MICRO 2 + 3

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- **Lecture 2**

Pathogen Microbiology and Identification

- **Streptococcus pneumoniae**
- Gram-positive, lancet-shaped diplococci
- Optochin sensitive
- Bile soluble
- **Viridans streptococci**
- Not optochin sensitive
- Not bile soluble
- **Haemophilus influenzae**
- Small **Gram-negative** (not Gram-positive) coccobacillus
- Fastidious organism
- Requires **hemin (X factor)** and **NAD (V factor)**
- Grows on **chocolate agar**, not plain blood agar
- **Moraxella catarrhalis**
- Gram-negative diplococcus
- Oxidase-positive
- DNase-positive
- Does not cause mucosal infections such as otitis, sinusitis, and COPD exacerbations.

Pathogenesis and Host Defenses

- **Capsule**
- Differences in pneumococcal serotype virulence are **capsule-dependent**
- **Colonization**
- Pneumococcal disease most commonly begins from **endogenous strains colonizing the upper respiratory tract**, not direct inhalation into alveoli
- **Spleen**
- Critical for defense against **pneumococcal bacteremia**
- **Non-typeable H. influenzae (NTHi)**

- **Unencapsulated**
- Common respiratory tract commensal
- Causes **mucosal infections**: otitis media, sinusitis, COPD exacerbations
- **Autolysin**
- Virulence factor involved in bacterial self-lysis and inflammation
- **Does NOT evade mucosal IgA** (IgA protease does)

Clinical Manifestations

- **Pneumococcal pneumonia**
- Abrupt fever
- Chest pain
- Rusty sputum
- Lobar consolidation on chest X-ray
- **Pneumococcal sinusitis**
- Severe headache
- Stuffy or runny nose
- Post-nasal drip

Diagnosis

- **Urinary antigen test**
- Used for diagnosis of pneumococcal pneumonia
- **Multiplex PCR**
- Used to identify underlying causes of community-acquired pneumonia

Management

- Management of community-acquired pneumonia is **always based on**:
- Minimal inhibitory concentration (MIC)
- Local epidemiology
- Patient factors (allergy, severity, comorbidities)

- **High-dose amoxicillin alone is NOT universally appropriate** for pneumococcal CAP

• **Moraxella catarrhalis**
• **~90% produce β-lactamase**, significantly affecting antibiotic choice

Prevention and Vaccination
• **Vaccines**
• Licensed vaccines exist for **encapsulated strains** of *S. pneumoniae* and *H. influenzae*
• **No licensed vaccine** for *M. catarrhalis*
• Hib vaccine
• Protects against **H. influenzae type b**
• Prevents **meningitis and epiglottitis**
• Pneumococcal conjugate vaccines
• Protect against **specific serotypes only**
• Provide herd immunity
• **Do NOT cover all pneumococcal types**

Lecture 3

Gram-Positive Pathogens

Staphylococcus aureus

Virulence Factors of Staphylococcus aureus
• PVL (Panton-Valentine Leukocidin)
• Strongly associated with:
• **Necrotizing pneumonia**
• **Abscess formation**
• Staphyloxanthin
• Enhances survival within neutrophils
• Neutralizes oxidative bursts

Identification

- **Golden-yellow, β-hemolytic colonies**
- **Do NOT reliably distinguish S. aureus** from all other Gram-positive cocci
- **Coagulase test**: **Definitive method of identification**

1. MRSA (Methicillin-Resistant Staphylococcus aureus)

Treatment

- **Vancomycin**
- **Linezolid**

- **Cannot be treated with Cefazolin** (cephalosporins are ineffective)

- In **MRSA bacteremia with secondary empyema**, **antibiotics alone are insufficient**, **drainage is required**, even if blood cultures clear rapidly

Post-Influenza Pneumonia

- Progressive cavitary pneumonia with **leukopenia**
- **Clindamycin monotherapy is NOT sufficient** because toxin suppression alone is inadequate
- Requires **bactericidal therapy**

Infection Control

- **Contact precautions** are essential for **MRSA control**

2. MSSA (Methicillin-Sensitive Staphylococcus aureus)

Treatment

- Can be treated with **Linezolid**

Gram-Negative Pathogens

<u>Acinetobacter species</u>

Clinical Importance

• Major cause of **Hospital-Acquired Pneumonia (HAP)** and **Ventilator-Associated Pneumonia (VAP)**
• Responsible for **hospital and ICU outbreaks**, due to ability to **survive on dry surfaces**
• Spread may occur **independently of direct patient-to-patient contact**
• **Biofilm formation on endotracheal tubes** explains why VAP **frequently relapses despite treatment**

Identification
• Gram-negative **non-fermenter**
• **Oxidase-negative**

<u>Klebsiella pneumoniae</u>

Risk Factors
• **Alcoholism** (increases aspiration risk → predisposes to pneumonia)
• **Diabetes mellitus**
• **Immunocompromised states**

Clinical Features & Complications
• Severe pneumonia associated with:
• **Lung abscesses** that often require **longer treatment** than anaerobic abscesses
• **Empyema** (Pus accumulation in the pleural space) that complicates pneumonia, especially in diabetics and immunocompromised patients

Imaging
• **Bulging interlobar fissures**
• **Suggestive but NOT pathognomonic**

Antibiotic Resistance & Treatment
• ESBL (Extended-Spectrum Beta-Lactamases)-producing strains: **Imipenem** (carbapenem) is the treatment of choice/ Third-generation cephalosporins are NOT appropriate

Infection Control
• **Environmental disinfection** plays a major role in controlling transmission

Stenotrophomonas maltophilia

Key Characteristics

- Gram-negative **non-fermenter**
- **Oxidase-negative**

Treatment

- **Cotrimoxazole (TMP-SMX)** is the **first-line drug of choice**

Multidrug-Resistant Gram-Negative Pneumonia

- **Colistin** is **NOT preferred first-line therapy** (Reserved as **last-line treatment** due to significant toxicity)

Gram-Negative Identification

- Oxidase-positive non-fermenters:
- **Pseudomonas aeruginosa** and **Burkholderia**

- Oxidase-negative non-fermenters:
- **Acinetobacter** and **Stenotrophomonas**