Lecture 20

Community acquired and Hospital acquired Pneumonia

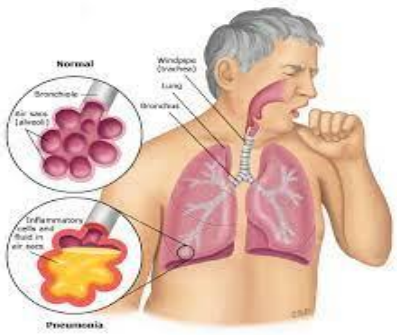
Entsar Hamed Ahmed

Professor of Medical Microbiology & Immunology

Learning objectives

- ✓ To define community and hospital acquired pneumonia (CAP and HAP).
- ✓ Enlist etiological agents for CAP and HAP.
- ✓ Discuss the microbiology of causative pathogens.
- ✓ Discuss the diagnosis techniques available for various pathogens.

Pneumonia



Pneumonia is a form of acute respiratory infection that affects the lungs. The lungs are made up of small sacs called alveoli, which fill with air when a healthy person breathes. When an individual has pneumonia, the alveoli are filled with pus and fluid, which makes breathing painful and limits oxygen intake.

Community-acquired pneumonia (CAP) refers to an acute infection of the pulmonary parenchyma acquired outside of the hospital.

Nosocomial pneumonia or hospital-acquired pneumonia (HAP) is defined as pneumonia that occurs 48 hours or more after hospital admission and is not present at the admission time. Ventilator-associated pneumonia (VAP) represents a significant subset of HAP occurring in intensive care units (ICUs).

N. B .The bacteria and viruses that most commonly cause pneumonia in the community are different from those health care settings.

Community Acquired Pneumonia

Typical	Atypical
S.pneumoniae	*Mycoplasma pneumoniae*
H.Influenzae	*Chlamydia pneumoniae*
M.catarrhalis	*Coxiella burnettii,*
K.Pneumoniae	*Legionella pneumophila,*
S.aureus	RSV, Influenza, VZ,
Pseudomonas aeruginosa	Adeno, Measles & Hanta virus, Fungi, Worms,
Anaerobes: *Bacteroides*	Pneumocystis

Pneumonia

	Key Clues	Most Common Causal Agent
Typical: high fever, productive cough, segmental or lobar opacity on x- ray	Adults (including alcoholics) Rusty sputum, often follows influenza	*Streptococcus pneumoniae*
	Neutropenic pts, burn pts, chronic granulomatous disease CGD, cystic fibrosis CF	Pseudomonas
	Alcoholic, abscess formation, aspiration, facultative anaerobic, gram-negative bacterium with huge capsule, currant jelly sputum	*Klebsiella pneumoniae*
	Nosocomial, ventilator, post-influeza Abscess formation Gram +, catalase +, coagulase + Salmon-colored sputum	*Staphylococcus aureus*
Atypical: low fever, dry cough, diffuse infiltrates (interstitial) on x-ray	Pneumonia teens/young adults; bad hacking cough; initially non-productive cough	*Mycoplasma pneumoniae* (most common cause of pneumonia in school age children
	Atypical with air conditioning exposure especially >50 yr, heavy smoker, drinker	*Legionella* spp.
	Atypical with bird exposure, hepatitis	*Chlamydophila psittaci*

❖ ***Streptococcus pneumoniae***

Distinguishing Features
• α hemolytic
• Optochin sensitive
• Lancet-shaped diplococci • Lysed by bile (bile soluble)

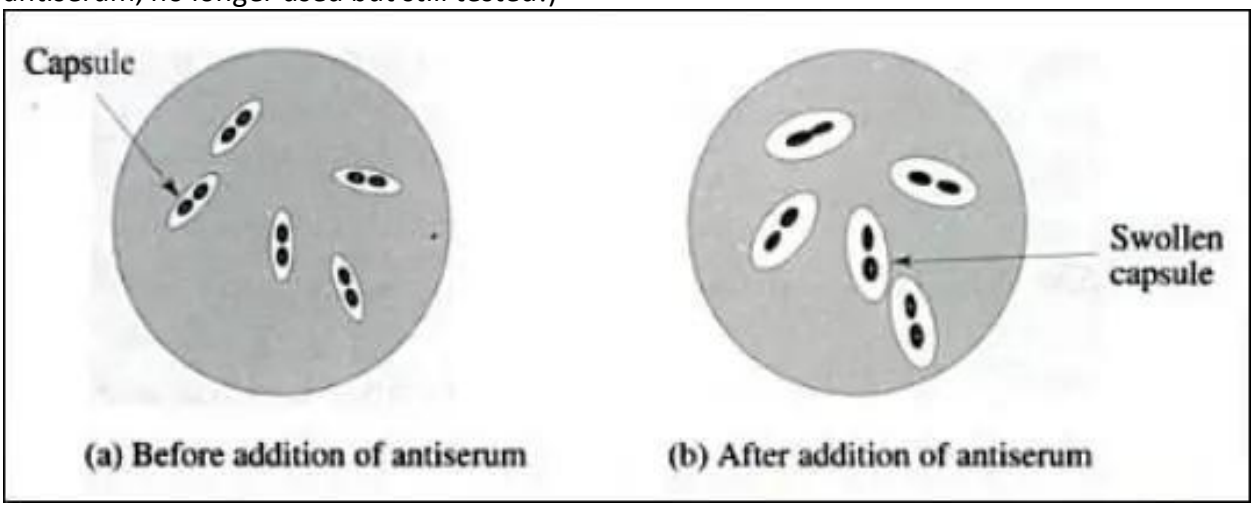
Reservoir: human upper respiratory tract

Transmission: respiratory droplets (not considered highly communicable; often colonize the nasopharynx without causing disease)

Pathogenesis
• Polysaccharide capsule is the major virulence factor
• IgA protease
• Teichoic acid
• Pneumolysin O: hemolysin/cytolysin: damages respiratory epithelium; inhibits leukocyte respiratory burst and inhibits classical complement fixation

Disease
• Typical pneumonia: most common cause (especially in decade 6 of life); shaking chills, high fever, lobar consolidation, blood-tinged, "rusty" sputum

Laboratory Diagnosis
• Gram stain and culture of CSF or sputum
• Quellung reaction: positive (swelling of the capsule with the addition of type-specific antiserum, no longer used but still tested!)



• Latex particle agglutination: test for capsular antigen in CSF
• Urinary antigen test

Prevention

• Antibody to capsule (>80 capsular serotypes) provides type-specific immunity

• Vaccine

– Pediatric (PCV, pneumococcal conjugate vaccine): 13 of most common serotypes; conjugated to diphtheria toxoid; prevents invasive disease

– Adult (PPV, pneumococcal polysaccharide vaccine): 23 of most common capsular serotypes; recommended for all adults age ≥65 plus at-risk individuals

❖ *Klebsiella pneumoniae*

Distinguishing Features

- Gram-negative rods with large polysaccharide capsule
- Mucoid, lactose-fermenting colonies on MacConkey agar • Oxidase negative

Reservoir: human colon and upper respiratory tract

Transmission: endogenous

Pathogenesis : capsule (impedes phagocytosis); endotoxin (causes fever, inflammation, and shock [septicemia])

Disease(s) : Pneumonia

– Community-acquired, most often older men; most commonly those with chronic lung disease, alcoholism, or diabetes (but this is not the most common cause of pneumonia in alcoholics; *S. pneumoniae* is.)

– Endogenous; assumed to reach lungs by inhalation of respiratory droplets from upper respiratory tract

– Sputum is generally thick and bloody (currant jelly) .

❖ *Pseudomonads*

Distinguishing Features

- Oxidase-positive, Gram-negative rods, nonfermenting

-Pigments: pyocyanin (blue-green) and fluorescein

-Grape-like odor

- Slime layer (Biofilm).

- Non–lactose fermenting colonies on EMB or MacConkey .

Reservoir: ubiquitous in water

Transmission: water aerosols, raw vegetables, flowers

Pathogenesis

•-Endotoxin causes inflammation in tissues and gram-negative shock in septicemia

-Pseudomonas exotoxin A ADP ribosylates eEF-2, inhibiting protein synthesis (like diphtheria toxin)

- Capsule/slime layer allows formation of pulmonary microcolonies; difficult to remove by phagocytosis.

Disease(s)

- Chronic granulomatous disease: pneumonias, septicemias.

- Cystic fibrosis: early pulmonary colonization, recurrent pneumonia; always high slime-producing strain.

❖ *Legionella pneumophila*

Distinguishing Features
-Stain poorly with standard Gram stain; gram-negative
- Fastidious requiring increased iron and cysteine for laboratory culture
(BCYE, buffered charcoal, yeast extract) • Facultative intracellular

Diagnosis
• Urinary antigen test .
• DFA (direct fluorescent antibody) on biopsy.

Prevention: routine decontamination of air-conditioner cooling tanks.

❖ *Mycoplasma pneumoniae*

Distinguishing Features

-Extracellular, tiny, flexible
- No cell wall; not seen on Gram-stained smear
- Requires cholesterol for in vitro culture

Reservoir: human respiratory tract

Transmission: respiratory droplets; close contact: families, military recruits, medical school classes.

Pathogenesis

- Attaches to respiratory epithelium via P1 protein
- • Inhibits ciliary action.

Diseases:

-walking pneumonia
- Pharyngitis
- May develop into atypical pneumonia with persistent hack (little sputum produced)
-Most common atypical pneumonia (along with viruses) in young adults.

Diagnosis

- Primarily clinical diagnosis; PCR/nucleic acid probes
- ELISA and immunofluorescence sensitive and specific
-Fried-egg-shaped colonies on sterol-containing media, 10 days e.g.(PPLO) media.
-Positive cold agglutinins (autoantibody to RBCs) test is nonspecific and is positive in only 65% of cases.

❖ *CHLAMYDIACEAE*

Family Features

• Obligate intracellular bacteria
• Elementary body/reticulate body • Not seen on Gram stain
• Cannot make ATP
• Cell wall lacks muramic acid

Genera of Medical Importance (in case of pneumonia)

• *Chlamydophila pneumoniae*

Reservoir

Human respiratory tract

Transmission

Respiratory droplets

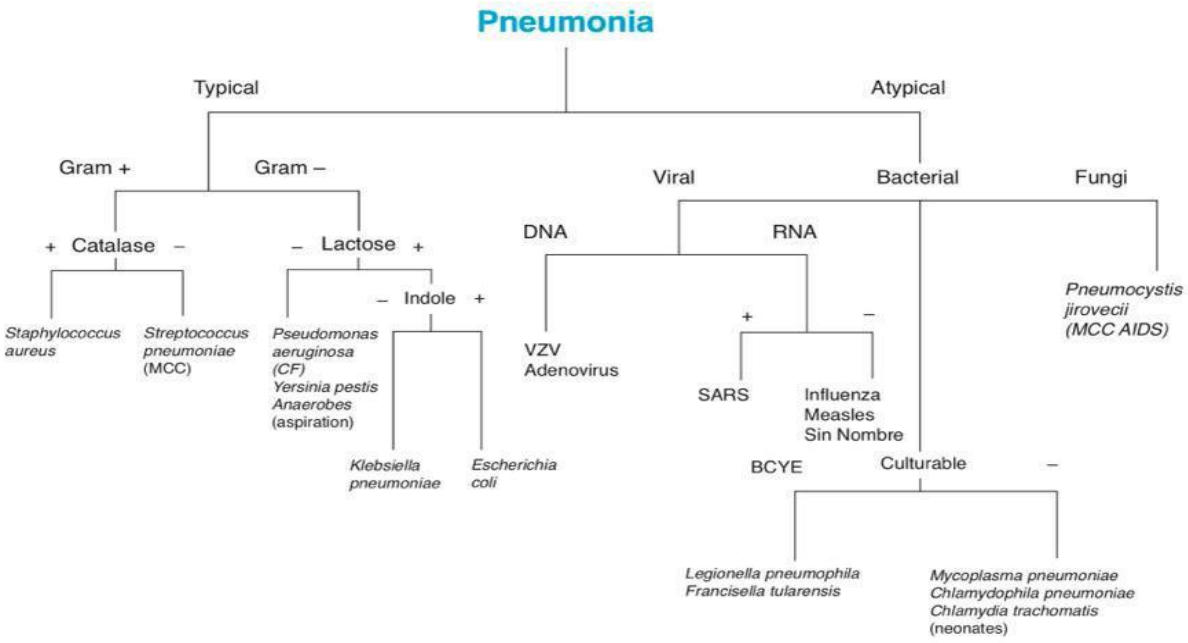
• *Chlamydophila psittaci*

Reservoir

Birds, parrots, turkeys

Transmission

Dust of dried bird secretions and feces.



Recall Questions

1- A 65 year old male presents with high grade fever, chest pain and cough productive of yellow sputum. CXR shows lobar infiltrates. Gram stain of sputum shows numerous pus cells and gram-positive diplococci. Which of the following is the most likely pathogen?

A. Streptococcus pyogenes
B. Staphylococcus aureus
C. Streptococcus pneumoniae
D. Haemophillus influenzae

2-A-55-year old male admitted to hospital with fever and cough and chest pain. Culture of sputum shows the growth of streptococcus pneumoniae.
How will you identify streptococcus pneumoniae in laboratory?

A. Optochin sensitivity
B. Bacitracin sensitivity
C. X V factor requirement
D. Coagulase test

3- A 36- year old female develops new chest infiltrates, fever while in hospital for last one week. Her respiratory specimen culture reveals the growth of Klebsiella pneumoniae. What is the microbiologic feature for this bacterium?

A. Gram positive cocci chains
B. Motile Gram-negative rods
C. Non motile Gram-negative rods
D. Gram positive cocci clusters

- Reference

KAPLAN Medical, USMLE Step 1 Lecture Notes 2021, Immunology and Microbiology, p:211,233,234,235,238,239,248,262,266,267,383 , 399