



Team 435

PATHOLOGY

As a doctor you should know what can threaten your patient's life
should know what makes your patient suffers from pain

That's why you study pathology

Lecture 4

Pneumonia:

What is pneumonia?

It can be very broadly defined as any infection in the lung. However, Pneumonia is an inflammatory condition affecting the pulmonary parenchyma; it's characterized mainly by consolidation¹ of the pulmonary tissue. This consolidation of parts of the lung occurs because of the presence of an exudate (w/inflammatory infiltrate), fibrin, and fluid.

Types of pneumonia: (EXTRA)

1. Community-Acquired Acute Pneumonias

- Most are bacterial in origin. C
- Infection follows a viral upper respiratory tract infection.
- The onset usually is abrupt, with high fever, shaking chills, pleuritic chest pain, and a productive mucopurulent cough; occasional patients may have hemoptysis.
- **S. pneumoniae** (i.e., the pneumococcus) is the most common cause.

2. Community-Acquired Atypical Pneumonias:

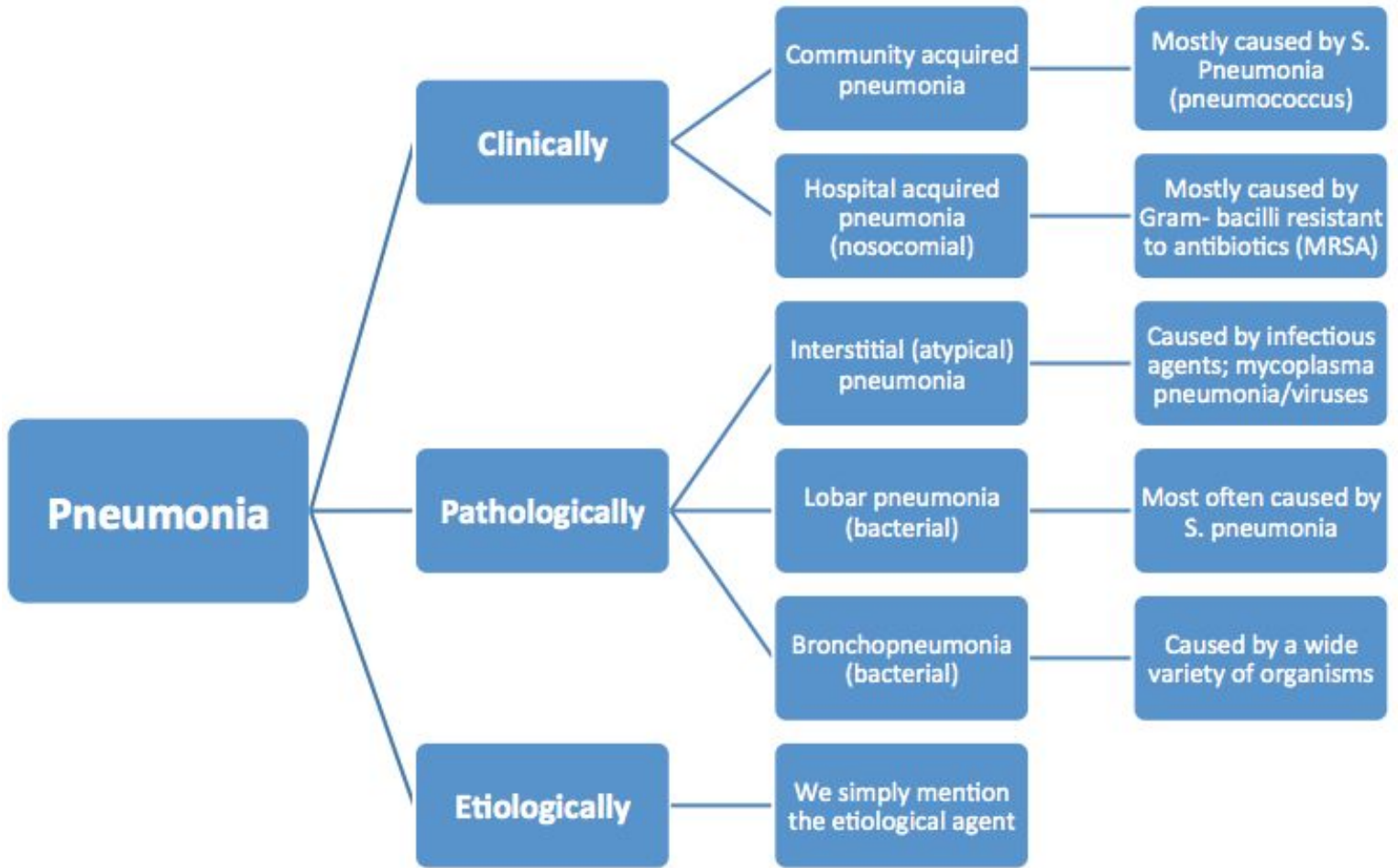
- Mycoplasma pneumoniae is the most common.
- **Mycoplasma** infections are particularly common among children and young adults.

3. Hospital-Acquired Pneumonias (Nosocomial):

- Nosocomial infections are common in hospitalized persons with severe underlying diseases.
- Those on mechanical ventilation represent a particularly high-risk group.
- Gram-negative rods (members of Enterobacteriaceae and Pseudomonas spp.) and S. aureus are the most common isolates.

¹ Solidification (زياده الكثافه), the tissue becomes more dense.

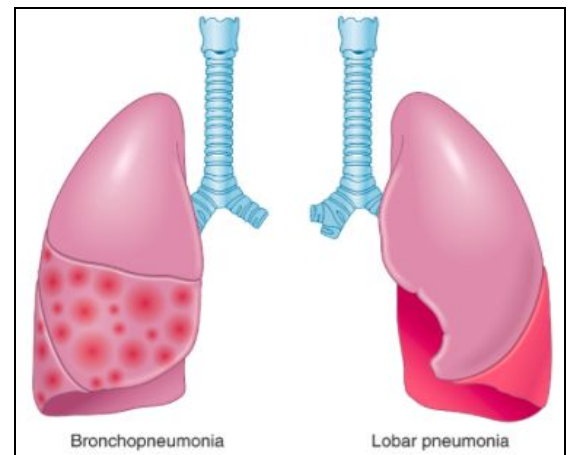
Classification of pneumonia:



Morphology:

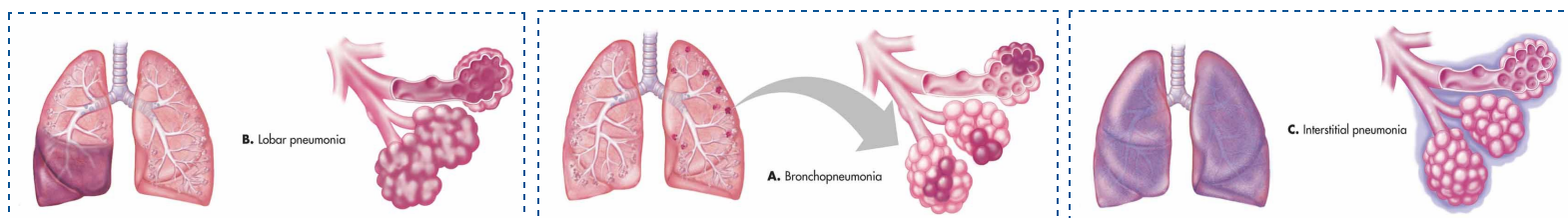
There are three morphologic and clinical patterns: **lobar pneumonia, bronchopneumonia and interstitial pneumonia.**

Therefore, it is best to classify pneumonias either by the specific etiologic agent or, if no pathogen can be isolated, by the clinical setting in which infection occurs.



Summary

Variant	Causative Organism	Characteristics
Lobar Pneumonia	Most frequently streptococcus pneumonia (pneumococcus)	Predominantly intra-alveolar exudate resulting in consolidation. May involve the entire lobe. If untreated, may morphologically evolve through four stages; congestion, red hepatization, grey hepatization and resolution.
Bronchopneumonia	Many organisms including staphylococcus aureus, haemophilus influenzae, Klebsiella pneumonia, and streptococcus pyogenes	Acute inflammatory infiltrates extending from the bronchioles into the adjacent alveoli. Patchy distribution involving one or more lobes.
Interstitial Pneumonia	Most frequently viruses or mycoplasma pneumoniae	Diffuse, patchy inflammation localized to interstitial areas of the alveolar walls. Distribution involving one or more lobes.



Morphologic Variants of Pneumonia: Causative Organisms and Characteristics

- ❑ **Viral pneumonias are the most common type of pneumonia in childhood.**
- ❑ **Rickettsial pneumonias:**
 - Q fever is the most common rickettsial pneumonia.**
- ❑ **Pneumocystis carinii pneumonia.**
 - It's the most common **opportunistic infection in patients with acquired immunodeficiency syndrome (AIDS)**; it also occurs in other forms of immunodeficiency.
- ❑ **Hospital-acquired gram-negative pneumonias:**
 - These pneumonias are often fatal and occur in hospitalized patients.
 - Causes include *Klebsiella*, *Pseudomonas aeruginosa* and *Escherichia coli*.

Important Features of Selected Bacterial Pneumonias

Organism	Characteristics	Complication
Streptococcus pneumonia	Most common in elderly or debilitated patients, especially those with cardiopulmonary disease and malnourished persons	May lead to empyema (pus in the pleural cavity)
Staphylococcus aureus	Often a complication of influenza or viral pneumonias or a result of blood-borne infection in intravenous drug users; seen principally in debilitated hospitalized patients, the elderly, and those with chronic lung disease.	Focal inflammatory exudates or abscess formation frequent; may lead to empyema or to other infectious complications, including bacterial endocarditis and brain and kidney abscesses
Streptococcus pyogenes	Often a complication of influenza or measles.	Lung abscess
Klebsiella pneumonia	Most frequent in debilitated hospitalized patients and diabetic or alcoholic patients, high mortality rate in elderly patients	Considerable alveolar wall damage; leading to necrosis, sometimes with abscess formation.
Haemophilus influenza	Usually seen in infants and children but may occur in debilitated adults, most often those with chronic obstructive pulmonary disease.	Meningitis and epiglottitis in infants and children
Legionella pneumophila	Infection from inhalation of aerosol from contaminated stored water most often in air conditioning systems.	Can be quite severe requiring hospitalization, immunosuppressed persons may have a fatality rate of 30% to 50%. □

Pathogenesis:

In the era before antibiotics, pneumococcal pneumonia involved entire or almost entire lobes and evolved through four stages: **congestion, red hepatization, gray hepatization, and resolution.** Early antibiotic therapy alters or halts this typical progression.

What happens if it's not treated?

- Congestion.
- Red hepatization.
- Grey hepatization.
- Resolution.

EXTRA

The normal lung parenchyma remains sterile because of the efficiency of a number of immune and nonimmune defense mechanisms in the respiratory system, extending from the nasopharynx all the way into the alveolar air spaces

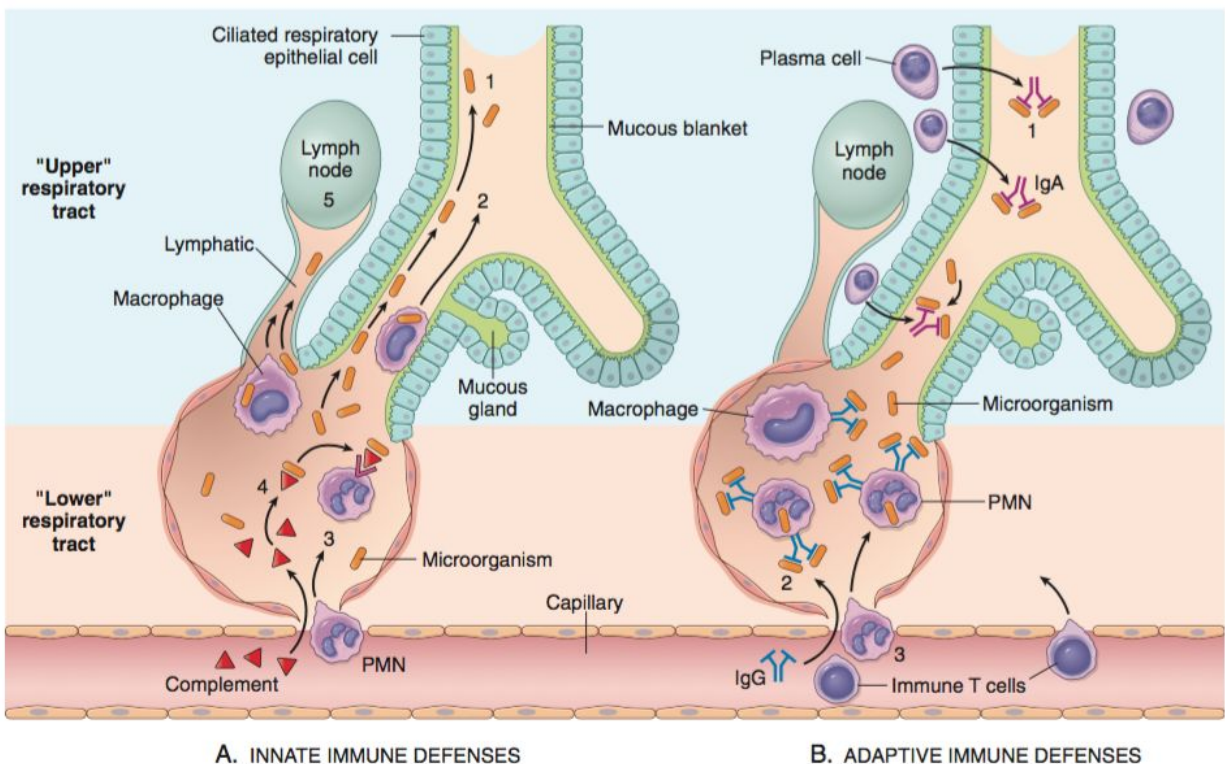
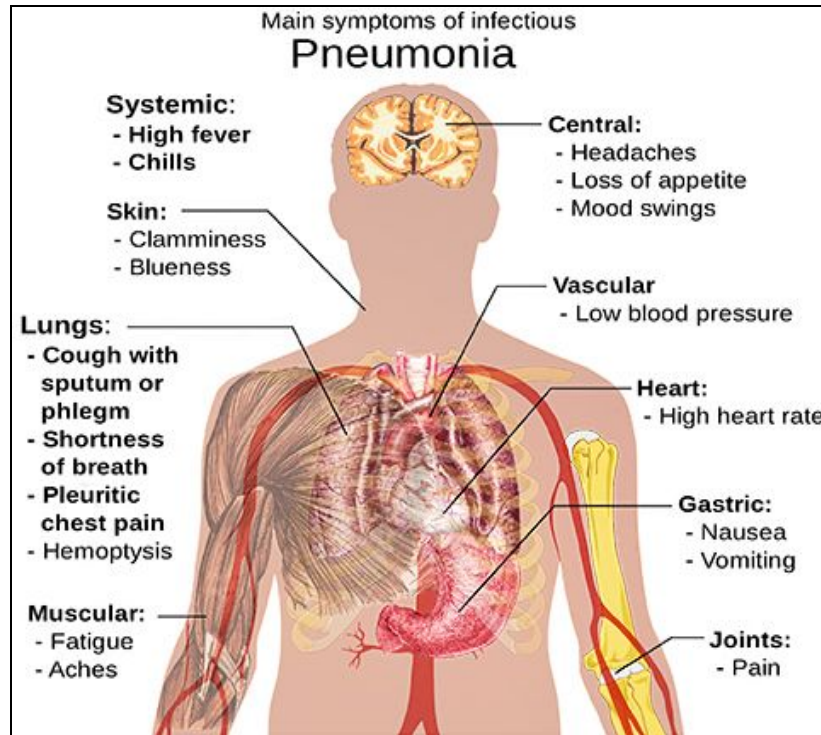


Figure 12-30 Lung defense mechanisms. **A**, Innate defenses against infection: 1, In the normal lung, removal of microbial organisms depends on entrapment in the mucous blanket and removal by means of the mucociliary elevator; 2, phagocytosis by alveolar macrophages that can kill and degrade organisms and remove them from the air spaces by migrating onto the mucociliary elevator; or 3, phagocytosis and killing by neutrophils recruited by macrophage factors. 4, Serum complement may enter the alveoli and be activated by the alternative pathway to provide the opsonin C3b, which enhances phagocytosis. 5, Organisms, including those ingested by phagocytes, may reach the draining lymph nodes to initiate immune responses. **B**, Additional mechanisms operate after development of adaptive immunity. 1, Secreted IgA can block attachment of the microorganism to epithelium in the upper respiratory tract. 2, In the lower respiratory tract, serum antibodies (IgM, IgG) are present in the alveolar lining fluid. They activate complement more efficiently by the classic pathway, yielding C3b (not shown). In addition, IgG is opsonic. 3, The accumulation of immune T cells is important for controlling infections by viruses and other intracellular microorganisms. PMN, polymorphonuclear cell.

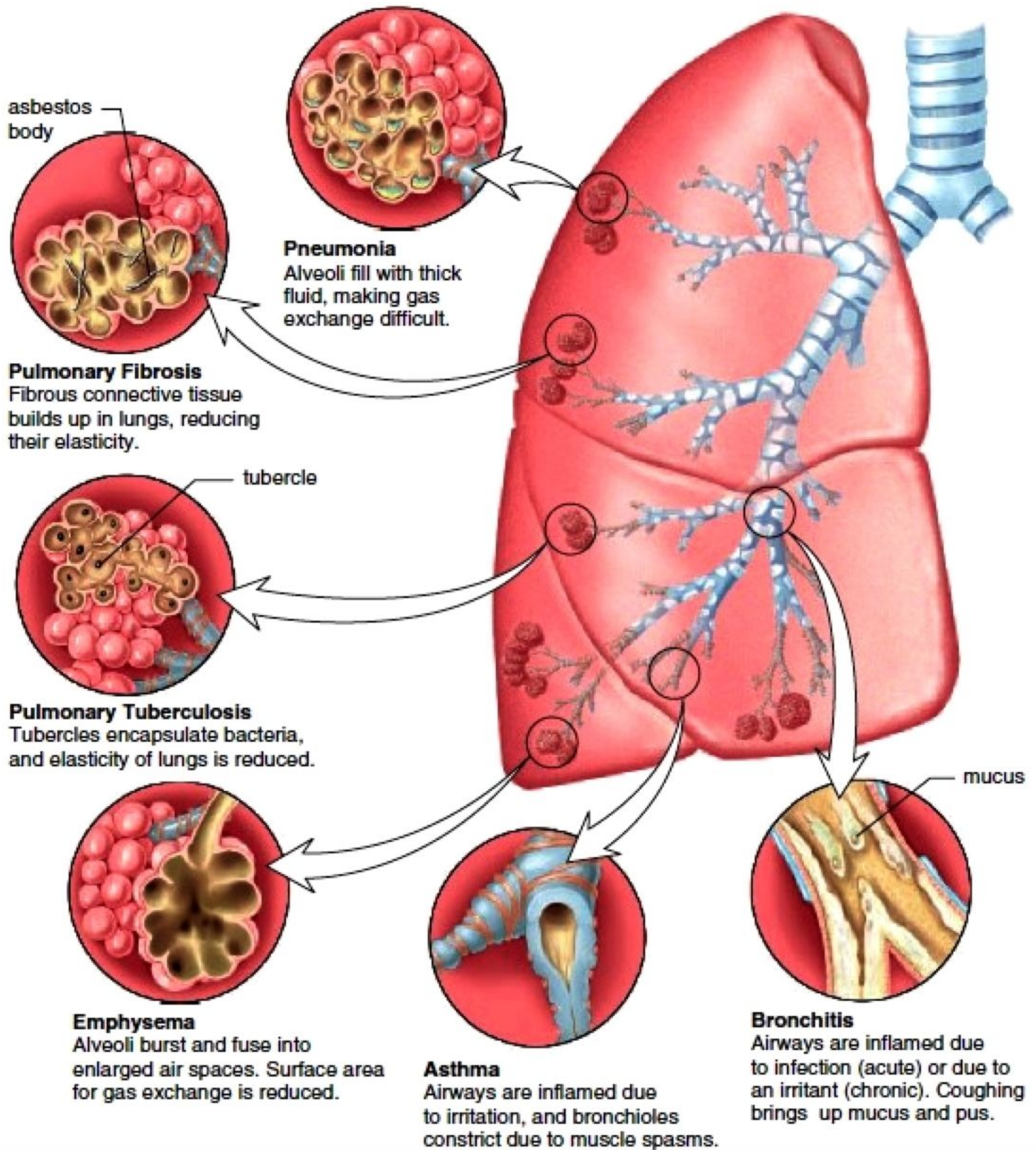
Summary and Notes:



- ❑ *S. pneumoniae* (the pneumococcus) is the most common cause of community-acquired acute pneumonia, **distribution of inflammation is usually lobar.**
- ❑ Morphologically, lobar pneumonias evolve through four stages: **1) Congestion 2) Red hepatization 3) Gray hepatization 4) Resolution**
- ❑ Other common causes of acute pneumonias in the community include:
 - **H. influenzae, M catarrhalis:** both associated with acute exacerbations of COPD
 - **S aureus:** usually secondary to viral respiratory infections
 - **K pneumoniae:** observed in patients who are chronic alcoholics
 - **P. aeruginosa:** seen in persons with cystic fibrosis, in burn victims, and in patients with neutropenia
 - **L. pneumophila:** seen particularly in organ transplant recipients

- ❑ In contrast with acute pneumonias, atypical 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
- ❑ The **most common** causes of atypical pneumonias include those caused by M. pneumoniae, viruses including influenza viruses types A and B, human metapneumovirus, C. pneumoniae, and C. burnetii (agent of Q fever).
- ❑ Immunocompromised (e.g., AIDs, malignancy, chemotherapy, autoimmune diseases) patients can easily acquire pneumonia. For example **fungal pneumonia** is very hard to infect healthy individuals however immunocompromised individuals are easily affected.

This picture below is to help you differentiate between different diseases



Now Check Your Understanding:

1. Which of the following is caused by a species of chlamydia?
 - A. Ornithosis
 - B. Non-specific urethritis
 - C. Pigeon-breeder lungs
 - D. A & B
2. The most common causative agent of interstitial pneumonia in children is:
 - A. Viruses
 - B. Bacteria
 - C. Fungi
3. A man was presented with a history of chest pain, cough, hypoxia, dyspnea and fever. After further examination abscess and effusion were found. Based on the information given, what is most likely the disease?
 - A. Pneumonia
 - B. Asthma
 - C. Carcinoma
 - D. Sarcoidosis
4. Which of the following does NOT cause a community acquired acute pneumonia?
 - A. Streptococcus pneumoniae
 - B. TB
 - C. Staphylococcus aureus
 - D. Legionella pneumophila
5. Which of these organisms causes Q fever?
 - A. Staphylococcus aureus
 - B. Legionella pneumophila
 - C. pneumocystis carinii
 - D. Coxiella burnetii
6. Which of these organisms is not hospital acquired and gram-negative?
 - A. Klebsiella
 - B. Pseudomonas aeruginosa
 - C. Escherichia coli
 - D. Streptococcus pneumoniae

1. D

2. A

3. A

4. B

5. D

6. D

7. A 30-year-old patient was previously diagnosed with bronchiectasis. However, he came to the clinic complaining of suddenly worsening symptoms (*exacerbation*). What could be the causative organism?

- A. Staphylococcus aureus
- B. Haemophilus influenza
- C. Legionella pneumophila
- D. pneumocystis carinii

8. Which of the following is NOT considered to be a common causative organism of otitis media?

- A. S.pneumoniae
- B. H.influenzae
- C. M.catarrhalis
- D. S. aureus

9. A teenager was presented to the ER after intravenous drug abuse, Which of these organisms might cause serious complications?

- A. S. aureus
- B. S.pneumoniae
- C. H.influenzae
- D. M.catarrhalis

10. A man was presented to the clinic with gram-negative bacterial pneumonia, he revealed that he was a chronic alcoholic, which of these organisms could be the cause of his infection?

- A. S. aureus
- B. K. pneumoniae
- C. H.influenzae
- D. M.catarrhalis

7. B

8. D

9. A

10. B

11. A patient was presented to the clinic with thick and gelatinous sputum, which she has difficulty coughing up. She mentioned that she was following an aggressive diet to lose weight before her wedding, which left her feeling weak all the time. She was diagnosed with pneumonia. Which of these organisms could be the cause of her infection?

- A. Staphylococcus aureus
- B. Legionella pneumophila
- C. pneumocystis carinii
- D. K. pneumoniae

12. An organ-transplant patient was diagnosed with pneumonia. Which of the following pathogens is likely to cause pneumonia in his case?

- A. Staphylococcus aureus
- B. Legionella pneumophila
- C. pneumocystis carinii
- D. K. pneumoniae

13. Of the following pathogens, which of those are the most common cause of pneumonia in HIV patients?

- A. Staphylococcus aureus
- B. pneumocystis jiroveci
- C. pneumocystis carinii
- D. K. pneumoniae

14. A 76-year-old man comes to the office in January with complaints of abrupt onset of cough, with small amounts of green sputum, worse in the morning without any blood in it. He also has fever as high as 103 F, Very rapid respiration 32 per minute, and chest pain on his right side, worsened with coughing. He exhibits some difficulty remembering the details of his illness. On the bases of these clinical findings you consider a diagnosis of pneumonia. Which one choice would you make?

- A. Obtain a chest x-ray and scheduled him to return tomorrow
- B. Treat his symptoms with antipyretics and cough syrup.
- C. Prescribed an oral antibiotic and also antibiotics and cough syrup and scheduled him to return in two days.
- D. Admit him to the hospital in the intensive care unit for parenteral antibiotic treatment

11. D

12. B

13.B

14.D

15. A 52-year-old woman, an electrical engineer and nonsmoker, has 3-month history of increasing dyspnea. On examination she is afebrile and normotensive. CT imaging of her chest shows lower lobe reticular opacities. A transbronchial biopsy is performed and microscopically shows patchy interstitial inflammation with lymphocytes and plasma cells. No organisms are identified. Her condition slowly worsens over the next 10 years. Which of the following is the most likely diagnoses?

- A. Desquamative interstitial pneumonitis
- B. Hypersensitivity pneumonitis
- C. Idiopathic interstitial fibrosis
- D. Nonatopic bronchial asthma
- E. Nonspecific interstitial pneumonia

16. A 54-year-old woman has had a mild fever with cough for a week. Her symptoms gradually improve over the next 10 days. She then begins to have increasing fever, cough, shortness of breath, and malaise. Now, on physical examination, her temperature is 37.9 C. there are inspiratory crackles on auscultation of the chest. A chest radiograph shows bilateral, patchy, small alveolar opacities. Chest CT scan shows small, scattered, ground glass and nodular opacities. A transbronchial biopsy specimen shows polypoid plugs of loose fibrous tissue and granulation tissue filling bronchioles, along with a surrounding interstitial infiltrate of mononuclear cells. She receives a course of corticosteroid therapy, and her condition improves. Which of the following is most likely diagnoses?

- A. Bronchiectasis
- B. Cryptogenic organizing pneumonia
- C. Desquamative interstitial pneumonitis
- D. Hypersensitivity pneumonitis
- E. Pulmonary alveolar proteinosis

17. A 54-year-old woman has had increasingly severe cough production of yellowish sputum for four days. On physical examination, her temperature is 38.9 C, and diffuse crackles are heard in the left lower lung posteriorly. Laboratory studies show a WBC count of 11,990/mm³ with 71% segmented neutrophils, 9% bands, 16% lymphocytes, and 4% monocytes. The representative gross appearance of the affected lung is shown in the figure. Which of the following pathogens is most likely to be cultured from this patient's sputum?



- A. *Cryptococcus neoformans*
- B. *Mycobacterium kansasii*
- C. *Mycoplasma pneumoniae*
- D. *Nocardia brasiliensis*
- E. *Pneumocystis jirovecii*
- F. *Streptococcus pneumoniae*

18. A 20-year-old man has had a mild fever with nonproductive cough, headache, and myalgias for the past week. On physical examination he has temperature of 37.9 C and erythema of the pharynx. Diffuse crackles are heard on auscultation of the lungs. A chest radiograph shows bilateral extensive patchy infiltrates. A sputum Gram stain shows normal flora. Cold agglutinin titer is elevated. He receives a course of erythromycin therapy, and his condition improves. Infection with which of the following organisms is most likely to produce these findings?

- A. *Legionella pneumophila*
- B. *Mycobacterium fortuitum*
- C. *Mycoplasma pneumoniae*
- D. *Nocardia asteroides*
- E. Respiratory syncytial virus

19. 35. A 26-year-old woman from East Asia developed a fever with chills over the past 4 days. Yesterday, she had increasing shortness of breath and nonproductive cough, headache, and myalgias. On physical examination, her temperature is now 38.6 C. A chest radiograph show right lower lobe infiltrates. Laboratory studies shows hemoglobin, 13.4 g/dL; hematocrit, 40.2%; platelet count, 78,400/mm³; and WBC count, 3810/mm³ with 70% segmented neutrophils, 2% bands, 5% lymphocytes, and 16% monocytes. Over the next 2 days, she has increasing respiratory distress requiring intubation and mechanical ventilation. A repeat chest radiograph shows worsening bilateral infiltrates. Infection with which of the following is most likely to have caused this patient's illness?

- A. Coronavirus
- B. Cytomegalovirus
- C. Ebola virus
- D. Herpes simplex virus
- E. Respiratory syncytial virus

20. A 56-year-old man is undergoing chemotherapy for leukemia. He has developed fever, nonproductive cough, dyspnea, pleuritic chest pain, and hemoptysis over the past week. A chest CT scan shows multiple 1- to 4-cm nodular densities having surrounding areas of ground-glass infiltrate (halo signs). Bronchoalveolar lavage is performed, and microscopic examination of the fluid shows narrow branching septate hyphae. A CBC shows Hgb, 13 g/dL; Hct, 38.7%; WBC count, 2000/uL; and platelet count, 200,100/uL. He has most likely developed an infection with which of the following organisms?

- A. *Aspergillus fumigatus*
- B. *Candida albicans*
- C. *Cryptococcus neoformans*
- D. *Moraxella catarrhalis*
- E. *Mucor circinelloides*

ANSWERS:

14. (D). Elderly patients and patients with other illnesses have a higher chance of complications following a community acquired pneumonia. And they need to be admitted to the hospital for parenteral antibiotic treatment and close monitoring. Elderly patients with tachypnea and acute alteration in mental status are at a higher risk of adverse outcomes from pneumonia. I need to be treated in the hospital

15. (E). Nonspecific interstitial pneumonia has both cellular and fibrosing patterns, but the former has a better prognosis. Some patients have an underlying connective tissue disease. Desquamative interstitial pneumonitis (DIP) is smoking-related. Hypersensitivity pneumonitis most often relates to episodic inhaled allergens and rarely progresses to marked interstitial disease. Idiopathic pulmonary fibrosis tends to have a more rapid course and involve more of the lungs. Nonatopic asthma is typically episodic and rarely progresses to extensive interstitial disease.

16. (B). Bronchiolitis obliterans is a feature of cryptogenic organizing pneumonia, an uncommon, nonspecific reaction to a lung injury, such as an infection or toxic exposure. Bronchiectasis involves ongoing inflammatory destruction with dilation of bronchi not reversed by corticosteroids. Desquamative interstitial pneumonitis (DIP) is an uncommon smoking-related interstitial disease in which monocytes gather to form intra-alveolar macrophages; DIP is not related to idiopathic pulmonary fibrosis. Hypersensitivity pneumonitis is a type III (and type IV) hypersensitivity response to an inhaled allergen. Pulmonary alveolar proteinosis is a rare idiopathic condition in which there are gelatinous alveolar proteinaceous exudates.

17. (F). The productive cough suggests an alveolar exudate with neutrophils, and the course is compatible with an acute infection. Bacterial organisms should be suspected. Pneumococcus is the most likely agent to be cultured in individuals acquiring pneumonia outside of the hospital, and particularly when a lobar pneumonic pattern is present, as in this case. The primary atypical pneumonia of Mycoplasma does not usually produce purulent sputum, unless there is a secondary bacterial infection, which is a common complication of viral and Mycoplasma pneumonias. Cryptococcal and mycobacterial infections typically produce granulomatous disease. Nocardiosis also is seen in immunocompromised patients and produces chronic abscessing inflammation. Pneumocystis pneumonia is seen in immunocompromised patients and is unlikely to produce a lobar pattern of infection.

18. (C). This primary atypical pneumonia is caused by *Mycoplasma pneumoniae*, a cell wall-deficient organism that is difficult to culture. Often, a diagnosis is made empirically. The findings are similar to those of other viral infections, and serologic testing shows the specific organism. *Legionella* can produce an extensive pneumonia with neutrophilic alveolar exudates, and the organisms are difficult to show—they may be revealed by Dieterle silver stain. *Mycobacterium fortuitum* is a rare infection that is most likely to be seen in very ill or immunocompromised individuals. Nocardiosis produces chronic abscessing inflammation; it is seen mostly in immunosuppressed individuals. Respiratory syncytial virus is typically an infection of early childhood.

19. (A). Severe acute respiratory syndrome is caused by a strain of coronavirus that is much more virulent than the coronaviruses known to be associated with the common cold. Cytomegalovirus is seen in immunocompromised patients and often involves multiple organs. Ebola virus is virulent and does not cause specific respiratory findings. Herpes simplex virus is a very rare cause of pneumonia, even in immunocompromised patients. Respiratory syncytial virus causes acute respiratory illness in young children.

20. (A). There are several patterns of pulmonary involvement with *Aspergillus* spp. Immunocompromised patients with neutropenia may develop invasive aspergillosis. Other patterns include allergic bronchopulmonary aspergillosis in persons with asthma and an aspergilloma, or fungus ball, colonizing a cavitory lesion of tuberculosis or bronchiectasis. Candidiasis may also develop in the setting of neutropenia, but less commonly causes extensive lung involvement, appears as budding cells with pseudohyphae, and more likely produces an oral, nasal, or pharyngeal infection. Cryptococcosis can cause extensive pulmonary infections, particularly with loss of cell-mediated immunity, and the organisms have large mucoid capsules and exhibit narrow-based budding. *Moraxella* is a bacterial organism most often causing sinusitis, otitis, and upper respiratory infections. *Mucor* appears as broad, non-septated hyphae and is most often a complication of diabetic ketoacidosis, with nasal involvement.

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قال صلى الله عليه وسلم: من سلك طريقاً يلتمس به علماً سهل الله له به طريقاً إلى الجنة.

دعواتنا لكم بالتوفيق.