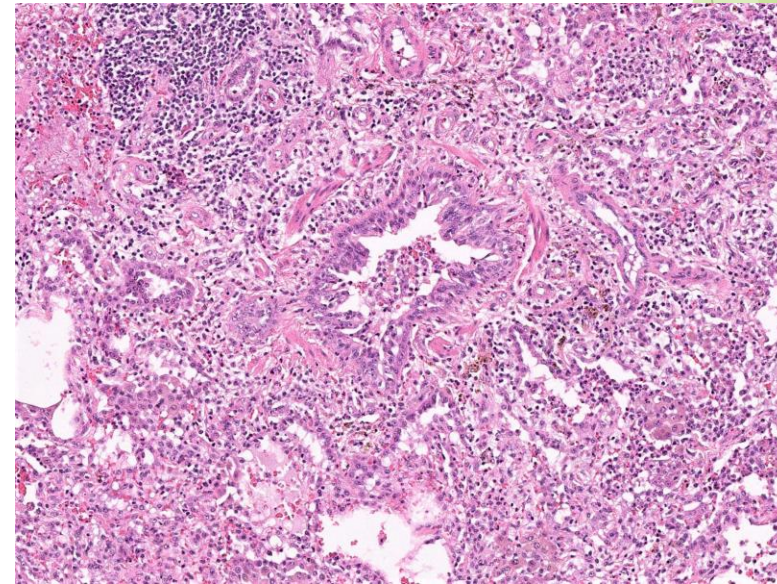
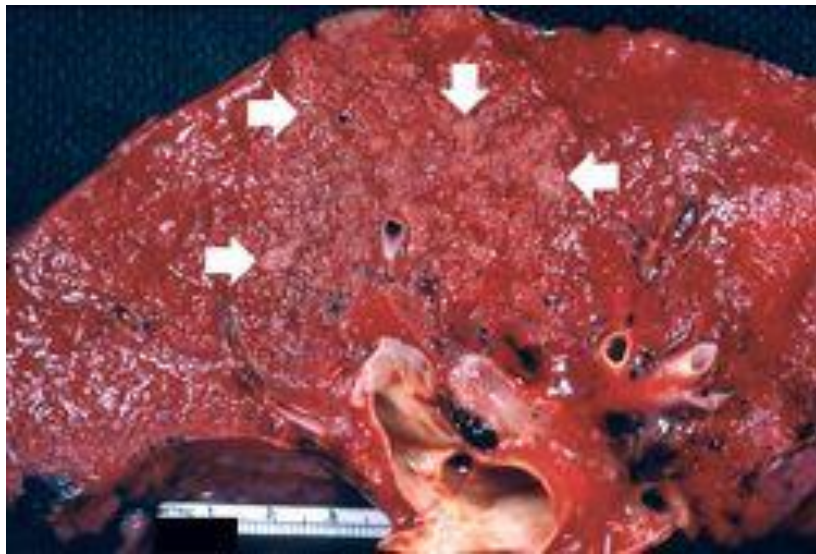


Bronchopneumonia

Patchy

- ▶ Foci of bronchopneumonia are consolidated areas of acute suppurative inflammation.
- ▶ The consolidation frequently bilateral and basal because of the tendency of secretions to gravitate to the lower lobes.
- ▶ Histologically, a neutrophil-rich exudate fills the bronchi, bronchioles, and adjacent alveolar space.

Like lobular pneumonia



Clinical Features

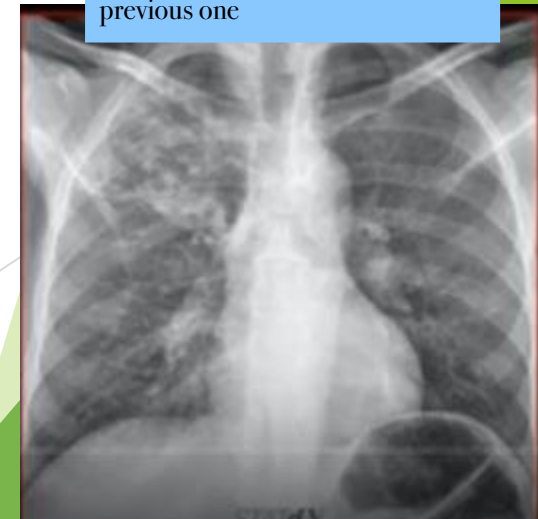
Filled by exudate neutrophils

- ▶ The major symptoms of typical community-acquired acute bacterial pneumonia are:
 - ▶ abrupt onset of high fever and shaking chills. Severely ill
 - ▶ cough producing mucopurulent sputum.
 - ▶ When pleuritis is present, it is accompanied by pleuritic pain. Will cause pain
- Radiology:
 - ▶ lobar pneumonia : whole lobe is radiopaque .
 - ▶ bronchopneumonia: focal opacities .
- Treatment: antibiotics.

Consolidation onj the lower lobe so it will be lobular pneumonia



Whitch foci on the both sides so it will be more severe than the previous one



2. Community-Acquired Viral Pneumonias.

▶ The most common causes of community-acquired viral pneumonias are:

- Influenza types A and B.
- The respiratory syncytial viruses.
- Human metapneumovirus.

Adenovirus and rhinoviruses.

Rubeola virus and varicella virus.

- Nearly all of these agents also cause upper-respiratory tract infections (“common cold”).

Crowded
and
military
forces

PATHOGENESIS



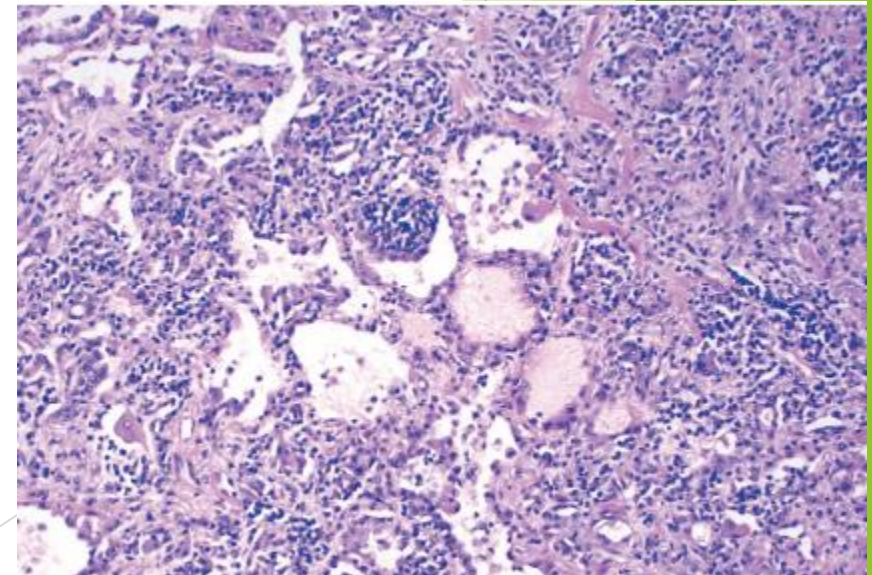
MORPHOLOGY

- ▶ Inflammatory reaction is largely confined to the walls of the alveoli.
- ▶ The septa are widened and edematous; they usually contain a mononuclear inflammatory infiltrate of lymphocytes, macrophages and, occasionally, plasma cells.

No neutrophils

- ▶ In the classic case, alveolar spaces in viral pneumonias are free of cellular exudate

When secondary there will be neutrophils



Clinical Features

- ▶ The clinical course of viral pneumonia is extremely varied, it may manifested as :
 - a severe upper-respiratory tract infection or “chest cold” that goes undiagnosed.
 - manifest as a fulminant, life-threatening infection in immunocompromised patient.
- Generally the patient presented with:
 - Fever.
 - headache.
 - Malaise.
 - Cough with minimal sputum

Hospital-Acquired Pneumonias

- ❖ Nosocomial, or hospital-acquired, pneumonias are defined as pulmonary infections acquired in the course of a hospital stay.
- ❖ Nosocomial infections are common in:
 - ▶ hospitalized individuals with severe underlying disease.
 - ▶ Immunosuppressed.
 - ▶ those on prolonged antibiotic regimens. Resistance
 - ▶ Patients on mechanical ventilation .
- ❖ Most common organisms:
 - ▶ Gram-negative rods (members of Enterobacteriaceae and Pseudomonas spp.) and S. aureus

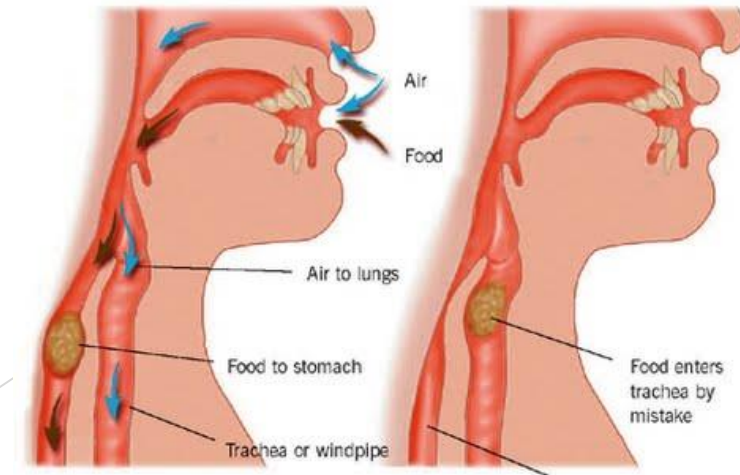


Aspiration Pneumonia

Cant control the reflex

- ❖ Aspiration pneumonia occurs in debilitated patients or those who aspirate gastric contents while unconscious (e.g., after a stroke) or during repeated vomiting.
- ❖ The resultant pneumonia is partly chemical, due to the extremely irritating effects of the gastric acid, and partly bacterial.
- ❖ Complication of Aspiration pneumonia is :
 - ▶ Death in individuals predisposed to aspiration.
 - ▶ In those who survive, abscess formation is a common complication.

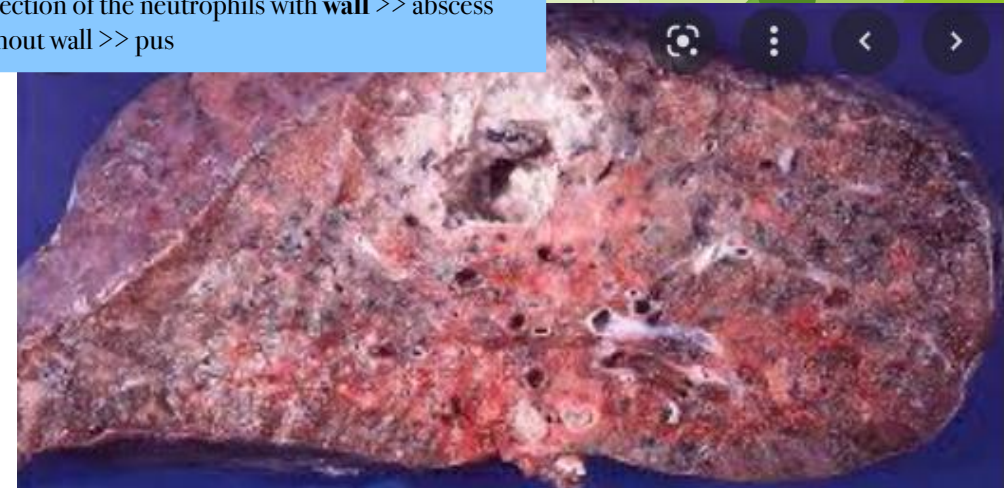
Gastric acid that entered the trachea that will damage the mucosa



Lung Abscess

- ▶ Lung abscess refers to a localized area of suppurative necrosis within the pulmonary parenchyma, resulting in the formation of one or more large cavities.
- ▶ The causative organism may be introduced into the lung by any of the following mechanisms:
 - ▶ 1. Aspiration of infective material from carious teeth or infected sinuses or tonsils
 - ▶ 2. Aspiration of gastric contents.
 - ▶ 3. As a complication of necrotizing bacterial pneumonias.
 - ▶ 4. Bronchial obstruction.
 - ▶ 5. Septic embolism.

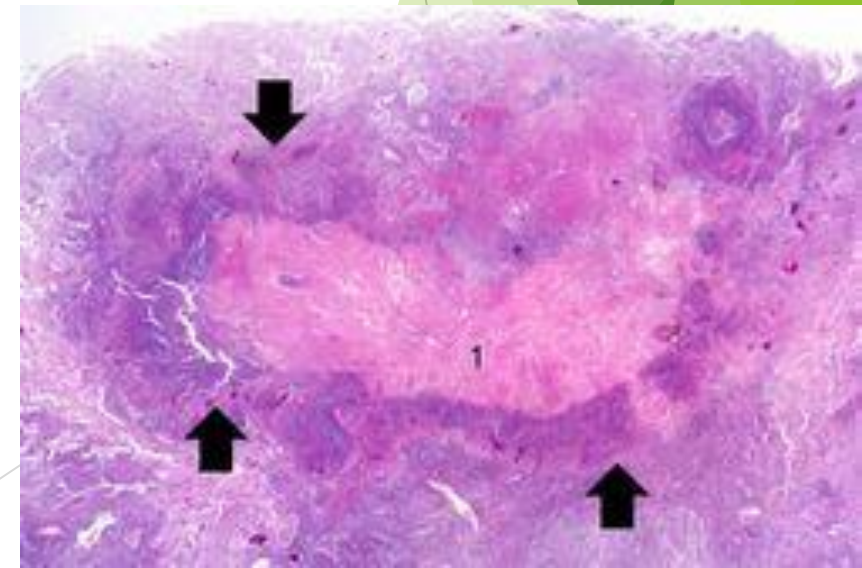
Collection of the neutrophils with **wall** >> abscess
Without wall >> pus



MORPHOLOGY

Septic embolism from the endocarditis

- ▶ Abscesses range in diameter from a few millimeters to large cavities 5 to 6 cm across.
- ▶ On histologic examination:
- ▶ The suppurative focus is surrounded by variable amounts of fibrous scarring and mononuclear infiltration (lymphocytes, plasma cells, macrophages), depending on the chronicity of the lesion.



Clinical Features

- Prominent cough that usually yields copious amounts of foul-smelling, purulent, or sanguineous sputum.
- Spiking fever and malaise.
- Clubbing of the fingers, weight loss, and anemia.
- Abscesses occur in 10% to 15% of patients with bronchogenic carcinoma.

Clubbing finger with chronic

