Pathology Of lobar Pneumonia & Bronchopneumonia

COLOR INDEX:

MAIN TEXT (BLACK)

FEMALE SLIDES (PINK)

MALE SLIDES (BLUE)

IMPORTANT (RED)

DR'S NOTE (GREEN)

EXTRA INFO (GREY)

Editing file:

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 and its classification which principally include bronchopneumonia, lobar pneumonia and atypical pneumonia.
- Can appreciate the etiology and pathogenesis of lung abscess.

Join here first to access the next two links : **click me**

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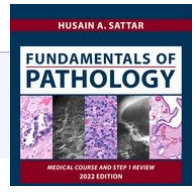

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PULMONARY INFECTIONS

Definition

Pneumonia defined as **any infection in the lung**.

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.
The vulnerability of the lung to infection despite these defenses **is not surprising 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.

Pneumonias are classified by the specific etiologic agent, which determines the treatment, or if no pathogen can be isolated, by the clinical setting in which the infection occurs, we also know that the vast majority are upper respiratory tract infections caused by viruses, but bacterial and fungal infections can also occur.

443: Dr's note: why our lungs are protective:

1- presence of macrophages

2- presence of cillia

PULMONARY INFECTIONS

Etiology	• Loss or suppression of the cough reflex, as a result of coma, anesthesia, neuromuscular disorders, drugs (may lead to aspiration of gastric contents). • Injury to the mucociliary apparatus, by either impairment of ciliary function or destruction of ciliated epithelium, due to cigarette smoke, inhalation of hot or corrosive gases, viral diseases, or genetic defects of ciliary function • Interference with the phagocytic or bactericidal action, of alveolar macrophages by alcohol, tobacco smoke, anoxia, or oxygen intoxication. • Pulmonary congestion and edema. • Accumulation of secretions in conditions such as cystic fibrosis and bronchial obstruction

PULMONARY INFECTIONS	
Pathogenesis & classification	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. Classification of pneumonia can be made according to causative agent
Anatomic classification of pneumonia	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. 2. Interstitial: • Influenza virus (children), Mycoplasma pneumoniae.

Community-Acquired Acute Pneumonia

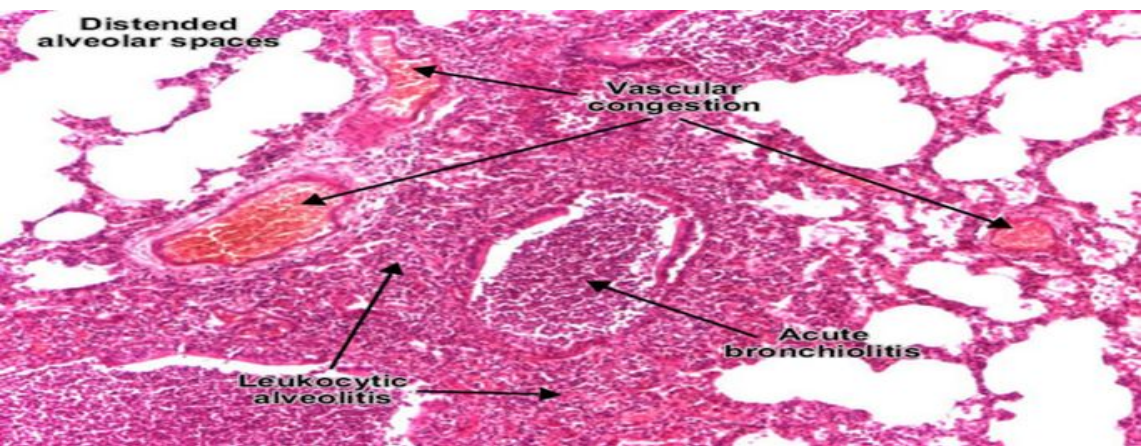
Those are common features and causes for all Community-Acquired

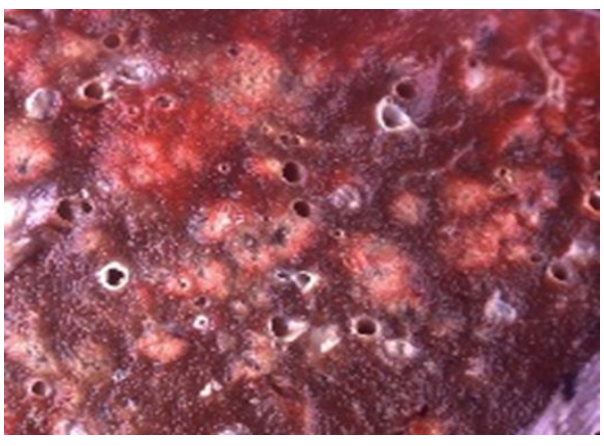
Common features	• Usually, Bacterial. • Can follow URT infection. • It can be lobar or bronchopneumonia. • Reduced air entry and dullness by percussion.
Clinical features	Sudden onset of high fever, chills, pleuritic chest pain and productive cough, may be with hemoptysis.
Causes	The most common cause 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 intravenous drug abuser: Staphylococcus aureus
More common in	Underlying chronic disease e.g., DM, COPD, and congestive heart failure. Congenital or acquired immune deficiency. Decreased or absent splenic function.

Community-Acquired Acute Pneumonia

Bronchopneumonia

Grossly	patchy consolidation of the lung, slightly elevated, dry, granular, gray-red to yellow, and poorly delimited at their margins, Usually it involves lower lobes (basal) bilaterally because there is a tendency of the secretions to gravitate into the lower lobes. also well developed lesions are 3-4 cm ill defined nodules.
Micro	suppurative, neutrophil-rich exudate that fills the bronchi, bronchioles, and adjacent alveolar spaces. Most common agents are: - Streptococcus pneumoniae, - Haemophilus Influenza, in COPD





Community-Acquired Acute 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**

Stage I: Congestion	lung is heavy, boggy and red. The intra-alveolar space is filled with fluid, few scattered neutrophils and numerous bacteria.
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.
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.
Stage IV: Resolution	exudates within the alveoli are being enzymatically digested, resorbed, ingested by macrophages or coughed up.

Clinical features

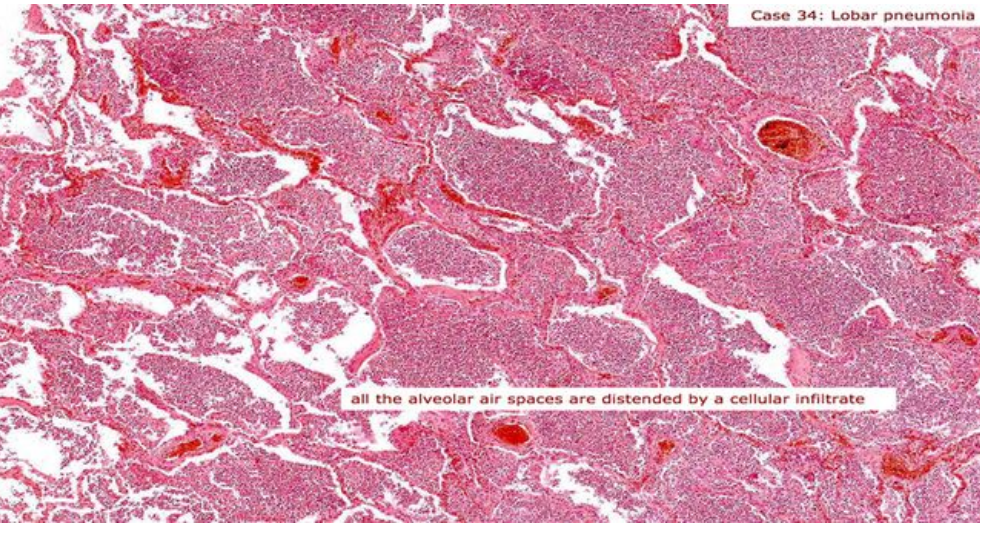
Abrupt onset of high fever, shaking chills, cough productive mucopurulent sputum occasional patients may have hemoptysis.

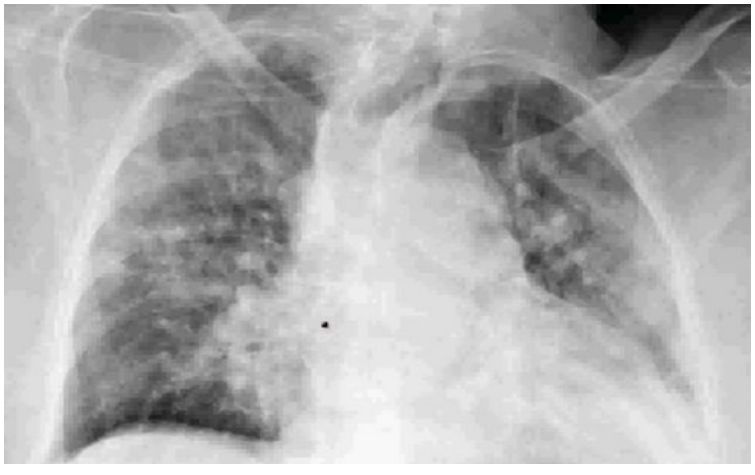
When fibrinosuppurative pleuritis is present, it is accompanied by pleuritic pain and pleural friction rub.

Radiology:

in lobar pneumonia there is a radio opaque (consolidation) well circumscribed lobe.

in bronchopneumonia there are multiple small opacities usually basal and bilateral.



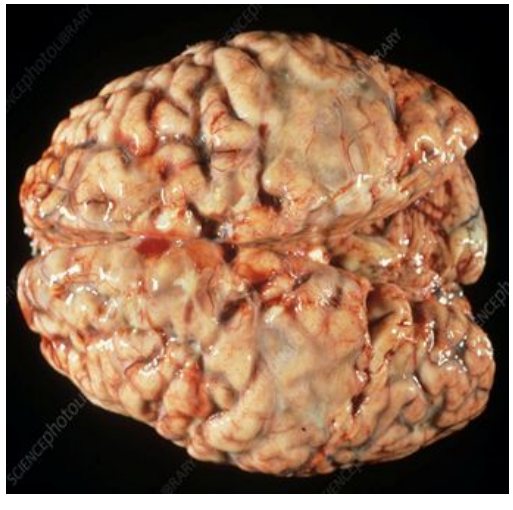


Multiple small opacities (consolidation)

Community-Acquired Acute Pneumonia

Complications	• **Tissue destruction and necrosis**, causing **abscess formation** (particularly common with type 3 pneumococci or Klebsiella infections). • **Spread of infection** to the pleural cavity, causing the intrapleural fibrinosuppurative reaction known as **empyema.** • **Bacteremic dissemination** to the heart valves, pericardium, brain, kidneys, spleen, or joints, causing metastatic abscesses, endocarditis, meningitis, or suppurative arthritis.






COMMUNITY-ACQUIRED ATYPICAL (VIRAL AND MYCOPLASMAL) PNEUMONIAS

Characterized by **patchy inflammation** in the lungs confined to the **alveolar septae** and **pulmonary interstitium** and therefore it is called **interstitial pneumonitis.**

The term atypical denotes the moderate amount of sputum, **no physical findings** of consolidation, only moderate elevation of white cell count, and **lack of alveolar exudate.**

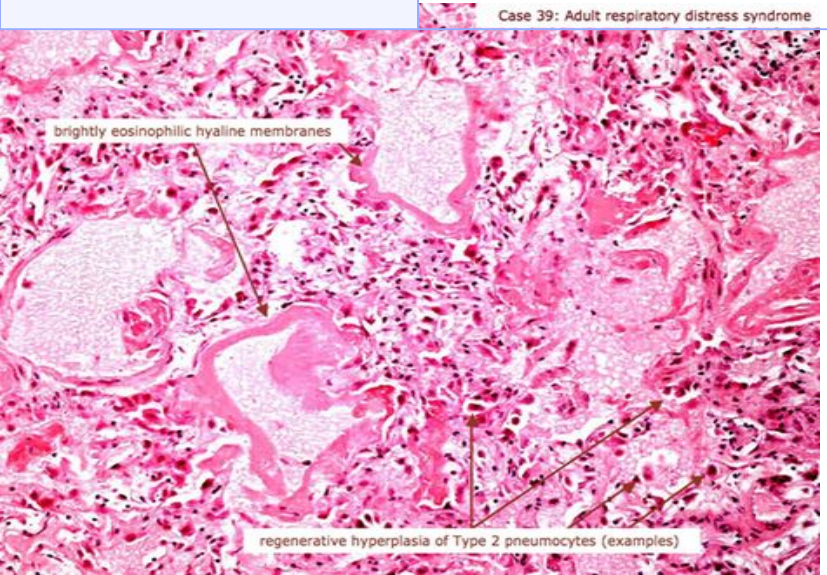
It is caused by many organisms but the **most common is Mycoplasma pneumonia** (common in children and young adults).

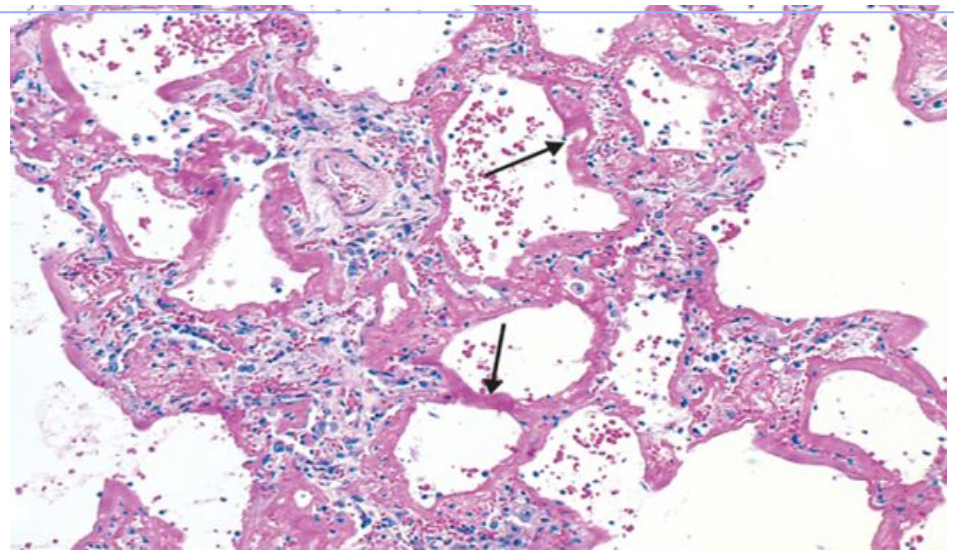
Others include:

- 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.

COMMUNITY-ACQUIRED ATYPICAL (VIRAL AND MYCOPLASMAL) PNEUMONIAS

Grossly	• All causal agents produce essentially similar morphologic patterns. • The lung involvement may be quite patchy or may involve whole lobes bilaterally or unilaterally. • The affected areas are red-blue and congested. The pleura is smooth, and pleuritis or pleural effusions are infrequent.
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).





COMMUNITY-ACQUIRED ATYPICAL (VIRAL AND MYCOPLASMAL) PNEUMONIAS

Clinical features

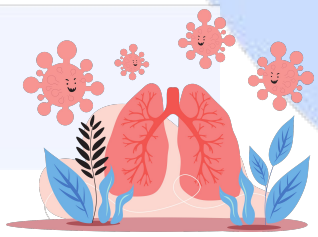
The clinical course is extremely varied, Many cases masquerade as severe upper respiratory tract infections or as chest colds

Cough may be absent, and the major manifestations may consist only of fever, headache, muscle aches, and pains in the legs.

The ordinary sporadic form of the disease is usually mild with a low mortality rate, below 1%. Interstitial pneumonia (good prognosis).

Secondary bacterial infection by staphylococci or streptococci is common in such circumstances.

HOSPITAL-ACQUIRED PNEUMONIA



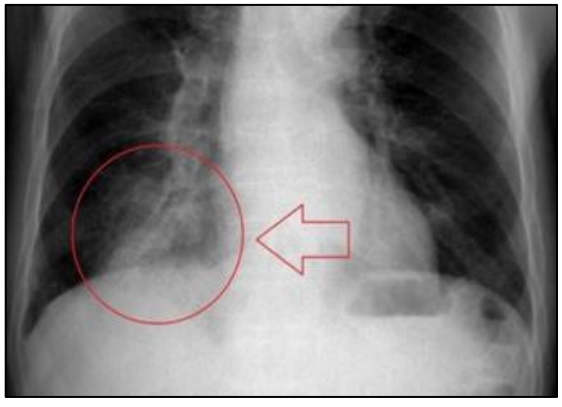
	Hospital acquired Pneumonia (Other types of pneumonia)
Definition	acquire terminal pneumonias while hospitalized (nosocomial infection)
Cause	Gram-negative organisms like Klebsiella, Pseudomonas aeruginosa and E. coli have been implicated
Predisposing factor	severe underlying conditions e.g., immunosuppression, prolonged antibiotic therapy, intravascular catheter and pt. with mechanical ventilator

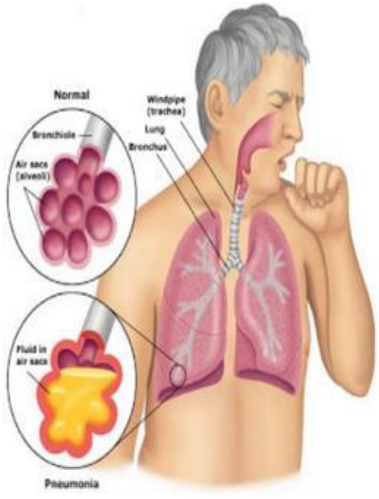
Aspiration pneumonia

	Aspiration pneumonia (Other types of pneumonia**)**
Epidemiology	Occurs in markedly debilitated patients or those who aspirate gastric contents either while unconscious (e.g., after a stroke) or during repeated vomiting (Occur to healthy individual)
Features	These patients have abnormal gag and swallowing reflexes that predispose to aspiration
Etiology	• The resultant pneumonia is partly **chemical** because of the extremely irritating effects of the gastric acid, and partly **bacterial** from the oral flora. • Typically , more than one organism is recovered on culture, aerobes being more common than anaerobes

Aspiration pneumonia

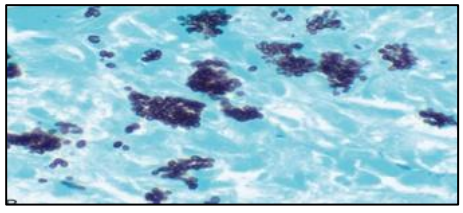
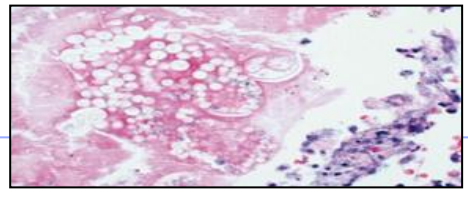
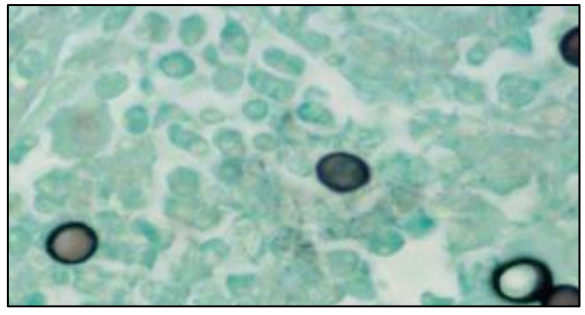
Necrotizing pneumonia	This type of pneumonia is often necrotizing, pursues a fulminant clinical course, and is a frequent cause of death
complication	In those who survive, lung abscess is a common complication





Usually found in the lower right side of the lung because of the anatomy of the right bronchus

Chronic pneumonia

Overview	• Is most often a localized lesion in an immunocompetent person, with or without regional lymph node involvement. • 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
Etiology	There is typically granulomatous inflammation (necrotic or not): • Bacteria (e.g., M. tuberculosis) (A key info for chronic Pneumonia) • Fungi (Histoplasma capsulatum, Coccidioides immitis, Blastomyces)
People At Risk	immunocompromised, immunocompetent.
Morphology	  

Opportunistic pneumonias

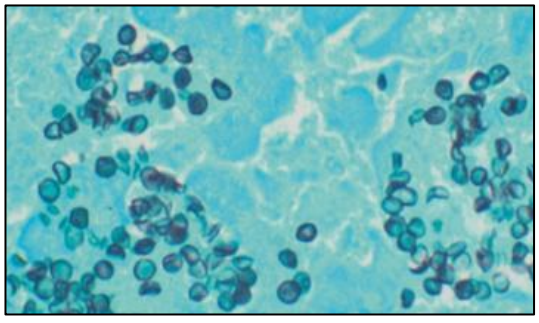
	Opportunistic pneumonias (Other types of pneumonia)
People At Risk	• Infections that affect immunosuppressed patients (AIDS, cancer patients and transplant recipients) • Is one of the most common and serious complications in patients whose immune defenses are suppressed by disease, immunosuppressive therapy for organ transplants, chemotherapy for tumors, or irradiation
Organisms	• Cytomegalovirus. • Pneumocystis jiroveci (formerly P. carinii) • Mycobacterium avium-intracellulare. • Invasive aspergillosis. • Invasive candidiasis. • "Usual" bacterial, viral, and fungal organisms
Clinical features	The appearance of a pulmonary infiltrate, with or without signs of infection (e.g., fever)

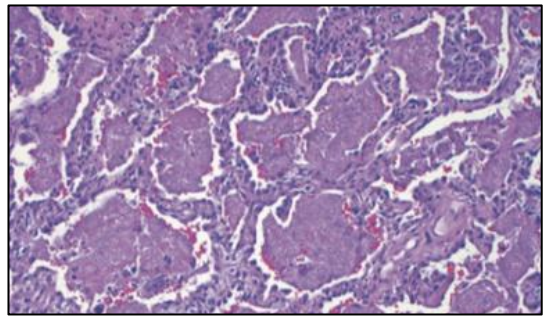
Opportunistic pneumonias

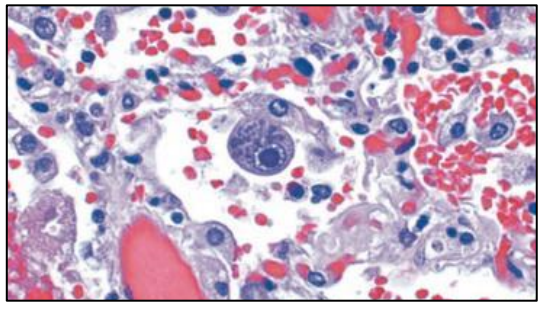
Morphology

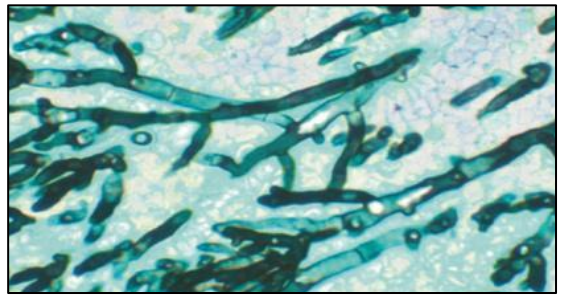
TABLE 15–9 Causes of Pulmonary Infiltrates in Immunocompromised Hosts

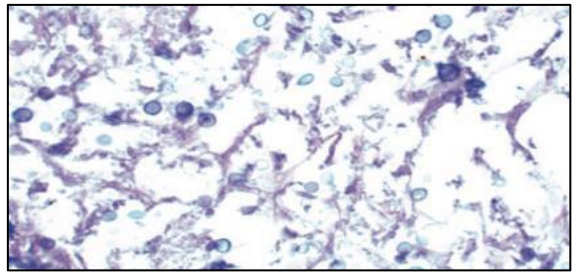
Diffuse Infiltrate	Focal Infiltrate
COMMON	
Cytomegalovirus	Gram-negative rods
Pneumocystis jiroveci	*Staphylococcus aureus*
Drug reaction	*Aspergillus*
	Candida
	Malignancy
UNCOMMON	
Bacteria	*Cryptococcus*
Aspergillus	*Mucor*
Cryptococcus	*Pneumocystis jiroveci*
Malignancy	*Legionella pneumophila*







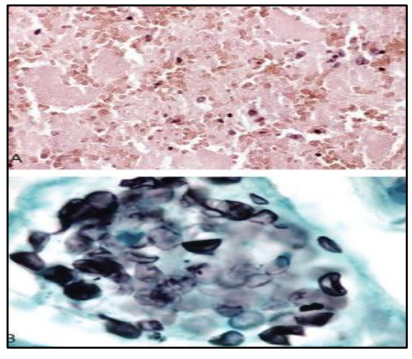




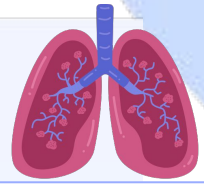
Pneumocystis Pneumonia

	Pneumocystis Pneumonia (Other types of pneumonia
Overview	• **P. jiroveci** (formerly P. carinii) is an opportunistic infectious agent considered as a fungus. • Seen in immunocompromised individuals especially AIDS
Effective methods of diagnosis	• 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 “bubbly, 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)

Bubbles like shape in the alveolar space is a strong hint for Pneumocystis

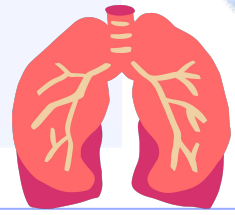


Lung abscess



Features	• Is localized suppurative necrotic process within the pulmonary parenchyma • tissue necrosis and marked acute inflammation • Abscess is filled with necrotic suppurative debris
Causative organisms	• Staphylococci • Streptococci • Gram-negative • organisms Anaerobes
Pathogenesis	• Can follow aspiration • As a complication of pneumonia • Septic emboli • Tumors • Direct infection
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



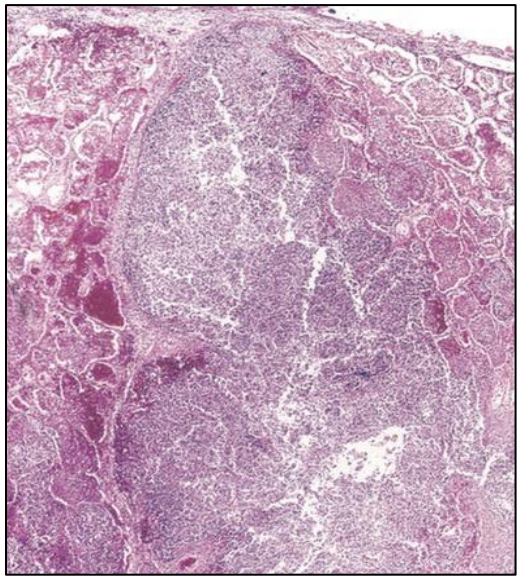
Complications	• Bronchopleural fistula and pleural involvement resulting in empyema. • Massive hemoptysis, spontaneous rupture into uninvolved lung segments. • Non-resolution of abscess cavity. • Bacteremia could result in brain abscess and • meningitis.
Prognosis	• With antibiotic therapy 75% of abscess resolve.
Morphology	• Variable in size • Single or multiple • Pulmonary abscesses due to aspiration are • more common on the right (because of the more vertical right main bronchus) and are most often single. • Abscesses that develop in the course of pneumonia or bronchiectasis are usually multiple, basal, and diffusely scattered.

Lung abscess

The cardinal histologic change in all abscesses is suppurative destruction of the lung parenchyma within the central area of cavitation

Cavitation

Pus



Big cystic lesion filled with exudate

Summary

• S. pneumoniae (the pneumococcus) is the most common cause of community-acquired bacterial pneumonia and usually has a lobar pattern of involvement.

• Morphologically, lobar pneumonias evolve through four stages: congestion, red hepatization, gray hepatization, and resolution.

• Other common causes of bacterial pneumonias in the community include H. influenzae and M. catarrhalis (both associated with acute exacerbations of COPD), S. aureus (usually secondary to viral respiratory infections), K. pneumoniae (observed in chronic alcoholics), P. aeruginosa (seen in individuals with cystic fibrosis, in burn victims, and in patients with neutropenia), and L. pneumophila, seen particularly in organ transplant recipients.

• Viral pneumonias are characterized by respiratory distress out of proportion to the clinical and radiologic signs, and by inflammation that is predominantly confined to alveolar septa, with generally clear alveoli.

• Common causes of viral pneumonia include influenza A and B, respiratory syncytial virus, human metapneumovirus, parainfluenza virus, and adenovirus

Summary

Overview

A. A- **Pneumonia**: inflammation of the lung parenchyma.

B. B- **Predisposing factors:**

- ❖ diabetes mellitus
- ❖ Old age
- ❖ Chronic diseases
- ❖ Immune deficiency
- ❖ alcoholics
- ❖ Malnutrition

C- Symptoms:

- ❖ Fever (pyrexia).
- ❖ Chills.
- ❖ Malaise.
- ❖ Mucopurulent cough.
- ❖ chest pain (specially when it reach the pleural cavity).
- ❖ Rusty tasty sputum.

D- Investigations:

- ❖ High WBC (shift to the left) ❖ High ESR
- ❖ High C-reactive proteins

Classification

Classification can be based on 3 principal:

1.**Clinical Classification**:

A- Community acquired pneumonia

B- Hospital acquired (Nosocomial) pneumonia C- Aspiration pneumonia

2- **pathological Classification**

A- Lobar pneumonia

B- Bronchopneumonia C- interstitial pneumonia

3- **Based on the etiology (based on the organism)** :

- ❖ streptococcus pneumonia
- ❖ staphylococcus pneumonia
- ❖ klebsiella pneumonia ❖ Mycoplasma pneumonia

Interstitial pneumonia

-Characterized by patchy inflammation in the lungs confined to the alveolar septae and pulmonary interstitium.

- Mainly caused by obligated intracellular organisms: viruses - Mycoplasma chlamydia.

Diagnosis: Cold Agglutination test is Positive in Mycoplasma primary atypical pneumonia

Complications: Adult respiratory distress syndrome (ARDS).

Summary

Bronchopneumonia

-Patchy and focal pneumonia that affects the bronchi, bronchioles and the surrounding alveoli.

-It can be caused by many organisms.

Opportunistic pneumonia

1.happens mainly in patient that are immunocompromised such as (AIDS, cancer patient and transplant recipients)

2.Common organism that cause this type of pneumonia:

- ❖ Pneumocystis jiroveci
- ❖ Cytomegalovirus
- ❖ Invasive aspergillosis

Lobar pneumonia

-Inflammation and consolidation that affect one or two lobes

-Mainly caused by streptococcus pneumonia

-It Can be associated with:

1- pleuritis

2- lung abscess (specially if it caused by pyogenic organism eg: staphylococcus)

Lobar pneumonia happens in 4 stages:

STAGE 1 congestion:

Lung is heavy, boggy and red. The intra-alveolar space is filled with fluid, few scattered neutrophils and numerous bacteria. (we can detect the organism)

1- vascular dilation

STAGE 2 red hepatization:

Alveolar spaces are filled with neutrophils , red cells (congestion) and fibrin. Grossly the lung is film/solid red and liver-like

STAGE 3 grey hepatization:

Here the red cells are reduced but neutrophils and fibrin(fibrinopurulent/suppura tive exudate) are still present. Grossly the lung is still firm/solid and liver-like but grey.

3- less exudate here

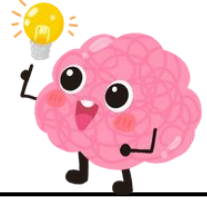
STAGE 4 resolution:

Exudates within the alveoli are being enzymatically digested , resorbed, ingested by macrophages or coughed up.(pas cells start to diseapers)

4- alveoli open again

Various organisms that cause pneumonia

- ❖ streptococcus pneumonia → community acquired + lobar pneumonia
- ❖ Streptococcus pyogenes → Bronchopneumonia
- ❖ H.influenzae + Moraxella catarrhalis → in COPD patient (Bronchopneumonia)
- ❖ Anaerobic bacteria eg: (bacteroides) → aspiration pneumonia
- ❖ Chlamydia pneumonia is transmitted by inhalation of dried excreta of infected birds ornithosis/psittacosis.
- ❖ legionella pneumonia: Especially in immunocompromised - posttransplant. the bacteria loves water tanks or any wet things.



KEYWORDS

Pneumonia	• Fever • Chills • Mucopurulent Cough • Rusty tasty sputum (bad smelling) • Chest pain Not specific for pneumonia but you will find it
Lobar Pneumonia	• Widespread fibrinosuppurative consolidation or pleuritis • Pleuritic pain • Pleural friction rub • Has the 4 stages
Bronchopneumonia	• Patchy and focal pneumonia that affects the bronchi, bronchioles and the surrounding alveoli.
Interstitial pneumonia	• Caused by Mycoplasma • Complication :Soup bubble
Hospital acquired pneumonia	• 48 h after hospitalisation or more • Gram-negative organisms like Klebsiella,Pseudomonas aeruginosa and E. coli have been implicated

KEYWORDS

Aspiration pneumonia	• These patients have abnormal gag and swallowing reflexes that predispose to aspiration • aspirate gastric contents
Chronic Pneumonia	• typically granulomatous inflammation
Opportunistic pneumonias	• Pneumocystis jiroveci • Cytomegalovirus

Answers:
1-D 2-B 3- D 4-D

MCQ

1- What is the most common cause of Community-Acquired Bacterial Pneumonia (atypical)?			
A)Haemophilus influenzae	B)Streptococcus Pneumonia	C)S.aureus	D)Mycoplasma Pneumonia
2- Which of the following isn't a predisposing factor for CAP atypical pneumonia?			
A)Alcoholism	B)Young children	C)Malnutrition	D)Both A & C
3- Which of the following is a possible complication of typical pneumonia?			
A)empyema	B)Abscess formation	C)Bacteremic dissemination	D)All of the above
4- The most common cause of Hospital-Acquired Pneumonia			
A)H.influenzae	B)S.aureus	C)Streptococcus Pneumonia	D)Pseudomonas aeruginosa

Answers:
5- B 6- A 7-A

MCQ

5- what type of pneumonia is often necrotizing and is a frequent cause of death?			
A)Chronic pneumonia	B)Aspiration pneumonia	C)Acute pneumonia	D)opportunistic pneumonia
6- In what stage does neutrophils exist as few and scattered ?			
A)stage I (congestion	B)stage III (gray hepatization)	C)stage II (red hepatization)	D)stage IV (Resolution)
7- Which of the following is NOT a common sign or symptom of pneumonia?			
A)Dry cough	B)Dyspnea	C)Purulent sputum	D)Fever

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