Streptococcus pneumoniae

Core Course: Medical Microbiology
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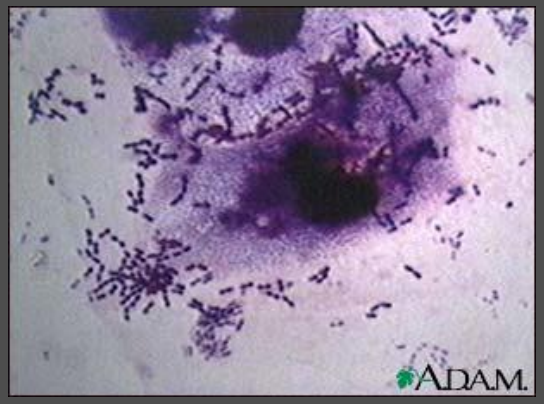
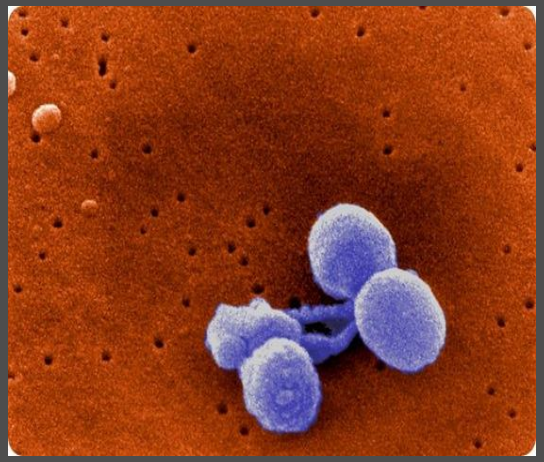
INTRODUCTION:

- Common name **Pneumococcus.**
- Formerly known as **Diplococcus pneumoniae**.
- Has been reclassified as S. pneumoniae because of its genetic relatedness to streptococcus.
- Normal inhabitants of the upper respiratory tract of human beings.

Streptococcus pneumoniae

- Nasopharynx of healthy people
- Gram-positive bacteria
- Paired (diplococci) or appear in chains
- May also infect brain (pneumococcal meningitis) and blood stream (pneumococcus septicemia)





Scanning Electron Micrograph of Streptococcus pneumoniae. Source: CDC/ R. Facklam, J. Carr

MORPHOLOGY:

- Pneumococci are Gram positive small(1µm), slightly elongated cocci, with one end broad & other end pointed, presenting a flame shaped or lanceolate appearance.
- They occur in pairs, with the broad ends opposing each other.
- They are capsulated & the capsule encloses each pair.
- They are nonmotile & nonsporing.

CULTURE & CULTURAL CHARACTERISTICS:

- They grow only in enriched media.
- They are aerobes & facultative anaerobes.
- The optimum temperature being 37ºC & pH 7.8.
- Growth is improved by 5-10% CO2.

Media used: Blood agar

Colony morphology: On blood agar, after incubation for 18 hours, the colonies are small, dome shaped & glistening, with an area of α-haemolysis.

On further incubation the colonies become flat with raised edges & central umbonation called as **Draughtsman** or **carrom coin** appearance.

BIOCHEMICAL REACTIONS:

1) Catalase test: Negative.

2) Bile solubility test: Positive.

3) It ferments inulin.

PATHOGENICITY:

Source of infection:

i) Endogenous- from the colonized area.
ii) Exogenous- patients or carriers.

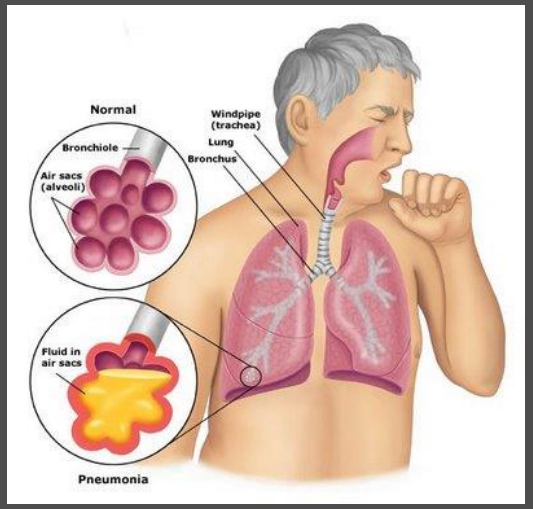
Mode of infection: By inhalation.

Symptoms

- cough (often produces rust colored mucus)
- fever and chills
- shortness of breath
- chest pain
- fatigue

Diagnosis

- Chest x-ray (in hospitals and clinics)
- Blood test
- Sputum culture
- physical examination
- CT scan



Antigenic structure:

1. Capsular polysaccharide:

- It is the most important antigen & type specific.
- Since it diffuses into infective tissue & culture medium it is called as **specific soluble substance(SSS)**.
- Pneumococci are classified into types based on the nature of capsular polysaccharide & more than 90 serotypes are recognised & named 1,2,3…..

2. M protein: It is not associated with virulence.

3. ‘C’ Carbohydrate antigen:

- It is present in all pneumococci so species specific.

- An abnormal protein(β-globulin) that precipitates with ‘C’ carbohydrate antigen of pneumococci, appears in the acute phase sera of cases of pneumonia but disappears during convalescence. It also detected in sera of patients with some other illness. This is known as the **C**-**R**eactive **P**rotein(**CRP**). It is an ‘acute phase’ substance, produced in hepatocytes. Its production is stimulated by bacterial infections, inflammation, malignancies & tissue destruction

Virulence factors:

1. Capsule: It is antiphagocytic.

2. Pneumolysin: It is a membrane damaging toxin has cytotoxic and complement activating properties.

Mechanism of Pathogenesis:

Entry of pneumococci into nasopharynx

↓

Colonization of nasopharynx

↓

May cause infection of the middle ear, paranasal sinuses & respiratory tract by direct spread

↓

Infection of meninges can also occur, by contiguity or through blood

↓

Enters blood causing bacteremia, which may also lead to disseminated infections as in the heart, peritoneum or joint

Disease:

1. Otitis media & sinusitis

2. Pneumonia
   a. Lobar pneumonia
   b. Bronchopneumonia

3. Tracheobronchitis

4. Meningitis

5. Other infections- empyema, pericarditis, conjunctivitis, suppurative arthritis & peritonitis.

LABORATORY DIAGNOSIS:

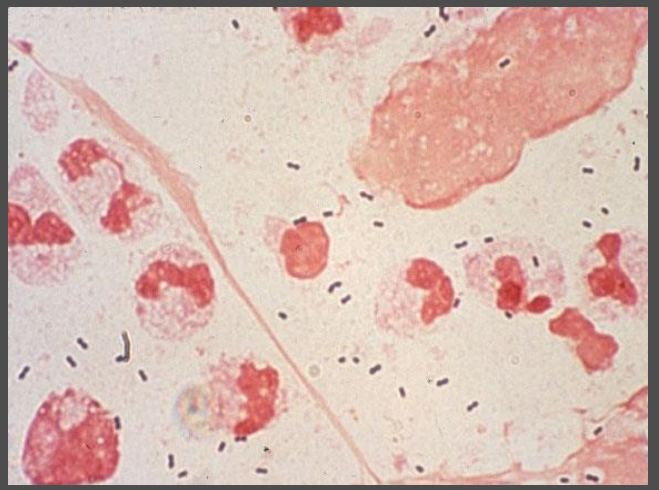
Specimens to be collected:

- Sputum,
- CSF,
- Blood,
- Synovial fluid,
- In children laryngeal swab can be taken if sputum can not be collected.

Methods of examination:

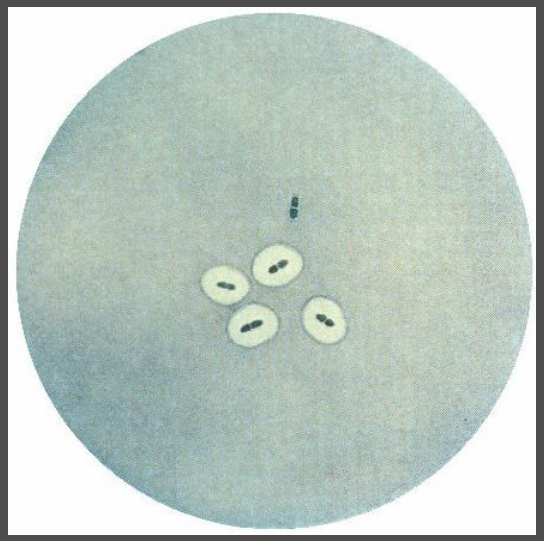
1. Direct microscopy:

Gram stained smears reveals Gram positive lanceolate shaped diplococci with numerous pus cells.



2. Quellung(capsular swelling) reaction:

- It is described by Neufeld.
- On a slide the sputum is mixed with type specific antiserum against capsular antigen & a loopful of methylene blue solution. The capsule becomes swollen & refractile.



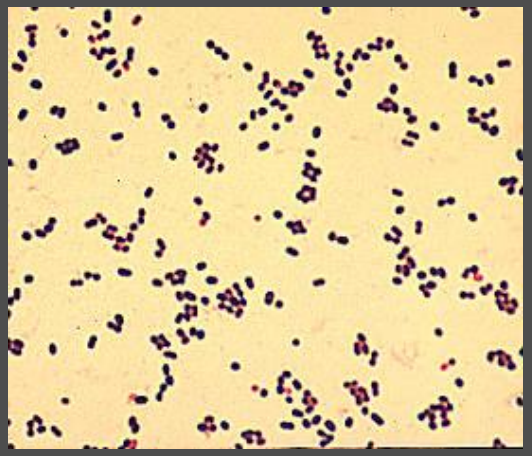
3. Antigen detection: Capsular polysaccharide antigen in blood, CSF & urine can detected by

- Passive latex agglutination,
- Counter immunoelectrophoresis,
- Coaggutination.

4. Culture:

a) Media used:

b) Colony morphology:



c) Gram's smear:
Smears are examined from the culture plate and reveals Gram positive lanceolate shaped diplococci.

d) Capsular swelling reaction: Positive.

It is done by mixing the suspension of colonies from the culture plate and a loopful of type specific antiserum & a drop of methylene blue solution on a slide.

e) Biochemical reactions:

5. Animal inoculation: From specimens where organisms are expected to be scanty, isolation may be obtained by intraperitoneal inoculation in mice.

6. Serology: Antibodies can be demonstrated by agglutination & precipitation test.

TREATMENT:

- For penicillin sensitive strains Penicillin is drug of choice for serious cases & Amoxycillin for milder ones.
- For penicillin resistant strains a third generation cephalosporin is indicated.
- Vancomycin is to be reserved for life threatening illness with highly resistant strains.

Treatment

- Antibiotics, <$1/dose
  - Amoxicillin – inhibit cell wall formation
  - Erythromycin- inhibit protein synthesis
- 1 out of 5 children with pneumonia receives antibiotics

THANK YOU