

Lecture – 03

Bacteria Causing Pneumonia



Microbiology Team - 430

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▪ Definition :

- **Pneumonia** is a Disease of alveoli and respiratory bronchioles. It may Involve one lobe , or can be around bronchi patchy (consolidation vs bronco-pneumonia) or can be interstitial.
- **Clinically:** New opacity on chest radiography in the presence of respiratory symptoms. *(cough , dyspnea , fever , if it's severe they will have hypoxia)*

▪ Epidemiology :

- **Common in winter months.**
- It is the sixth leading cause of death in USA.
- 3 million develop pneumonia and 600,000 hospitalized in USA.
- The risk factors are old age, asthma, smoking, alcoholism diseases and immunosuppressant HIV,DM (Diabetes mellitus)and (Chronic lung and heart in *S.pneumoniae*)
- Newly discovered organism and emerging resistance.

▪ Classification :

Pneumonias can be classified in two ways either by **anatomic** changes that happens to the lung or by the **pathogen** that affect the lung:

• Anatomy

- Lobar: entire lobe. *(Infection that only involves a single lobe of a lung)*
- Bronchopneumonia. *(Affects the lungs in patches around the tubes "bronchi or bronchioles")*
- Interstitial. *(involves the areas in between the alveoli)*

- **Pathogen**

- **Gram-positive:** as *Streptococcus pneumoniae*, Staphylococcus aureus, Group A hemolytic streptococci. *(Cause Community – acquired pneumonia)*.
- **Gram-negative Bacteria:** Klebsiella pneumonia, *Haemophilus influenza*, Moraxella catarrhal and E.coli. *(Cause hospitalized – acquired pneumonia)*.
- **Atypical Bacteria:** *Mycoplasma pneumoniae*, chlamydomphila pneumoniae and *legionella*. Anaerobic bacteria. *(Affect Atypical patients)*
- Viral and fungal

Acquired environment:

- Community Acquired Pneumonia ‘CAP’. *(Infectious pneumonia in a person who has not recently been hospitalized)*
- Hospital Acquired Pneumonia ‘HAP’. *(Pneumonia acquired during or after hospitalization for another illness or procedure with onset at least 72 hrs after admission)*
- Nursing home acquired and immunocompromised host

- **Most common cause of community-acquired pneumonia :**

Children

- **Viral** *(the most common cause in the children)*
 - *Respiratory Syncytial virus*
 - Parainfluenza virus
 - Human metapneumovirus
- **Bacterial**
 - *S.pneumoniae (the second common)*
 - *H.influenza type B*
 - Group B streptococci in neonate

Adult

- *S.pneumoniae*. (the most common)
- *Mycoplasma pneumoniae*, chlamydothila pneumoniae or *respiratory viruses*

- *The second common depending on the season.*
- *In winter → Viral.*
- *In summer → Mycoplasma*

- Special conditions:
 - **Chronic lung diseases:**
 - *S.pneumoniae*
 - *H.influenza*
 - **Recently hospitalized:**
 - *Gram negative, legionella*
 - **Recent influenza:**
 - *S.pneumoniae*
 - *S.aureus*

- The difference between typical and atypical community-acquired pneumonia : (**Very important table**)

Variable	Typical	Atypical
Etiology	<i>S.pneumoniae</i> , <i>H.influenza</i>	<i>Mycoplasma pneumoniae</i> , <i>chlamydophila pneumonia</i> , <i>legionella</i> , TB, viral or fungal
Clinical presentation	Sudden onset of fever, chill, productive cough, shortness of breath and chest pain	Gradual onset headache, sore throat and body ache
Diagnosis Gram Stain	Useful	Useless (no cell wall)
Radiography	Lobar infiltrate	Dramatic changes: patchy or interstitial
Treatment with penicillin	Sensitive	Resistant. (Because penicillin work in cell wall, and atypical organisms have no cell wall! However , <i>Erythromycin</i> works on them)

▪ Importance of history taking in patient with community-Acquired pneumonia

History	Pathogen
Solid organ transplant	Any pathogen Bacterial , viral, fungal,or parasitic
HIV	<i>Pneumocystis jirovecii</i>
Travel to some area in USA	Endemic Mycosis
Exposure to air-conditioning, cooling towers, hot tub, hotel stay, grocery store mist machine	<i>Legionella pneumophila</i>
Exposure to Turkeys, chickens, ducks or parrots	<i>Chlamydia psittaci</i>
Exposure to contaminated bat caves	<i>Histoplasma capsulatum</i>
Exposure to sheep, goat or cattle	<i>Coxiella burnetii</i>
Exposure to rabbits	<i>Francisella tularensis</i>
Occupation	<i>Mycobacterium tuberculosis</i> , HIV

▪ Diagnosis :

- Physical examination
 - Respiratory signs on consolidation
 - Other systems
- Chest x-ray examination

- Laboratory
 - CBC- leukocytosis
 - Electrolytes (**↓ Na (hyponatremia) in Legionella**)
 - Urea, creatinine, LFT
- Sputum Gram stain- 15%
- **Sputum culture** (because it is easy , fast)
- Bronchoscopic specimens
- Blood culture 6-10%
- **NP swab for respiratory viruses.** (*NP : Nasopharyngeal*)
- **Legionella urine antigen** (*Detect the Legionella antigen in the urine*)
- Serology for M.pneumoniae and C.pneumoniae
- Cold agglutination M.pneumoniae (*Type of serology test*)
- More Invasive procedure in sick patient (*When the patient come with transplant or very sick*)

▪ Management :

- Outpatient or inpatient (hypotension, confusion and oxygenation) and age.
- Previous treatment in the past 3 months. (*may the patient had resist against some drug*)
- Resistance patterns in the community.

▪ Antibiotics selection :

	Macrolide (Azithromycin or clathromycin)	Fluoroquinolone(FQ)	Ceftriaxone (βlactam)
Outpatient	√		
Outpatient with comorbidity and or macrolides treatnet		√	√ + macrolide
Inpatient Non ICU		√	√+ macrolide
Inpatient ICU			√ + macrolide or FQ

- **Macrolide** is the most common drug used in CAP.
- There are some patients were treated by **Macrolide** before, so they develop resistant to the drug. In those patients we have to use other drug (**Fluoroquinolone**) or (**Macrolide + Ceftriaxone**)

Organisms	Antibiotics
<i>Pseudomonas</i>	Macrolide + ceftazime or FQs
<i>MRSA</i>	Vancomycin or linezolid
<i>Chlamydia psittaci</i>	Macrolide or tetracycline
<i>Coxiella burnetii</i>	Macrolide or tetracycline
<i>Legionella</i> (have high fever and ↓ Na level (hyponatremia))	Erythromycin

■ Complications :

- Death 10% , 40% (ICU) within 5 days. (because they have lung complication or cardiac complication and sometime developed abscess)
- Mainly old age with severe pneumonia.
- Respiratory and cardiac failure.
- Empyema 10%.

■ Prevention :

- Vaccination:
 - Influenza
 - *S.pneumoniae*
- Prevention of Aspiration:
 - Head Position
 - Teeth cleaning

Mycoplasma pneumonia

- Common **adolescence** crowded places like schools.
- **Usually gradual mild.**
- **Atypical pneumonia.**
- May be associated with a skin rash and hemolysis.

Chlamydophila pneumonia

- Obligate intracellular organism.
- 50% of adults Sero -positive.
- Mild disease.
- Sub clinical infections common.
- 5-10% of community acquired pneumonia.

Legionella pneumophilla

- **Cause outbreak , ICU.**
- **Hyponatraemia common.**
($<130\text{mMol}$)
- Bradycardia.
- $\text{WBC} < 15,000$.
- Abnormal LFTs. (*Liver Function Test*)
- Raised CPK.
- Acute Renal failure.
- **Urinary antigen.**
- **Treatment erythromycin.**
- **main clinical feature are high fever and hyponelia**