

Streptococcus Species



Introduction

- One of the two main human pathogens.
- Gram positive cocci.
- Oval shaped.
- Arranged in chains and pairs.
- Catalase negative.
- Non motile.
- Facultative anaerobe.
- Capsulated/ non capsulated.

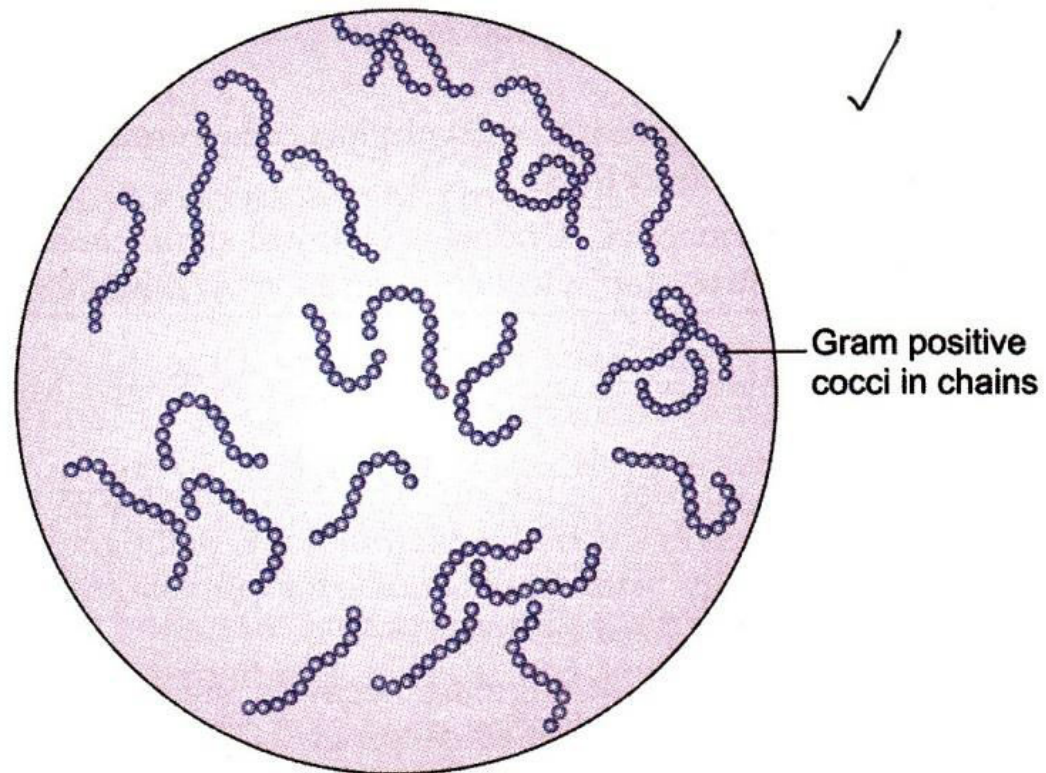
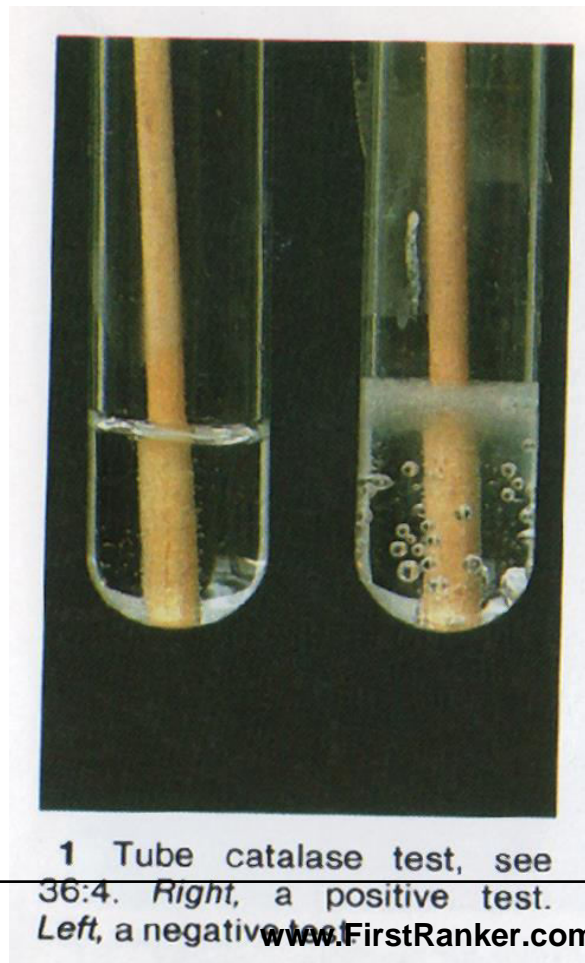


Fig. 25.1: Streptococci

Catalase Test



Classification

- Based on :
 - Serology: using Lancefields antibodies to cell wall carbohydrate.
 - Hemolysin test.
 - Biochemical tests.

Serology

- It is based on C carbohydrate present in the cell wall and its specificity is determined by an amino sugar.
- Antibodies to carbohydrate are detected and classified into A to U.
- There are more than 20 groups in Lancefield grouping.
- All Lancefield groups are pyogenic in nature.

Hemolysin test

- There are three types of hemolysis on blood agar plate namely
 - Alpha hemolysis:
Green zone around the bacterial colony which is due to incomplete hemolysis of RBCs in the agar.
 - Beta hemolysis:
Clear zone of hemolysis around the bacterial colony of blood agar which is due to complete lysis of RBCs. It is produced by an enzyme hemolysin O & S.

Beta streptococci have two antigens in their cell wall.

1. C-carbohydrate
2. M protein

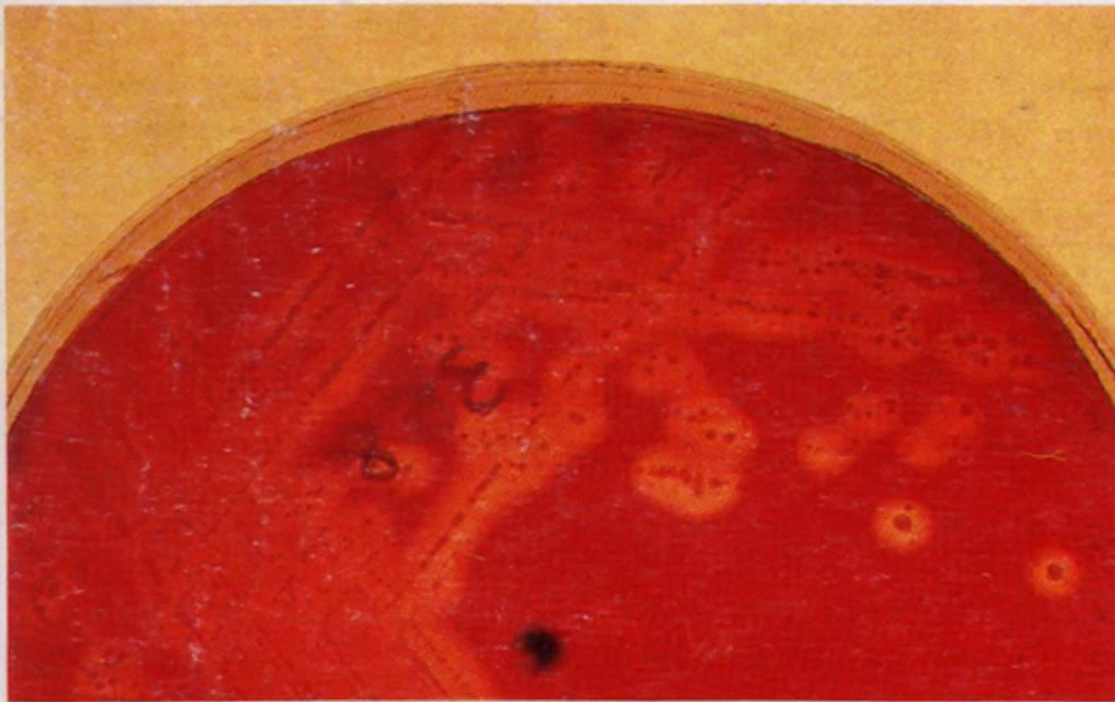
M protein : is an important virulence factor and determines the type of group A, B streptococcus. It is antiphagocytic in nature.

Approximately 80 serotypes are present on the basis of M protein. Some strains produce rheumatic fever and some cause kidney infections.

- Gama Hemolysis:

No hemolysis is produced on blood agar by the bacterial colonies.

Beta-Haemolytic Colonies

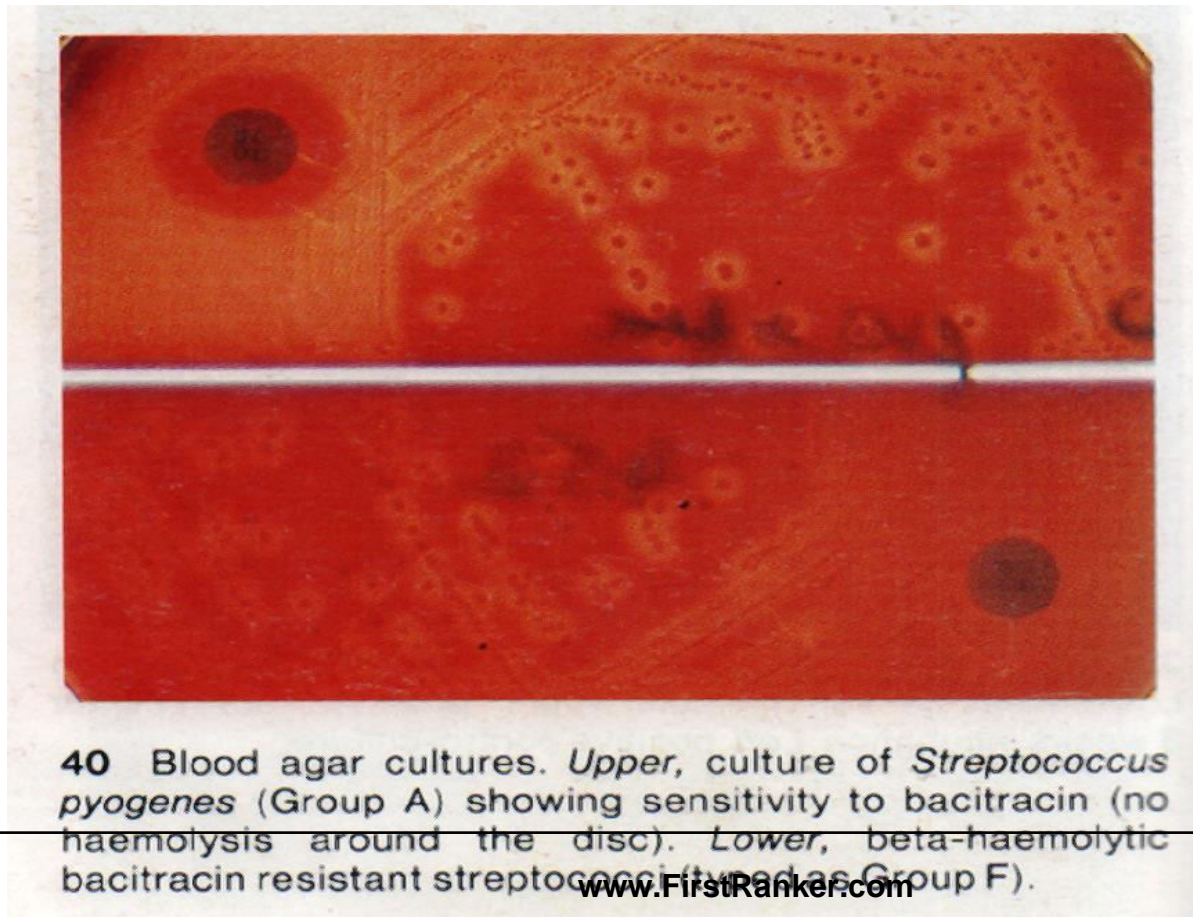


39 Throat swab culture showing beta-haemolytic *Streptococcus pyogenes* (Group A) and non-haemolytic streptococci on crystal violet blood agar.

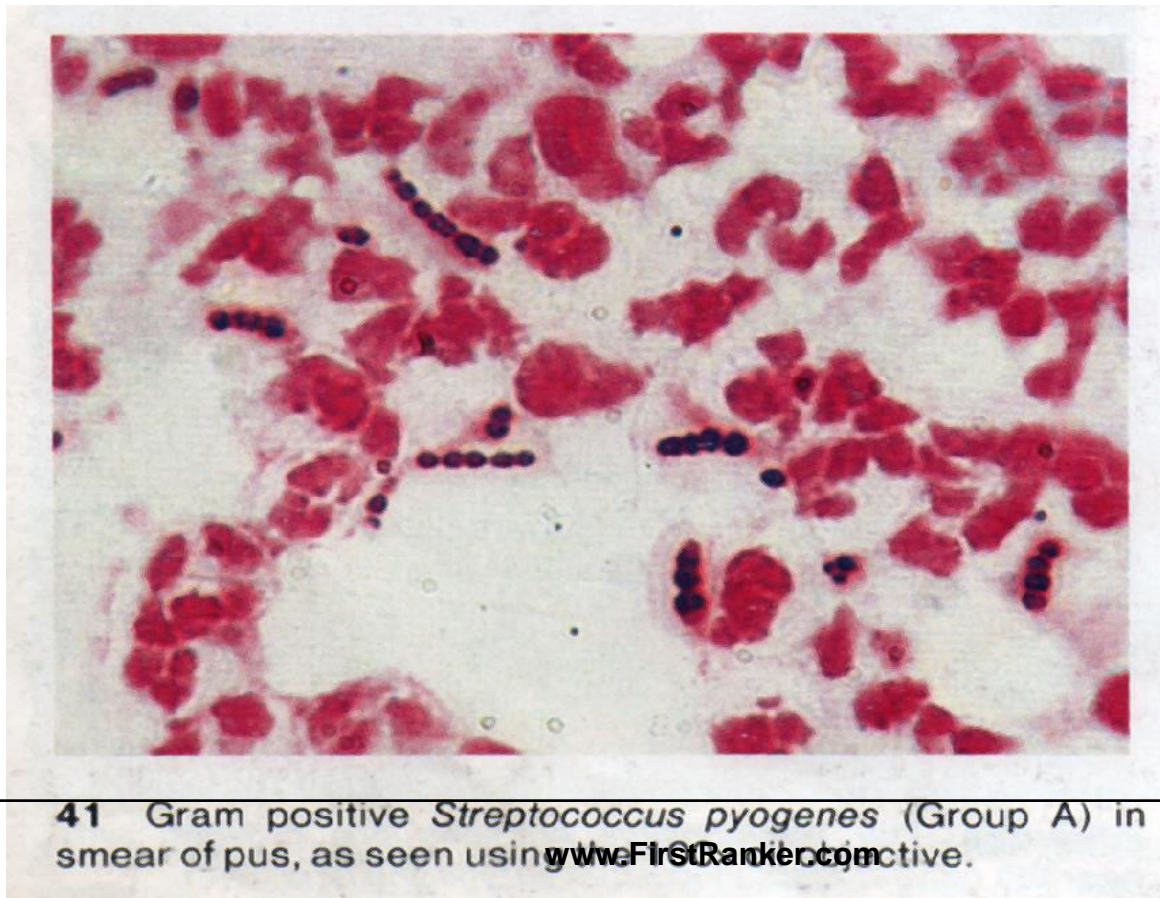
Biochemical Tests

- Following tests are done to classify different bacteria on the basis of chemical reaction.
 - CAMP Test – *Streptococcus agalactae*.
 - Growth inhibition to the bacitracin disc – *Streptococcus pyogenes*.
 - Sensitivity to optochin disc – *Streptococcus Pneumoniae*.
 - Bile solubility test – *Streptococcus faecalis*.

Bacitracin Sensitivity



Streptococcus Pyogenes



Medically important Streptococci

- Streptococcus Pyogenes – Group A
- Streptococcus agalactae – Group B
- Streptococcus faecalis – Group D
- Streptococcus bovis – Group D
- Streptococcus Pneumoniae
- Viridans group Streptococci

Diseases caused by Streptococcus

- **Strept. Pyogenes (Group A)**: produces bacterial diseases like cellulitis, pharyngitis, impetigo, necrotizing skin lesions and streptococcal toxic shock syndrome.
- Two immunogenic diseases i.e Rheumatic fever and glomerulonephritis are also caused.

- **Streptococcus agalactae (Group B)** : is the leading cause of neonatal sepsis and meningitis.
- **Streptococcus faecalis (Group D)**: causes hospital acquired urinary tract infection (UTI) and endocarditis.

- **Streptococcus Pneumoniae:** causes pneumonia in young children and low immunity adults.
- **Viridans group Streptococci & Streptococcus bovis :** common cause of endocarditis.

Beta Hemolytic Streptococci

Beta Hemolytic Streptococci

- Lancefield group A – U on the basis of antigenic differences in C- carbohydrates.
- **Group A :**
 - Streptococcus pyogenes is the most important human pathogen causing sore throat and skin infections.
 - The organism adheres to the epithelium via pili covered by lipoteichoic acid and M proteins.
 - Growth is inhibited by bacitracin disc.

- **Group B:**

- Streptococcus agalactae colonizes in the genital tract of women, causes neonatal meningitis and sepsis.
- Resistant to bacitracin.

- **Group D :**

Comprises of

- Enterococci – Ent. faecalis, Ent. faecium
 - Non enterococci - Strept. bovis
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- They are normal flora of gut and can produce UTI, biliary and CVS infections.
 - Hardy organisms and can grow in saline and bile.
 - Non enterococci cause similar infections but the organisms are less hardy.

- **Group C , E, F, G, H, K-U :**
 - Cause human diseases infrequently.

Transmission

- Most Streptococci are part of the normal flora of skin, throat and intestine but produce diseases only when they gain entry to the blood circulation.
- Viridance group and Strept. pneumoniae are chiefly found in oropharynx.
- Strept. pyogenes is found on skin.
- Streptagalactae is found in vagina and colon.

Pathogenesis

- Pyogenic inflammation.
- Exotoxin production.
- Immunogenic.

Pyogenic Inflammation

- M protein is the most important antiphagocytic factor. Group A produces 3 enzymes.
 - **Hyaluronidase** : It degrades hyaluronic acid which forms ground substance of subcutaneous tissue. It is also known as spreading factor since it facilitates the spread of infection to the tissue.
 - **Streptokinase** : It activates plasminogen to form plasmin which dissolves fibrin into clot, thrombi and emboli. It is used to lyse fibrin clots in coronary vessels in heart attack patients.

- **DNase** : Degrades DNA in exudates or necrotic tissues.
- **Toxins**: Various toxins are produced by streptococci.
 - **Erythrogenic toxins** :
It causes rash of scarlet fever. It acts as a super antigen.

- **Streptolysin O :**

It is hemolysin which is inactivated by oxidation and causes rheumatic fever.

- **Streptolysin S :**

It is oxygen stable and is not activated by oxidation.

- **Pyogenic exotoxin A :**

Causes toxic shock syndrome.

- **Pyogenic exotoxin B :**
Rapidly destroys the tissue and causes necrotizing fasciatis.

Clinical Finding

- Group A causes pharyngitis, sinusitis, mastoiditis, meningitis, TSS. It can also cause endometritis.
- Group B causes neonatal sepsis, meningitis, pneumonia endocarditis and osteomyelitis.
- Group D causes UTI in hospitalized patients, indwelling catheters, pelvic infection.

Complications

- Immunogenic response to streptococci can result in two forms :
 - Acute glomerulonephritis.
 - Rheumatic fever.

▣ **Acute glomerulonephritis:**

It occurs 2 to 3 weeks after the acute skin infection. Antigen-antibody complex gets deposited on glomerular basement membrane of the kidney leading to acute infection. This process can be stopped by avoiding colonization of skin by streptococcus group A.

- ▣ **Acute Rheumatic fever:**

It occurs two weeks after pharangitis. It is characterized by fever, migratory polyarthrititis and carditis.

Mitral and aortic valves are involved.

Prevalent in children between the age of 5-15 years.

- ASOT (Anti streptolysin O titer):
- Rheumatic fever is due to immunological reaction between cross reacting antibodies to M protein of streptococcus A with antigens of joints , hearth and brain.
- It can be prevented if treated within 8 days.

Lab Investigations

- Clinical presentation.
- Throat swab culture.
- CAMP test.
- Asculin test.
- Serological tests (ASOT).

Treatment

- Penicillin G or amoxicillin.
- Erythromycin or Clindamycin in allergic patients.

Prevention

- Prompt treatment to group A streptococcal infections.
 - Preventive benzyl penicillin every month.
 - Use of amoxycillin preoperatively.
 - All pregnant women should be screened for Group B streptococcus by vaginal and rectal cultures at 37 weeks gestation.
 - Penicillin is administered at the time of delivery.
 - No vaccine.
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Alpha Hemolytic Streptococci

Introduction

- Two types of streptococci which produce alpha hemolysis.
 - *Streptococcus pneumoniae*
 - Viridans Group *Streptococcus*

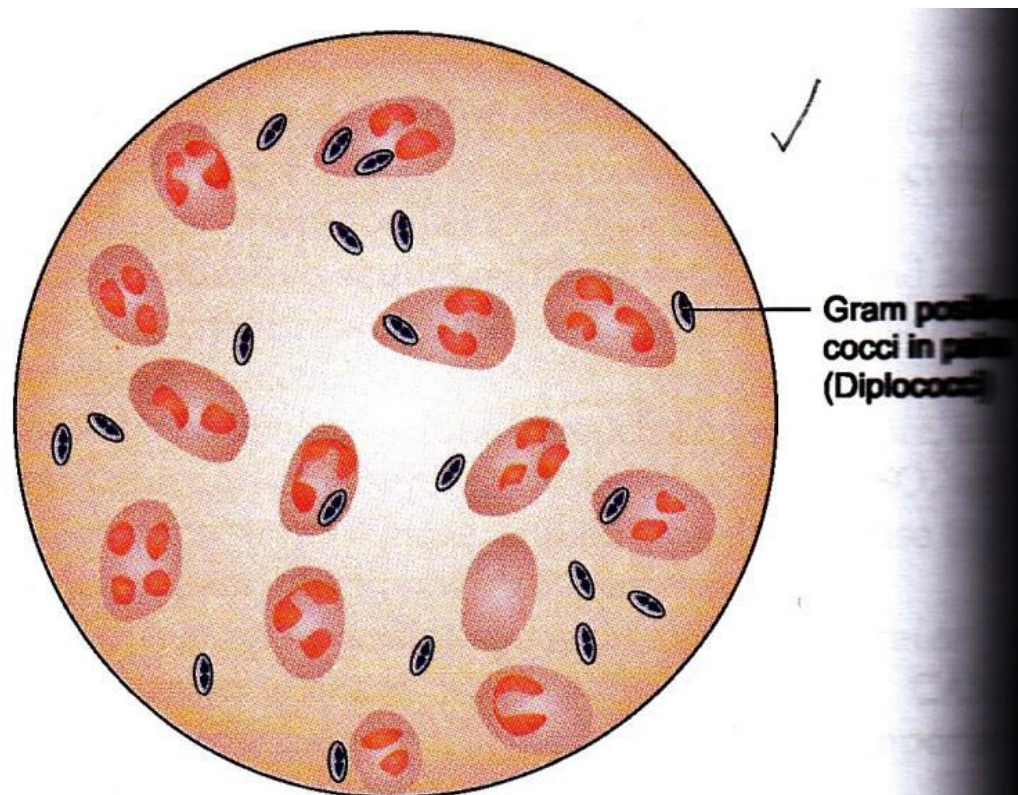
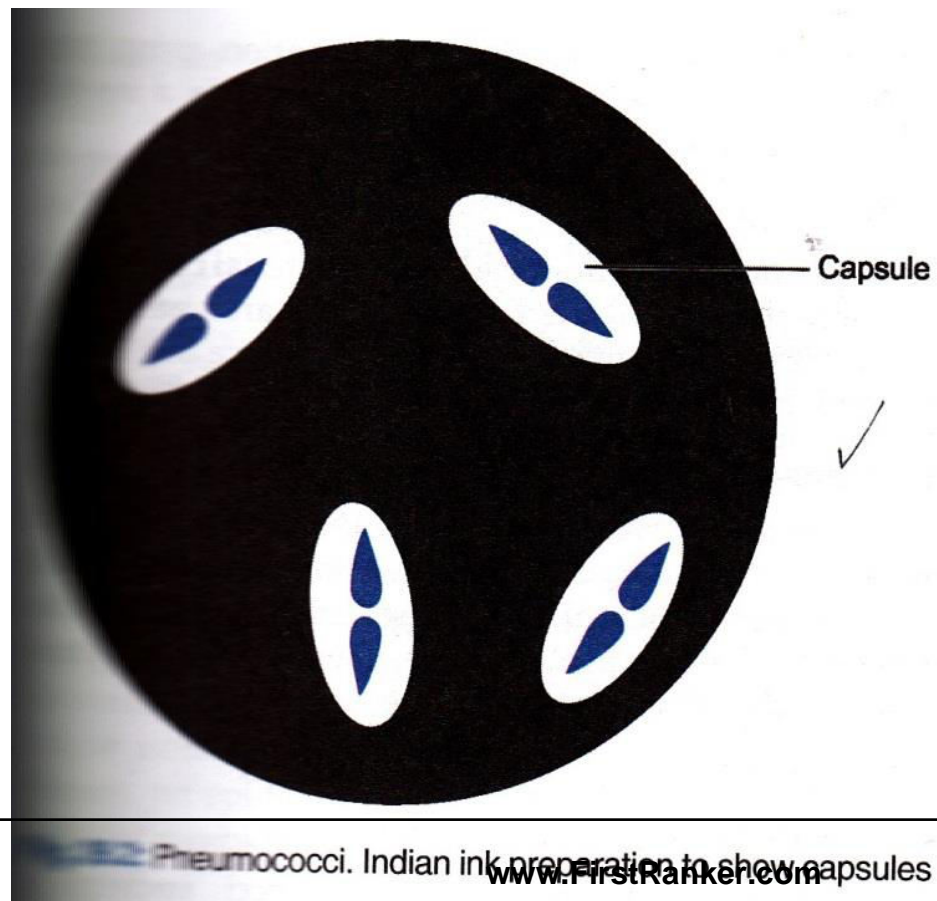
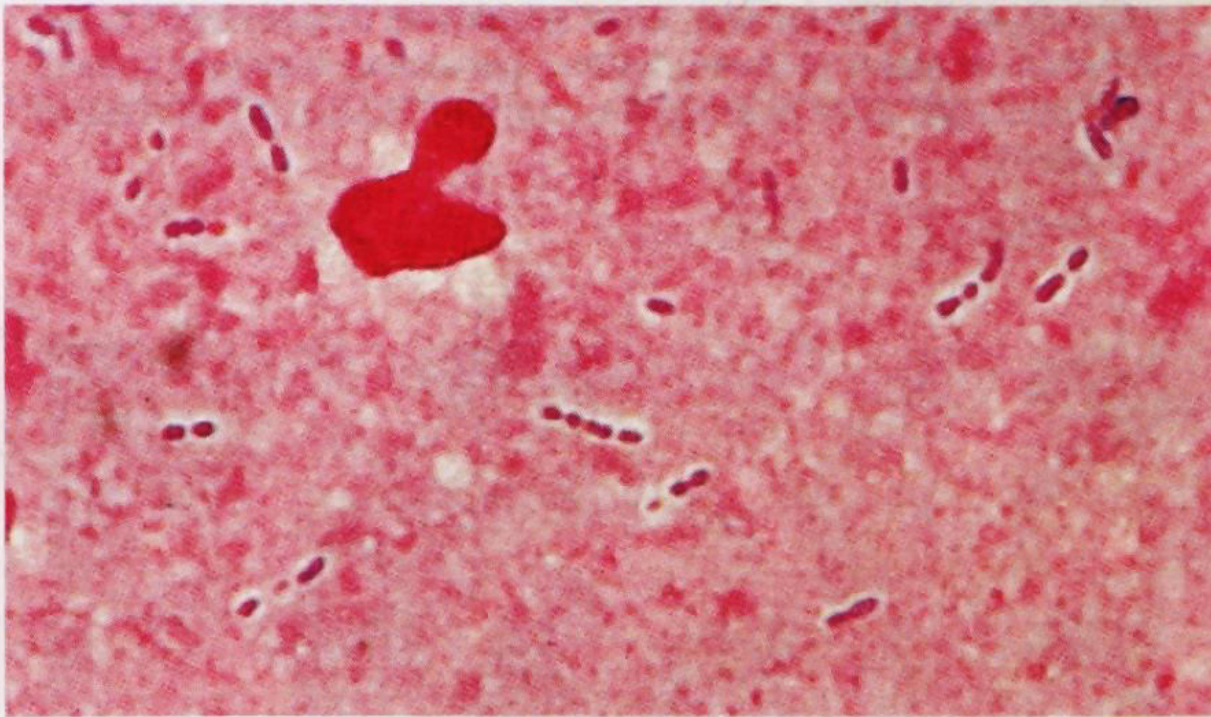


Fig. 26.1: *Str. pneumoniae*



Capsules of Pneumococci



46 Gram positive capsulated diplococci of *Streptococcus pneumoniae*, as seen using the 100× oil objective. The capsules appear as unstained areas around the pneumococci.

Streptococcus pneumoniae

- Most common cause of community acquired pneumonia.
- It produces following diseases namely bacteremia, meningitis, upper respiratory tract infection, otitis media, sinusitis, mastoiditis and conjunctivitis.

General Characteristics

- Gram positive, lancet shaped cocci in pairs or short chains.
- Tend to be oval with pointed ends.
- Thick capsule around the organism.
- Produce alpha hemolysis.
- Lysed by bile salts.
- Growth is inhibited by optochin disc on blood agar.

- Capsule produces quellung reaction.
- Capsule acts as virulence factor.
- It interferes with phagocytosis.
- C-substance in the cell wall reacts with normal serum proteins made by liver called CRP.
- It is increased in acute infection, 1000 folds and is used to monitor the progress of the disease.

Transmission

- 5-50% of normal healthy people harbor virulent organism in oropharynx.
- It is not a communicable disease.
- Disease incidence increases with predisposing factors which include :
 - Alcohol or drug intoxication.
 - Abnormality in the respiratory system.
 - Pulmonary congestion.
 - Splenectomy

Pathogenesis

- Pneumococci produces IgA protease which enhances the ability of the organism to colonize in upper respiratory tract.
 - It multiplies in the tissue and causes inflammation.
 - Polysaccharide capsule is the main virulence factor.
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- Lipoteichoic acid activates the complement and induces inflammatory cytokines production.

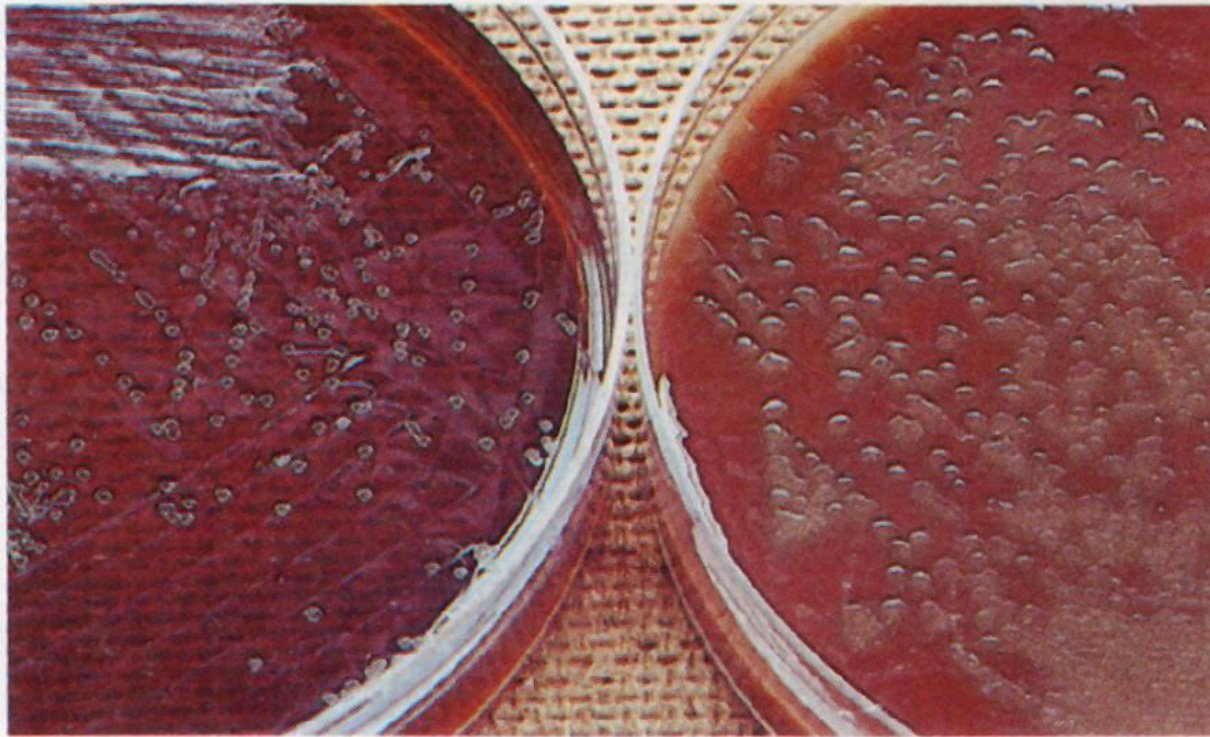
Clinical findings

- Sudden chills, fever, cough and pleuretic pain.
- Sputum is red / brown color.
- It is prominent cause of ear infection sinus, eyes, bronchioles and sepsis in immunocompromised patients.

Lab Diagnosis

- Gram smear - Lancet shaped Gram positive diplococci.
- Smear Culture - Positive in 15-25% cases. Draughtsman colonies on blood agar.
- Quellung Reaction.
- Bile soluble
- Alpha hemolytic colonies on blood agar.
- Growth inhibited by optochin.
- CSF culture.

Draughtsman Colonies of Pneumococcus



44 *Streptococcus pneumoniae* cultures. *Left*, ringed ('draughts-men') colonies on lysed blood agar. *Right*, mucoid colonies showing alpha-haemolysis on chocolate agar.

Optochin Disc Sensitivity



43 Culture of *Streptococcus pneumoniae* on blood agar showing alpha-haemolytic colony sensitive to optochin disc.

Treatment

- Penicillin G is the drug of choice.
- Erythromycin.
- Quinolone & vancomycin in resistant cases.

Prevention

- Mortality rate is high in elderly people, immunocompromised and debilitated persons.
- Polysaccharide vaccine (Polyvalent 23 type) is recommended. It has 5 years protection and needs booster dose after it.
- Conjugated vaccine comprises of diphtheria toxoid with a carrier protein. It is given to young children.

Viridans Group Streptococcus

- Alpha hemolysis or no hemolysis on blood agar.
- Produces green zone around the colony as a result of incomplete hemolysis of red cells.
- Not bile soluble.
- Growth not inhibited by optochin disc.

- Viridans group comprises of the following :
 - Streptococcus mitis
 - Streptococcus sanguis
 - Streptococcus mutans

- Sanguis and mitis are the normal flora in the mouth and colon. They enter the blood stream after dental surgery.
- Few strains can cause brain abscess in combination with mouth anaerobic organisms.
- Mutans produce polysacchride in dental plaque leading to dental caries and peridontal abscess.

Peptostreptococci

- They are the members of the normal flora of the gut, mouth and female genital tract. They are anaerobic organisms.
- They participate in mixed anaerobic infections e.g. peptostreptococci and viridans streptococci both are members of normal flora but are found in brain abscess following dental surgery.