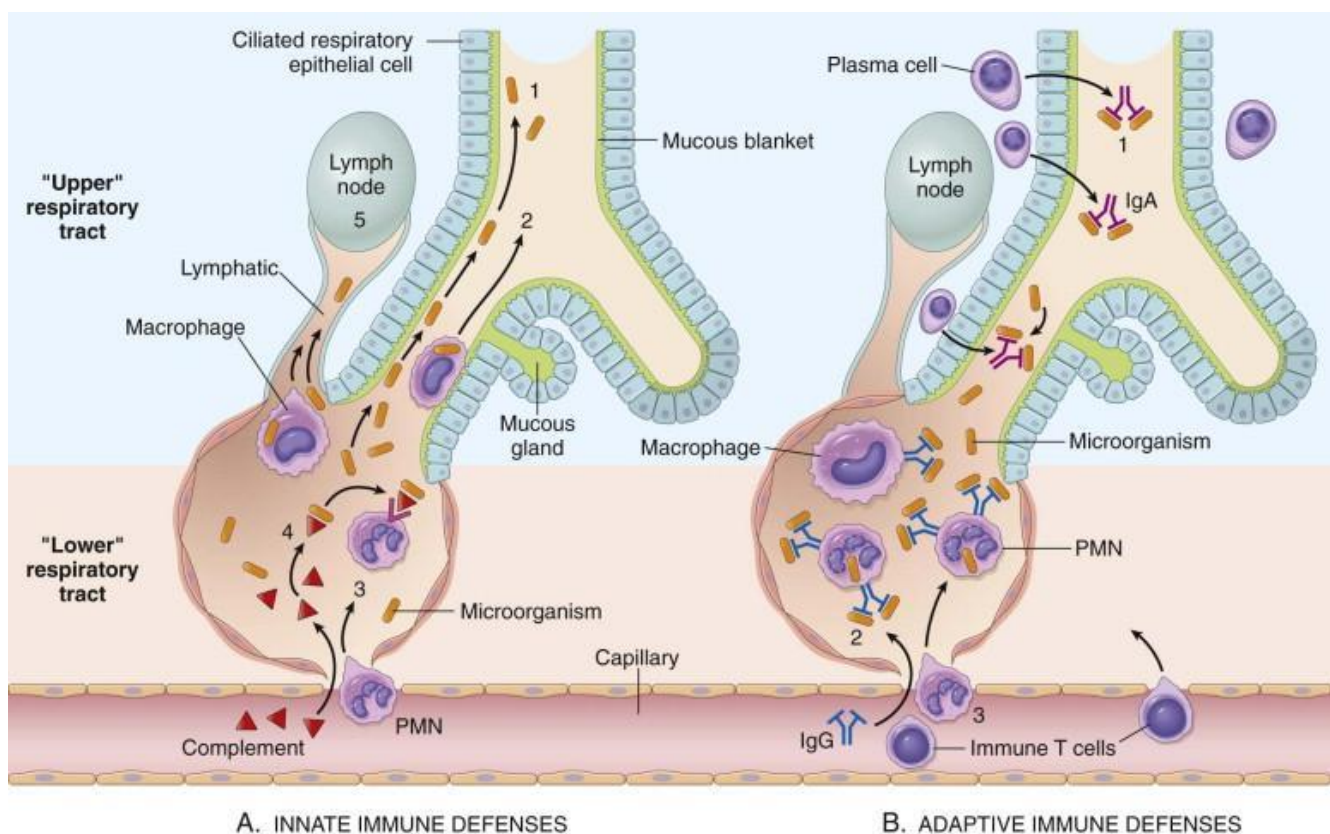


PULMONARY INFECTIONS

Pulmonary infections in the form of pneumonia are responsible for one sixth of all deaths in the United States.

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



Despite the multitude of defense mechanisms, “chinks in the armor” do exist, predisposing even healthy persons to infections.

Defects in innate immunity (including neutrophil and complement defects) and humoral immunodeficiency typically lead to an increased incidence of infections with pyogenic bacteria.

In addition to inherited anomalies, several aspects of lifestyle interfere with host immune defense mechanisms and facilitate infections.

For example, cigarette smoke compromises mucociliary clearance and pulmonary macrophage activity, and alcohol not only impairs cough and epiglottic reflexes, thereby increasing the risk of aspiration, but also interferes with neutrophil mobilization and chemotaxis.

Pneumonia can be very broadly defined as any infection in the lung.

The clinical presentation may be as an acute, or as a chronic disease with a more protracted course.

Acute bacterial pneumonias can manifest as one of two anatomic and radiographic patterns, referred to

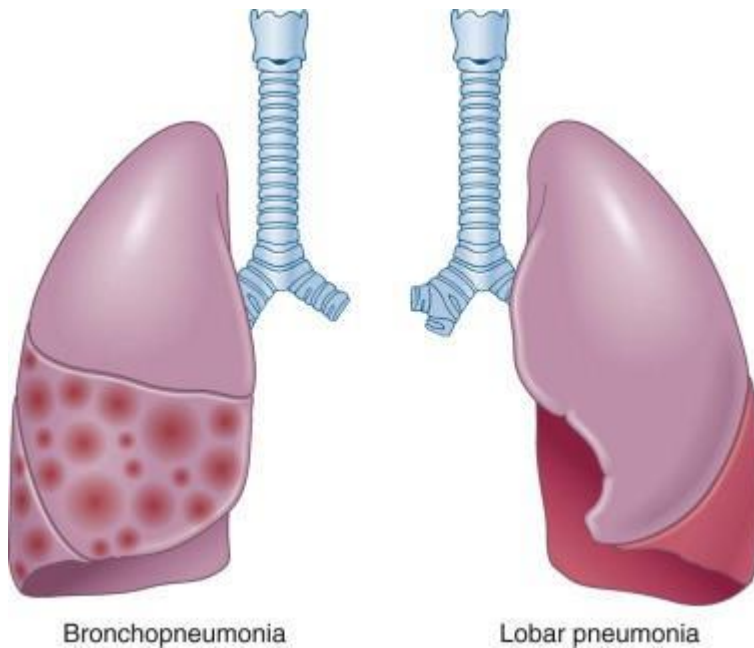
as bronchopneumonia and lobar pneumonia.

Bronchopneumonia implies a patchy distribution of inflammation that generally involves more than one lobe.

This pattern results from an initial infection of the bronchi and bronchioles with extension into the adjacent alveoli.

By contrast,

in **lobar pneumonia** the contiguous air spaces of part or all of a lobe are homogeneously filled with an exudate that can be visualized on radiographs as a lobar or segmental consolidation.



Streptococcus pneumonia is responsible for more than 90% of lobar pneumonias.

The anatomic distinction between lobar pneumonia and bronchopneumonia can often become blurry,

Therefore, it is best to classify pneumonias by the specific etiologic agent

Pneumonia can arise in seven distinct clinical settings, and the implicated pathogens are reasonably specific to each category, as summarized in Table below:

Community-Acquired Acute Pneumonia

Streptococcus pneumoniae

Haemophilus influenzae

Moraxella catarrhalis

Staphylococcus aureus

Legionella pneumophila

Enterobacteriaceae (*Klebsiella pneumoniae*) and *Pseudomonas* spp.

Community-Acquired Atypical Pneumonia

Mycoplasma pneumoniae

Chlamydia spp.—*Chlamydia pneumoniae*, *Chlamydia psittaci*, *Chlamydia trachomatis*

Coxiella burnetii (Q fever)

Viruses: respiratory syncytial virus, human metapneumovirus, parainfluenza virus (children); influenza A and B (adults); adenovirus (military recruits)

Nosocomial Pneumonia

Gram-negative rods belonging to Enterobacteriaceae (*Klebsiella* spp., *Serratia marcescens*, *Escherichia coli*) and *Pseudomonas* spp.
S. aureus (usually methicillin-resistant)

Aspiration Pneumonia

Anaerobic oral flora (*Bacteroides*, *Prevotella*, *Fusobacterium*, *Peptostreptococcus*), admixed with aerobic bacteria (*S. pneumoniae*, *S. aureus*, *H. influenzae*, and *Pseudomonas aeruginosa*)

Chronic Pneumonia

Nocardia

Actinomyces

Granulomatous: *Mycobacterium tuberculosis* and atypical mycobacteria, *Histoplasma capsulatum*, *Coccidioides immitis*, *Blastomyces dermatitidis*

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 Acute Pneumonias

Most community-acquired acute pneumonias are bacterial in origin.

Not uncommonly, the 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 of community-acquired acute pneumonia.

2- Community-Acquired Atypical Pneumonias

The term *primary atypical pneumonia* initially was applied to an acute febrile respiratory disease characterized by patchy inflammatory changes in the lungs, largely confined to the alveolar septa and pulmonary interstitium. The designation *atypical* denotes the moderate amounts of sputum, absence of physical findings of consolidation, only moderate elevation of white cell count, and lack of alveolar exudates.

Atypical pneumonia is caused by a variety of organisms, *Mycoplasma pneumoniae* being the most common.

Mycoplasma infections are particularly common among children and young adults.

They occur sporadically or as local epidemics in closed communities (schools, military camps, prisons).

Other etiologic agents are *viruses*, including influenza types A and B, the respiratory syncytial viruses, human metapneumovirus, adenovirus, rhinoviruses,

Nearly all of these agents can also cause a primarily upper respiratory tract infection (“**common cold**”).

The common pathogenetic mechanism is attachment of the organisms to the respiratory epithelium followed by necrosis of the cells and an inflammatory response.

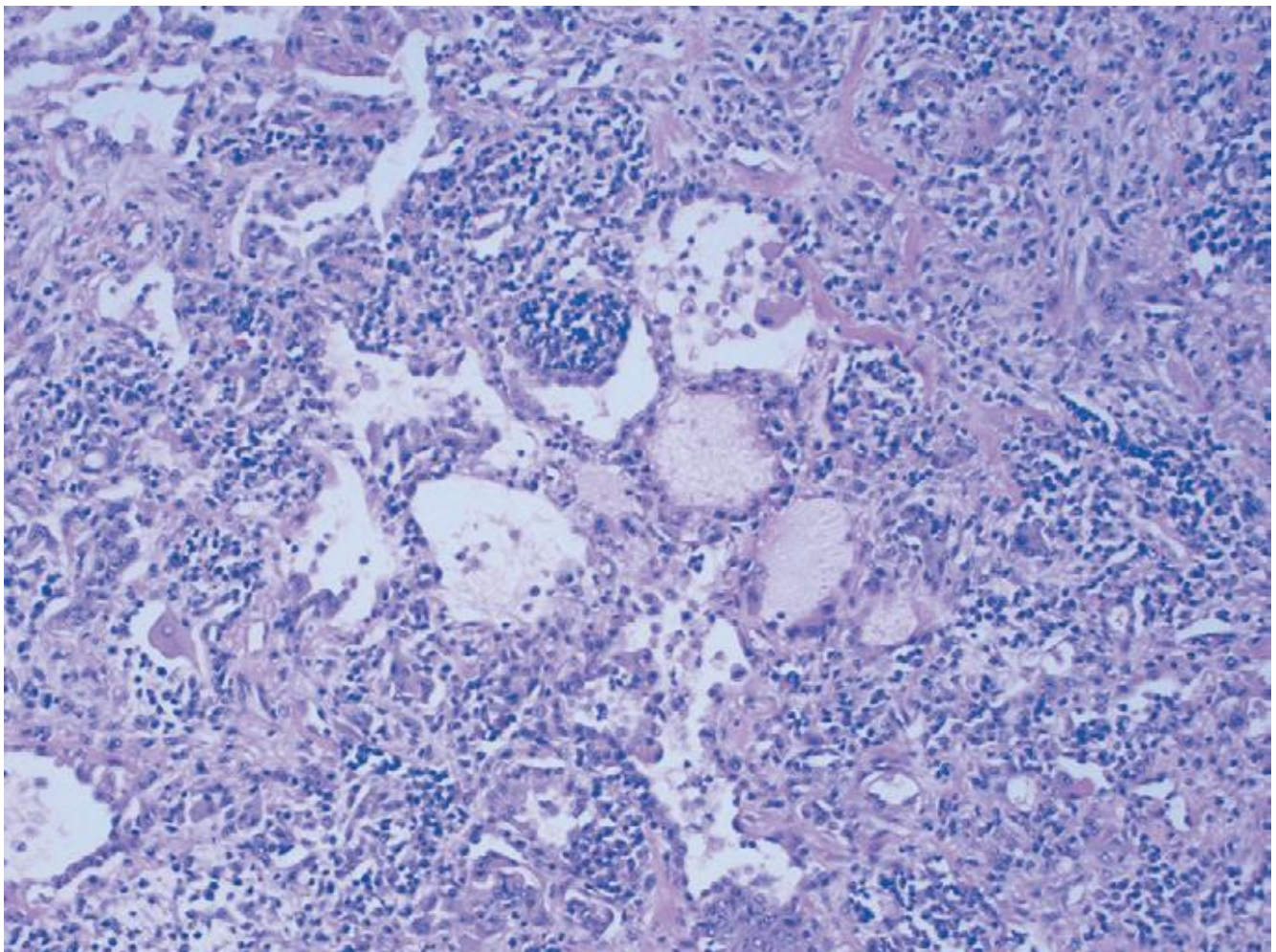
MORPHOLOGY

Regardless of cause, the morphologic patterns in atypical pneumonias are similar.

The process may be patchy, or it may involve whole lobes bilaterally or unilaterally.

Macroscopically, the affected areas are red-blue, congested, and subcrepitant.

On histologic examination, the **inflammatory reaction is largely confined within the walls of the alveoli**



The septa are widened and edematous; they usually contain a mononuclear inflammatory infiltrate of lymphocytes, histiocytes, and, occasionally, plasma cells.

Superimposed bacterial infection, as expected, results in a mixed histologic picture.

3- 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 persons with severe underlying disease, those who are immunosuppressed, or those on prolonged antibiotic regimens.

Gram-negative rods (members of Enterobacteriaceae and *Pseudomonas* spp.) and *S. aureus* are the most common isolates; unlike with community-acquired pneumonias, *S. pneumoniae* is not a major pathogen in nosocomial infections.

4- Aspiration Pneumonia

Aspiration pneumonia occurs in debilitated patients or those who aspirate gastric contents either while unconscious (e.g., after a stroke) or during repeated vomiting.

These patients have abnormal gag and swallowing reflexes that facilitate aspiration.

5- Chronic Pneumonias

Chronic pneumonia most often is a localized lesion in an immunocompetent person, with or without regional lymph node involvement.

There is typically granulomatous inflammation, which may be due to bacteria (e.g., *M. tuberculosis*) or fungi.

Tuberculosis is by far the most important entity within the spectrum of chronic pneumonias.

6- 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:

- *Aspiration of infective material* from carious teeth or infected sinuses or tonsils, particularly likely during oral surgery, anesthesia, coma, or alcoholic intoxication and in debilitated patients with depressed cough reflexes.
- *Aspiration of gastric contents*, usually accompanied by infectious organisms from the oropharynx.
- *As a complication of necrotizing bacterial pneumonias.*
- *Bronchial obstruction*, particularly with bronchogenic carcinoma obstructing a bronchus or bronchiole.
- *Septic embolism*, from septic thrombophlebitis or from infective endocarditis of the right side of the heart.
- In addition, lung abscesses may result from *hematogenous spread of bacteria* in disseminated pyogenic infection.

This occurs most characteristically in staphylococcal bacteremia and often results in multiple lung abscesses.

Anaerobic bacteria are present in almost all lung abscesses.

7- Pneumonia in the Immunocompromised Host

The appearance of a pulmonary infiltrate and signs of infection (e.g., fever) are some of the most common and serious complications in a person in whom the immune and defense systems are suppressed by disease, by immunosuppression for organ transplantation and antitumor therapy, or by irradiation.

Some of the more common pulmonary pathogens are

- (1) the bacterial agents *P. aeruginosa*, *Mycobacterium* spp., *L. pneumophila*, and *Listeria monocytogenes*;
- (2) the viral agents cytomegalovirus and herpesvirus;
- (3) the fungal agents *P. jiroveci*.

THANK YOU