PATHOLOGY TEAM
439

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Lobar & Broncho--Pneumonia

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.
- Is able to appreciate the aetiology and pathogenesis of lung abscess.

Index:
Important
NOTES
Extra Information

Rikabi's content

Pneumonia / pulmonary infection

Definition

Pneumonia can be very broadly defined as any infection in the lung.
*inflammation of the lung parenchyma

Symptomes

- High fever in bacterial , mild in viral.
- cough (mucopurulent/rusty/blood tinged sputum).(productive).
- chills.
- pleuritic chest pain.
- sometimes : dyspnea, hemoptysis.

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.

*usually associated with consolidation of lung tissue.
*increased density in pulmonary tissue caused by inflammatory exudate.

Respiratory tract infections are more frequent than infections of any organ,why?

(Helpful video)

- lung epithelium is exposed to contaminated air
  The vulnerability of the lung to infection despite these defenses is not surprising because many microbes are airborne and readily inhaled into the lungs.
- nasopharyngeal flora are regularly aspirated during sleep, even by healthy individuals.
- lung diseases render the lung parenchyma vulnerable to virulent organism. often lower local immune defenses.

investigation

*increased WBCs count
*very high neutrophils - the report will tell you that -(there is a shift to the left).
Shift to the left : immature form of neutrophils (band neutrophils) the nucleus will become banded , because there is to much demand ما تلحق تفصل اللوبز عن بعضها .

Pneumonia can be acute or chronic

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.

Morphology- Anatomic classification of pneumonia :

Classification can be made according to **causative agent** or **gross anatomic distribution** of the disease as the following :

Alveolar " Typical " :

Bronchopneumonia:

(**Streptococcus pneumoniae**, **Haemophilus influenzae, Staphylococcus aureus)** Represent an extension from preexisting bronchitis or bronchiolitis.

Extremely common tends to occur in two extremes of life.

- inflammation of the bronchi and surrounding alveoli. (Patchy).

- Lobar pneumonia:

(**Streptococcus pneumoniae**)

Acute bacterial infection of a large portion of a lobe or entire lobe (one or two entire lobes of the lung)

Classic lobar pneumonia is now infrequent.

Note: Overlap of the two patterns often occur.

Interstitial " Atypical" :

Interstitial (Atypical or Viral) :

1-Influenza **virus** (children).

2-Mycoplasma pneumoniae (The pattern is lobar).

3-chlamydia ;

- Concentrated in the interstitium of the lung.
- Mostly mononuclear infiltrate.
- obligate intracellular organism ،can cause 4 diseases :

1- interstitial pneumonia.

2- Conjunctivitis (Chlamydial trachoma).

3-Non-specific urethritis.

4-Cervicitis.

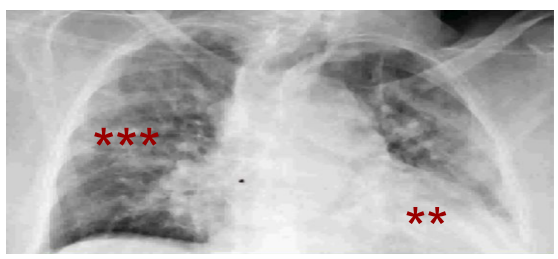
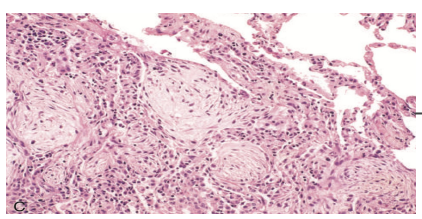
The clinical types of pneumonia :

Community-Acquired Acute Pneumonia	Community-Acquired Atypical Pneumonia	Opportunistic pneumonias / Pneumonia in the Immunocompromised Host	Chronic Pneumonia	Aspiration Pneumonia	Nosocomial Pneumonia

The etiology of pneumonia :

- Streptococcus pneumoniae (Pneumococcal).
- Staphylococcus aureus.
- Mycoplasma pneumoniae.
- chlamydia pneumoniae.
- klebsiella pneumoniae: "in chronic **alcoholic** people and who are debilitated"
- Viral pneumonia.
- legionella pneumonia: "Especially in immunocompromised - posttransplant. the bacteria **loves water** tanks or any wet things."
- haemophilus influenzae: "is the most common bacterial cause of acute exacerbations of COPD"
- moraxella catarrhalis organisms: "It is the second most common bacterial cause of acute exacerbation of COPD in adults".

Community-Acquired Typical pneumonia

Definition	pneumonia acquired outside hospitals or extended-care facilities.
Cause (usually bacteria)	- more common : **streptococcus pneumoniae** (Pneumococci). - **intravenous drug abuser : Staph. Aureus.** - Other Common Causes : Haemophilus influenzae, Moraxella catarrhalis, Staphylococcus aureus, Legionella pneumophila, Klebsiella pneumoniae and Pseudomonas aeruginosa spp،Mycoplasma pneumoniae, Chlamydia pneumoniae and Coxiella burnetii (Q fever)
More common on People Who have:	1- Chronic Diseases eg. DM, COPD and Congestive heart failure 2- immune deficiency 3- Decreased or absent Splenic Functions
Clinical features :	-Can follow URT infection **Abrupt onset of :** - high fever with sudden onset - 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 , Reduced air entry and dullness by percussion.
Radiology :	- ** in lobar pneumonia there is a radio opaque (consolidation) well circumscribed lobe. - ***in bronchopneumonia there are multiple small opacities usually basal and bilateral. 
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 (systemic) 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.

Lobar Pneumonia

involves a large widespread area of lung and sometimes even an entire lobe of lung and could affect more than one lobe. usually affects one entire lobe or two lobes (diffused) most of the time caused by Streptococcus Pneumoniae. (widespread fibrinosuppurative consolidation)

Caused by :

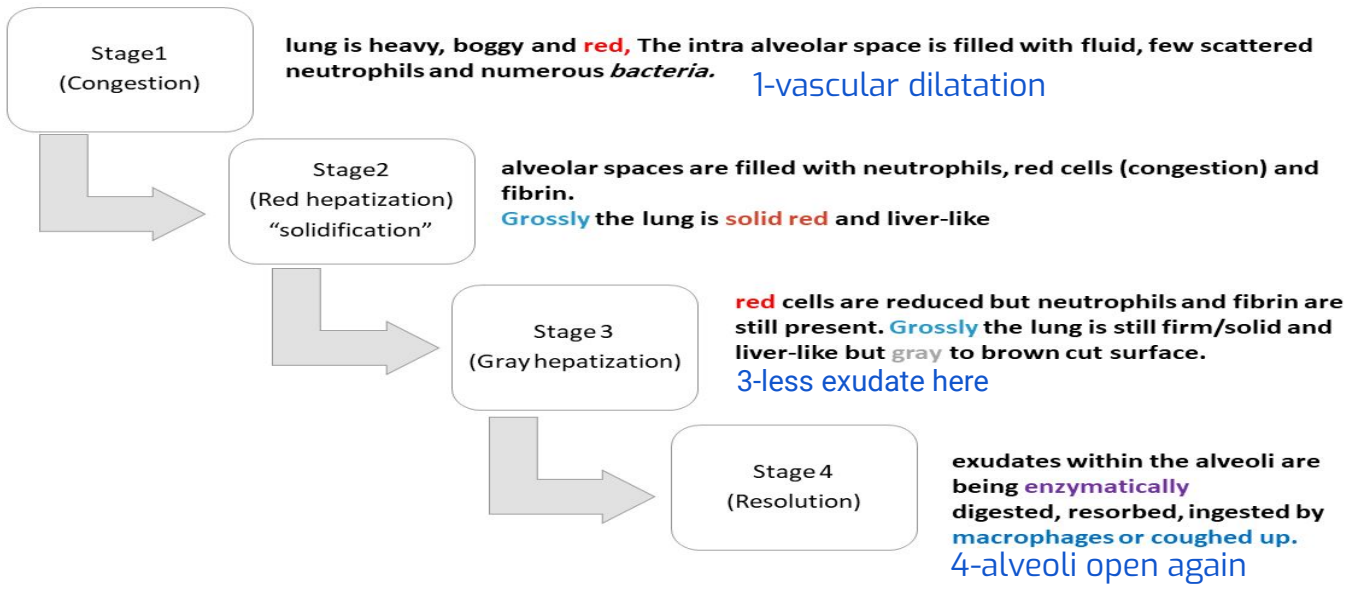
(**Streptococcus Pneumoniae (Pneumococci)** type 1,3,7 & 2) 90-95% of the cases.
rarely by: K. pneumoniae (in elderly) - H. influenzae - Pseudomonas - Proteus - Legionella pneumophila , staphylococci - streptococci

Common in :

- debilitated people (مضعف) old age or small age , chronic illnesses. many time associated with pleural effusion exudate very high LDH Protein (enzyme) very rich in fibrin and cells come with lateral sided chest pain

Labor pneumonia occurs in 4 stages:

Note from Prof rikabi: because the advanced antibiotics patients could not reach all stages when we treat them properly



Complications

- abscess is one of the major complications of pneumonia lobar or bronchial:
- pleuritis in addition to pneumonia in the area .

Predisposed factors

Streptococcus Pneumoniae capsule is rich in polysaccharide, so people with Splenectomy because rupture of spleen are more prone to develop Pneumococcal Pneumonia (spleen has a lot of macrophages and phagocytic cells that are avid and take the polysaccharide) this is a major predisposing factor

Morphology

Radiology: there is a radio opaque (consolidation) well circumscribed lobe.

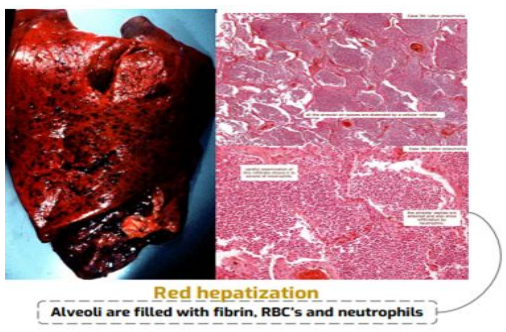


Fig. 13.30 Lobar pneumonia with gray hepatization. The lower lobe is uniformly consolidated.

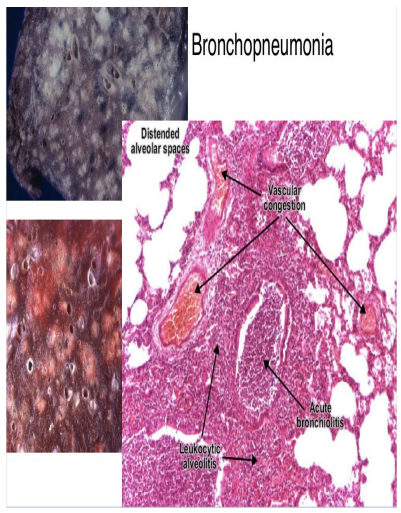
Bronchopneumonia

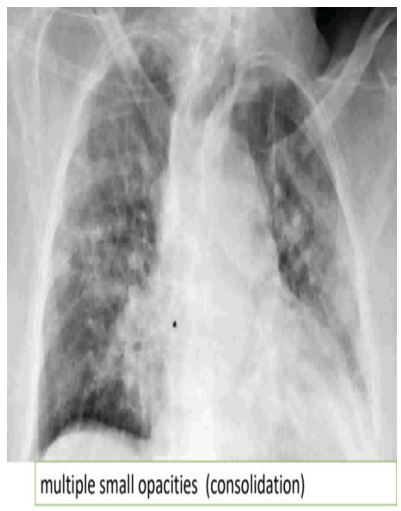
Bronchopneumonia

Is focal/patchy areas of consolidated acute suppurative inflammation **in one or more lobes.**
Usually it involves <u>lower lobes (basal) bilaterally .</u> **WHY?** 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.
Radiology:there are multiple small opacities usually basal and bilateral.

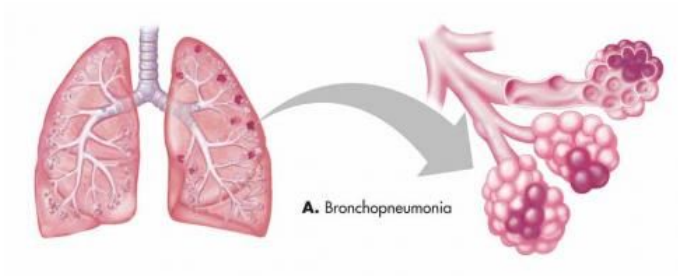




Caused by:

1-Streptococcus pneumoniae
2- Staphylococcus aureus
3-Klebsiella (and other gram-ves sometime)
4-Streptococcus viridans
5-Streptococcus pyogenes
6-coliform bacteria
7-Haemophilus Influenzae (in COPD)
8-Pseudomonas Aeruginosa (in Cystic Fibrosis)
9- Staphylococci (secondary bacterial pneumonia in children and healthy adults after viral respiratory illnesses) Common cold (viral infection) → secondary infection of Staph Aureus. Sometimes Strep. pyogenes

7-as above,Haemophilus Influenzae loves to cause pneumonia in children (even causes Epiglottitis)
And quite commonly cause acute exacerbation of chronic bronchitis in people who have COPD (3rd respiratory acute medical emergency that we mentioned throughout the respablock)
So If you know he has COPD you must make sure you give him antibiotic that attacks Haemophilus influenzae.



Most common in:

1- terminal patients (قاب قوسين او ادنى وغالبا أدنى للموت)
underlying advance disease.
eg. malignancy or diabetes.
we write that the cause of Death is BronchoPneumonia
(قبل الذهاب لمقابر أم الحمام Final Event غالبا تكون.)

Community Acquired Atypical Pneumonia

Also called Primary atypical pneumonia/interstitial pneumonitis

characteristics

· Characterized by patchy inflammation in the lungs confined to the alveolar septae and pulmonary interstitium and therefore it is called interstitial pneumonitis.
·The major inflammatory cell is lymphocyte , so when we find neutrophils it means there's a secondary infection.
· It is also called atypical pneumonia because it not the typical pneumonia in which the inflammation is primarily in the alveolar spaces.

Etiology

- the most common cause is **Mycoplasma pneumonia.**
- Others :
- Chlamydia spp. (C. pneumonia etc.) and Coxiella burnetii (Q fever).

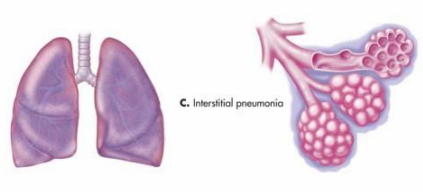
Chlamydia is transmitted by inhalation of dried excreta of infected birds and causes ornithosis/psittacosis.

Predisposing factors

malnutrition,alcoholism and any underlying debilitating disease.

Diagnosis

Test for Mycoplasma pneumoniae (Cold Agglutination test)
Positive in Mycoplasma (primary atypical pneumonia
It's called cold because we do the test under a low temperature.
·The mycoplasma will lead to the formation of some IgM in the circulation.
·We take a blood sample from the patient and add RBC's form a sheep (lamb) to it.
·The RBC's of the lamb will agglutinate because of the IgM.
-serological assays.
- polymerase chain reaction (PCR) .

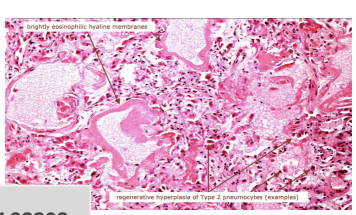


Microscopy

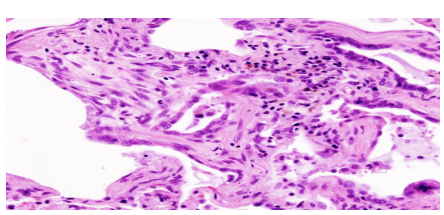
·Predominantly there is inflammation in the interstitium/alveolar wall.

·Alveolar septa are widened and edematous with mononuclear inflammatory infiltrate (and neutrophils in acute cases only).

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

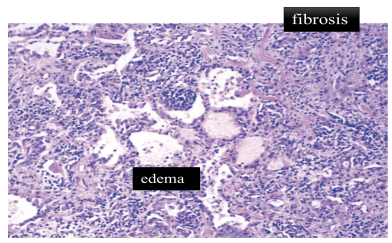


Server cases



Other types of Pneumonia

1- Community Acquired Viral Pneumonia

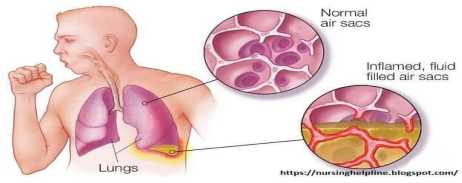
Etiology	·**influenza types A and B** ·**Respiratory syncytial viruses**(H.metapneumovirus) ·Adenovirus ·**Rhinoviruses** ·Rubeola virus ·Varicella (all of these agents also cause upper-respiratory tract infections) *Briefly all viruses that cause URTI
Mechanism	· The virus damage respiratory epithelium, 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 .
Morphology	The thickened alveolar walls are infiltrated with **lymphocytes** and some plasma cells which are spilling edema over into alveolar spaces. **In severe cases full-blown diffuse alveolar damage with hyaline membranes may develop** 
clinical course	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)
Complication	**Epithelial damage leading** to necrosis of the respiratory epithelium inhibits mucociliary clearance and predisposes to **secondary bacterial infections**. Such serious complications of viral infection are more likely in infants, older adults, malnourished patients, alcoholics, and immunosuppressed individuals. **The most likely organism which cause secondary bronchopneumonia is S.aureus.**

2- Nosocomial Pneumonia

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

Etiology	**Gram-negative organisms** like Klebsiella, Pseudomonas aeruginosa and E. coli And **methicillin resistant Staphylococcus aureus (MRSA).**
Epidemiology	severe underlying conditions e.g. immunosuppression, prolonged antibiotic therapy, intravascular catheter and pt. with mechanical ventilator

3- Aspiration pneumonia

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

4- Chronic pneumonia

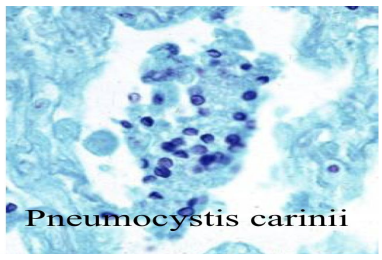
❖is most often **a localized lesion in an immunocompetent person and systemic dissemination in immunocompromised**, with or without regional lymph node involvement.
❖ There is typically granulomatous inflammation.
❖**Tuberculosis** is by far the most important entity within the spectrum of chronic pneumonias.

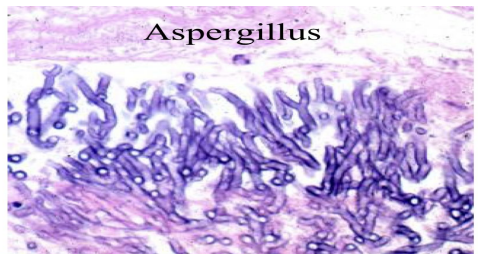
Etiology	M. tuberculosis) or fungi (Histoplasma capsulatum, Coccidioides. immitis,Blastomyces
Epidemiology	immunocompromised , immunocompetent

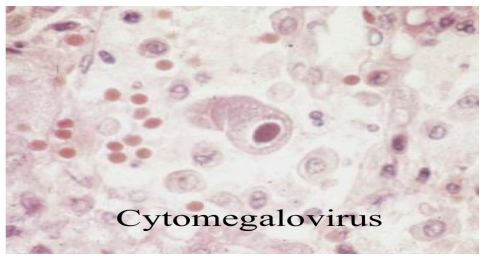
5- Opportunistic pneumonias

Etiology

- **Cytomegalovirus** يخلي الخلايا أكبر من حجمها الطبيعي نفس هذي البسة
- **Pneumocystis jiroveci (formerly P. carinii)**
- Mycobacterium avium-intracellulare
- **Invasive aspergillosis**
- **Invasive candidiasis**
- "Usual" bacterial, viral, and fungal organisms







Epidemiology

immunosuppressed patients (AIDS, cancer patients and transplant recipients)

Pneumocystis Pneumonia

Etiology

Pneumocystis jiroveci (formerly P. carinii) which is an opportunistic infectious agent considered as a fungus.

- Seen in immunocompromised individuals **especially AIDS.**

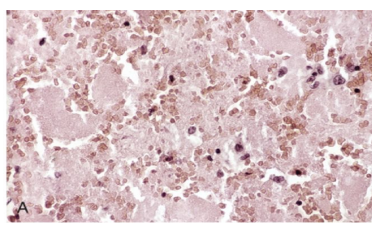
Diagnosis

❖ Identify the organism in **bronchoalveolar lavage** fluids or in a **transbronchial biopsy** specimen.

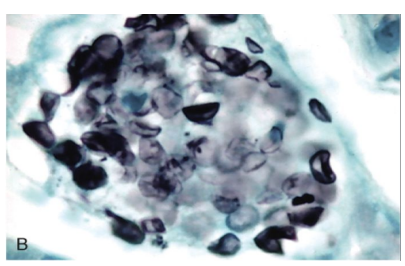
❖ Immunofluorescence antibody kits and PCR-based assays.

Microscopically

- characteristic intra-alveolar foamy (رغوي), pink- staining exudate on H&E stains



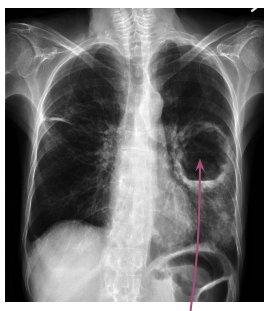
- organism is trapped in the foamy material and can be seen on **silver stain as oval cup shaped structures**



Lung abscess

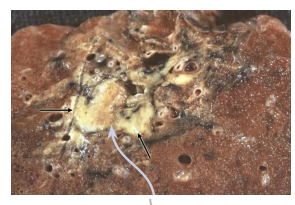
Features:
- Tissue necrosis Features
- marked acute inflammation.
- Abscess is filled with necrotic suppurative debris

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.**



Single fluid filled cavity

Lung abscess
Localized suppurative necrotic process within the pulmonary parenchyma.
cavity containing bacteria, fibrin,and neutrophils and lined usually with inflammatory granulation tissue.



Abscess is filled with necrotic suppurative debris

There are 3 organisms that love to make abscess (ممكن أي اورقانزيم لكن هذول اكثر من غيرهم):
Causative organisms:
A-staphylococcus
B-streptococcus
C-anaerobes
D-gram-ev organisms (klebsiella pneumonia ,very common in chronic alcoholics)
Prognosis:
with antibiotic therapy 75% of abscess resolve

Pathogenesis:
- Can follow aspiration.
- As a complication of bronchopneumonia.
- Septic emboli.
- Tumors.
- Direct infection.

Complications
1-Bronchopleural fistula and pleural involvement resulting in empyema in the pleura which is a purulent inflammation (purulent pleuritis) .
2-Massive hemoptysis, spontaneous rupture into uninvolved lung segments
3-Non-resolution of abscess cavity
4-Bacteremia could result in brain abscess and meningitis

Quiz

1- A 63-year-old man with small cell carcinoma of the left mainstem bronchus begins chemotherapy. During the treatment period, he becomes febrile and develops a productive cough. The temperature is 38.7°C (103°F), respirations are 32 per minute, and blood pressure is 125/85mmHg. A CBC shows leukocytosis (WBC = 18,500/µL). The patient's cough worsens, and he begins expectorating large amounts of foul- smelling sputum. A chest X-ray shows a distinct cavity with an air/fluid level distal to the tumor area. Which of the following is the most likely diagnosis?

a- Atelectasis	b- Bronchiectasis	c- Lobar pneumonia	d- Pulmonary Abscess

2- Which one of the following will cause patchy infiltration of the alveolar spaces with neutrophils especially around the Bronchioles ?

a- Tuberculosis Pneumonia	b- Lobar Pneumonia	c- BronchoPneumonia	d- Mycoplasma Pneumonia

3- A 65 Years old diabetic man was presented to his doctor clinic by history of sudden fever , chills, and pleuritic chest pain, also he has mucopurulent sputum he was diagnosed as having Community Acquired Pneumonia, what pathogen most likely cause of this condition

a- Staph Aureus	b-Pneumococci	c- Mycoplasma	d- RSV virus

4-A 64-year-old man presents with fever, chills, and increasing shortness of breath. The patient appears in acute respiratory distress and complains of pleuritic chest pain. Physical examination shows crackles and decreased breath sounds over both lung fields. The patient exhibits tachypnea, with flaring of the nares. The sputum is rusty-yellow and displays numerous neutrophils and erythrocytes. Which of the following pathogens is the most common cause of this patient's pulmonary infection?

a- Legionella pneumophila	b- Mycoplasma pneumoniae	c- Pseudomonas aeruginosa	d- Streptococcus pneumoniae

5-causative agent of lung abscess:A 36-year-old man with AIDS presents with fever, dry cough, and dyspnea. A chest X-ray shows bilateral and diffuse infiltrates. Laboratory studies reveal a CD4+ cell count of less than 50/ L. A lung biopsy discloses a chronic interstitial pneumonitis and an intra-alveolar foamy exudate.
A silver stain of a bronchoalveolar lavage is shown in the image. Which of the following organisms is the most likely pathogen responsible for these pulmonary findings?

a- Invasive aspergillosis	b- Cytomegalovirus	C-Pneumocystis jiroveci	d-none

6- after recovering from bronchopneumonia a 71 year old man returned to the hospital because of mild fever, chills, and fuel purulent smelling. On X-Ray examination show A cavity filled with PUS in the lower right lobe what is the most possible diagnosis of the patient.

a- Lung Abscess	b- Hypersensitivity Pneumonitis	C- Lobar pneumonia	d- pleuritis

1- D 2-C 3-B 4-D 5-C 6-A

Summary from Pathoma :

ORGANISM	HIGH-YIELD ASSOCIATIONS
Streptococcus pneumoniae	Most common cause of community-acquired pneumonia and secondary pneumonia (bacterial pneumonia superimposed on a viral upper respiratory tract infection); usually seen in middle-aged adults and elderly
Klebsiella pneumoniae	Enteric flora that is aspirated; affects malnourished and debilitated individuals, especially elderly in nursing homes, alcoholics, and diabetics. Thick mucoid capsule results in gelatinous sputum (currant jelly); often complicated by abscess

Table 9.2: Causes of Bronchopneumonia

ORGANISM	HIGH-YIELD ASSOCIATIONS
Staphylococcus aureus	2nd most common cause of secondary pneumonia; often complicated by abscess or empyema
Haemophilus influenzae	Common cause of secondary pneumonia and pneumonia superimposed on COPD (leads to exacerbation of COPD)
Pseudomonas aeruginosa	Pneumonia in cystic fibrosis patients
Moraxella catarrhalis	Community-acquired pneumonia and pneumonia superimposed on COPD (leads to exacerbation of COPD)
Legionella pneumophila	Community-acquired pneumonia, pneumonia superimposed on COPD, or pneumonia in immunocompromised states; transmitted from water source Intracellular organism that is best visualized by silver stain

Table 9.3: Causes of Interstitial (Atypical) Pneumonia

ORGANISM	HIGH-YIELD ASSOCIATIONS
Mycoplasma pneumoniae	Most common cause of atypical pneumonia, usually affects young adults (classically, military recruits or college students living in a dormitory). Complications include autoimmune hemolytic anemia (IgM against I antigen on RBCs causes cold hemolytic anemia) and erythema multiforme. Not visible on gram stain due to lack of cell wall
Chlamydia pneumoniae	Second most common cause of atypical pneumonia in young adults
Respiratory syncytial virus (RSV)	Most common cause of atypical pneumonia in infants
Cytomegalovirus (CMV)	Atypical pneumonia with posttransplant immunosuppression or chemotherapy
Influenza virus	Atypical pneumonia in the elderly, immunocompromised, and those with preexisting lung disease. Also increases the risk for superimposed *S aureus or H influenzae* bacterial pneumonia
Coxiella burnetii	Atypical pneumonia with high fever (Q fever); seen in farmers and veterinarians (*Coxiella* spores are deposited on cattle by ticks or are present in cattle placentas). *Coxiella* is a rickettsial organism, but it is distinct from most rickettsiae because it (1) causes pneumonia, (2) does not require arthropod vector for transmission (survives as highly heat-resistant endospores), and (3) does not produce a skin rash.

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- Hadi AlHemsi

Team members

غادة العثمان
غادة العبدي
فرح السيد
ريناد الحميدي
فاطمة آل هلال
غيداء العسيري
ساره المقاطي
هيا العنزي
لمى الأحمدي
مريم الرحيمي
الجوهرة البنيان
منى العبدلي
نورة الدهش
غيداء المرشود
لينا المزيد

Team members

خالد القبلان
صالح القرني
أحمد الخياط
بسام الأسمري
أحمد الحوامدة
ناصر السنبل
صالح القرني
يزيد القحاني
أحمد خواشكي
محمد الوهيبي
بندر الحربي
حمد الموسى
عمر الحلبي
فيصل الفضل