Streptococcus

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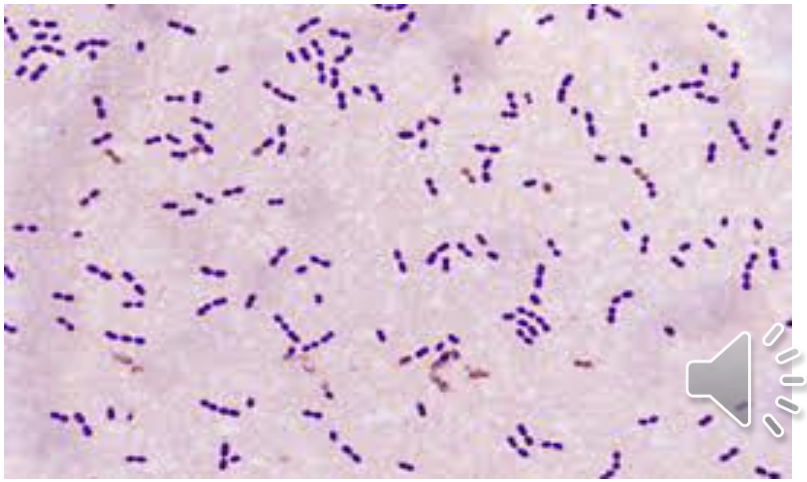
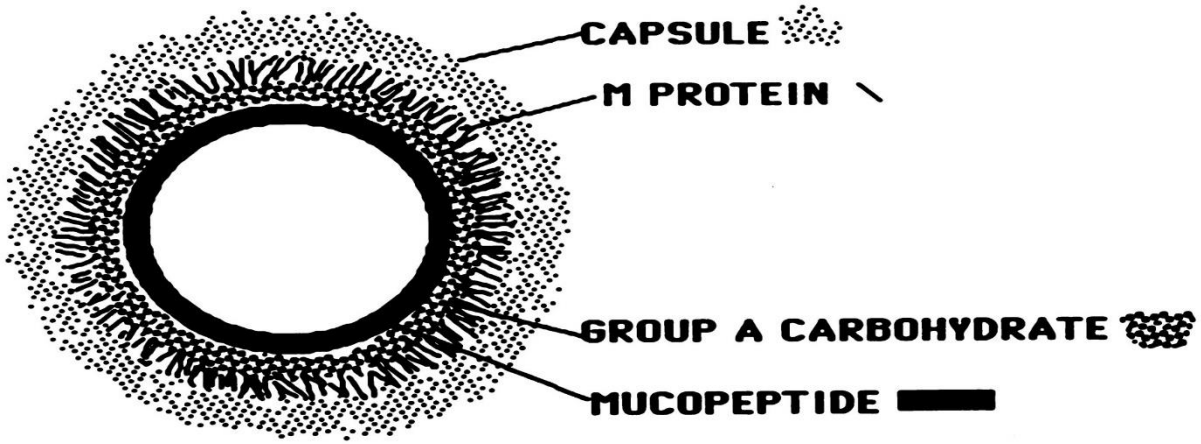
General Characteristics

- One of the important pyogenic cocci
- Gram positive
- Coccus = sphere (spherical or ovoid cells)
- Arranged pairs, in short or long chains
- Non motile
- Non sporing
- Catalase negative



General Characteristics

- Capsules polysaccharide developed in some species.
- In group A streptococci, pili (like hair) appear through the capsule partially consist from M protein and covered with lipoteichoic acid



General Characteristics

- Better growth on enriched media (blood agar)
- Fastidious Microorganisms
- Some are commensals in the upper respiratory tract and intestinal tracts.
- Most species are facultative anaerobes.
- One group are obligate anaerobes

General Characteristics

- Chain formation result is a connecting link between the cocci probably composed of material link the cell wall, is retained the cell division. These inter cellular bridges are not easily broken.

General Characteristics

- Chains do not elongate indefinitely, because in some cases streptococci produce a dechaining enzyme.
- The majority of strains in group-A are encapsulated and capsular material consists of hyaluronic acid.

Scientific classification

According to Rosenbach 1884

Kingdom: Bacteria

Phylum: Firmicutes

Class: Bacilli

Order: Lactobacillales

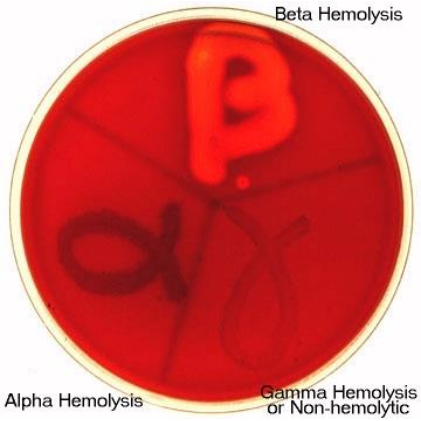
Family: Streptococcaceae

Genus: Streptococcus

Classification

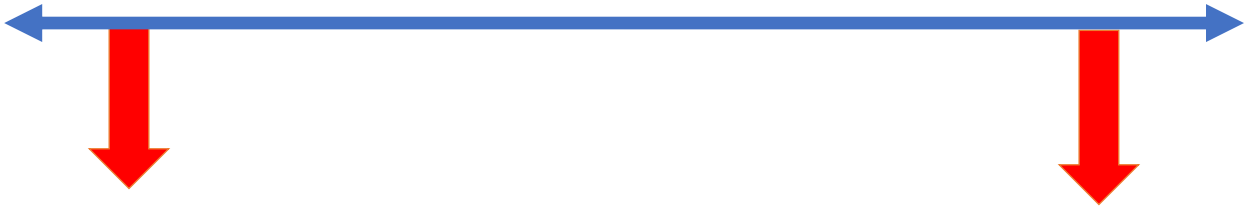
Classification of bacteria depend on the activities:

- Haemolysis patterns
- Rebecca lancefield: A…H, K…V
- Biochemical reactions
- Resistant to chemical factors
- Growth characteristics
- Genetic studies



Classification of streptococci

Based on O2



Aerobic and facultative anaerobes

Obligate anaerobes

Classification of streptococci

Aerobic and facultative anaerobes

Obligate anaerobes

With soluble haemolysin

without soluble haemolysin

Peptostreptococcus
Gamma haemolyic
No haemolysis

Beta-haemolytic streptococcus

Alpha hemolysis

Serological grouping on the basis Of group specific carbohydrate-C Of Lancefield classification.

S. Viridans
S. pneumoniae

The enterococcus group Classified into (4) Species by physiological, and biochemical properties

21 Lancefield groups

Classified into (5) Species by physiological and biochemical properties

Group A- Streptococcus pyogenes

Str. Salivarus
Str. Mutans
Str. Sangius
Str. Mitior
Str. Milleri

Enterococcus faecalis
Enterococcu durans
Enterococcu faecium

On the basis of Griffith serological Typing based on M-protein farther Classified into Over (60) serotypes.

Cultural characters

- The majority are aerobes and facultative anaerobes.
- the optimum temperature for growth is 37C. Fastidious bacteria grow on medium containing blood or serum.
- on serum broth or glucose broth after 24hrs granular growth is obtained and the medium remains clear with granules or powdery deposit.

Blood agar

- This is the medium of choice, and after 24hr the colonies are circular, translucent, low convex.
- Showing β-haemolysis (complete haemolysis) on fresh blood agar medium.
- The bacteria require about 15 amino acids and almost all the known types of the vitamin B complex are needed.

- Human blood is inferior to both horse and sheep blood in media for the identification of streptococci.
- The β-haemolysis produced by pyogenic streptococcus on blood agar plates incubated aerobically is usually due to the action of an oxygen stable S-haemolysin .
- by anaerobic incubation is due to additional action of the oxygen labile O-haemolysin.

- **Streptococci may produce a haemolysin but may not cause β-haemolysis.**
- ***Streptococcus pneumoniae* which causes greening broth aerobically and anaerobically, forms an oxygen sensitive haemolysin.**
- **The mucoid character of some strains is associated with the production of hyaluronic acid capsules.**

Biochemical reactions

- **Streptococci are catalase negative with the Possible exception of Peptostreptococcus and a few strains of group-D streptococcus.**

Antigenic structure

Antigenic structure of group-A streptococcus comprise of:

1. Capsular type hyaluronic acid
2. Cell wall proteins

- M protein

Also it is an important virulence factor, as this antigen inhibits phagocytosis. On the basis of M-protein, group A streptococcus has been classified into approximately 60 different antigenic types. M-proteins are firmly attached to the cell surface.

- T protein

T-antigens may frequently occur along with M-antigens

Antigenic structure

- **Other surface protein antigens.**
- **R protein (participate in agglutination reactions)**
- **F protein**
- **G protein**
- **P substances (body of streptococcus)**

Antigenic structure

3. Cell wall carbohydrate-c

- Lancefield classified the streptococcus into serological groups
- Group A: rhamnose-N-acetylglucosamine.

  S. pyogenes
- Group B: rhamnose glucosamine

  S. agalactiae

4. Cell wall peptidoglycan

5. Cytoplasmic membrane antigens

Toxin and enzyme

More than 20 extra cellular product which are antigenic are elaborated by group A-streptococci, the important toxins and enzymes formed by Streptococcus pyogenes are:

1- Haemolysins

- Streptolysin-S
- Streptolysin-O

2- Erythrogenic toxin or Pyrogenic Toxin

3- Toxic shock syndrome toxin

Toxin and enzyme

4- Streptokinase

5- Diphosphopyridine nucleotidase (DPN-ase)

6- Hyaluronidase

7- Deoxyribonuclease

8- Streptococcal proteinase

9- Amylase

10- Streptococcal opacity factor

Streptolysin -S

- Is responsible for the zones of haemolysis which surrounded colonies of Streptococcus pyogenes on the surface of blood agar plates.

- "S" refers to serum soluble due to the fact their haemolysin appears to be extracted from living streptococci which they are shaken with serum.

- It is oxygen stable and sensitive to heat and acid.

- Streptolysin-S is cell bound and its release from the cell depends on its association with some carrier molecules such as
- serum albumin
- ribonucleic acid
- It is not antigenic and no antibodies are formed .

Streptolysin -O

- Oxygen labile and produced in serum free broth.
- Under aerobic conditions it fails to produce haemolytic zone around colonies of streptococcus, but haemolysin is produced under reducing conditions such as
- Deep colonies in Pour plate technique
- Aanaerobic culture
- All strains of group-A streptococci produce streptolysin-O.
- Streptolysin-O is protein in nature and is strongly antigenic.

- Antibody to it is found in the sera of many patients following streptococcal infection.
- Antibody is known antistreptolysin.
- Antistreptolysin-O (ASO) titer of 200 or more is generally considered to be signal of recent infection.
- Measurement of serum antistreptolysin-O has become widely used as a test for establishing the occurrence of recent streptococcal infection.
- Streptolysin-O is toxin for leucocytes and has cardiotoxicity

Erythrogenic toxin or pyrogenic toxin

- It is a protein, antigenic, relatively heat stable but destroyed by boiling for one hour.
- This toxin is responsible for characteristic skin rash with pharyngitis and tonsillitis in scarlet fever
- It is also known as Dick toxin.
- Dick test use to confirm scarlet fever by pyrogenic toxin (super antigen) which cause toxic shock syndrome

Streptokinase

- It is known as streptococcal fibrinolysin. It transforming the plasminogen of human plasma into plasmin
- Active proteolytic enzyme which digests fibrin and other proteins.

Diphosphopyridine nucleotidase

It is antigenic and associated with leucotoxicity and thus produces destruction of leucocytes.

Hyaluronidase (spreading factor)

It is an enzyme which splits hyaluronic acid, an important component of the ground substance of connective tissue.

Deoxyribonuclease

It is an enzyme which cause depolymerization of DNA.

Streptococcal proteinase

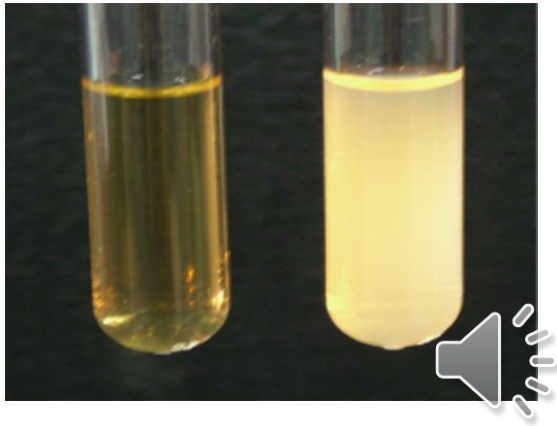
Tissue damage in the course of streptococcal infection. Some believe that it is capable of breaking down the M-protein on which the virulence of the organisms depends and thus might contribute to the patients recovery.

Amylase

This enzyme hydrolyses glycogen, amyloprotein and starch.

Streptococcal opacity factor (OF)

It is an alpha-lipoproteinase produced by certain serotypes which rise to opacity in serum broth.



Pathogenesis

A) Acute infections: suppurative disease

I- Tonsillitis (inflammation of the throat)

2- Pharyngitis

3- Otitis media

4- Necrotizing fasciitis

Pathogenesis

5- Meningitis

6- Paranasal sinusitis

7- Pneumonia

8- Cellulitis

9- Erysipelas

10- Impetigo

11- Puerperal fever

12- Septicemia

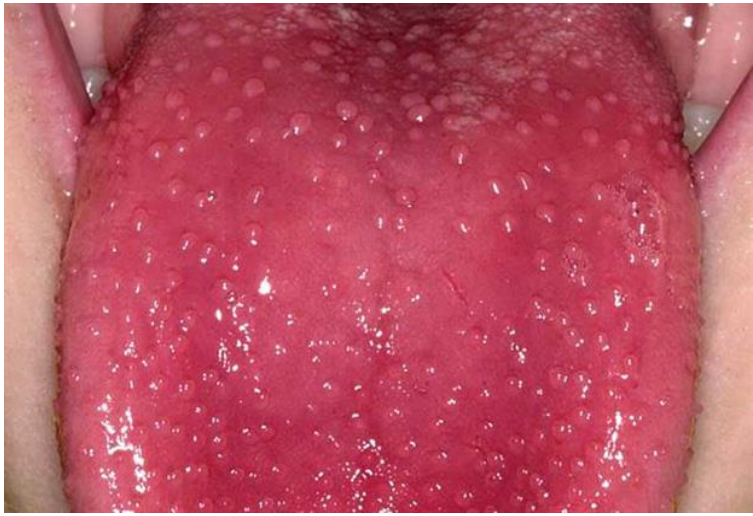
B) Non suppurative diseases:

1- Scarlet fever (strawberry tongue)

2- Rheumatic fever.

3- Acute glomerulonephritis.

4- Erythema nodosum



Laboratory diagnosis

The specimens to be obtained for the diagnosis depends on the nature of streptococcal infection.

A) Acute pyogenic infection

- By demonstrating the causative organism.
- The morbid material depends on the site of the lesion. It may be throat swab, pus swab, CSF, blood.
- The morbid material may be subjected to the following examination.

1- Smear examination

Laboratory diagnosis

2- Cultural examination

- Blood agar is the medium of choice for the growth of haemolytic streptococcus
- Special medium for the isolation of streptococci is crystal violet blood agar, contains $1/10^6$ concentration of crystal violet.
- Aerobic and anaerobic incubation may be done, depending on the site of the lesion.

Laboratory diagnosis

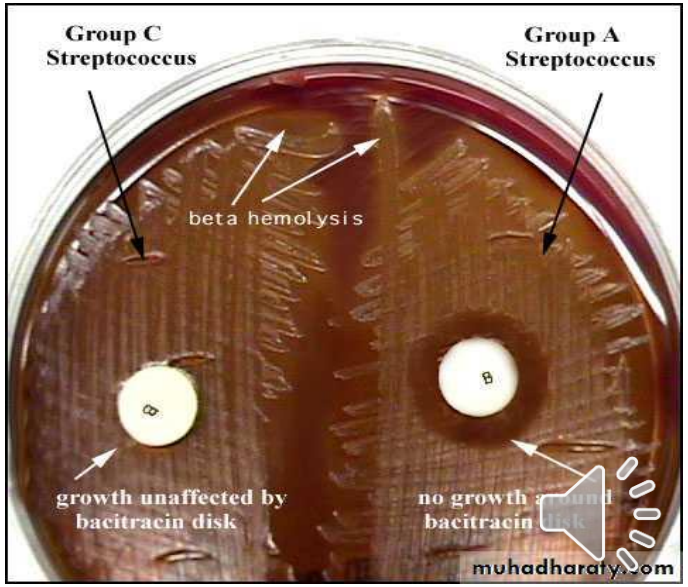
3- Fluorescent antibody technique

- For the most rapid identification of group A streptococci in clinical disease.
- Smear from serum broth culture of throat swab 2-3 hours old, may be stained with group A specific antibody conjugated with fluorescent dye.

Laboratory diagnosis

4- Bacitracin sensitivity

- A disc impregnated with 0.1 unit of bacitracin is placed on the surface of a heavily inoculated blood agar culture plate.
- To ensure rapid recognition of group A strains which are sensitive to this antibiotic .



Laboratory diagnosis

5- Serotyping of streptococci

- Is of academic interest and a research tool which can be only carried out in laboratories well equipped with different antisera.

Laboratory diagnosis

B) In non supportive diseases:

- In rheumatic fever and acute glomerulonephritis, the diagnosis of streptococcal infection may be established by demonstrating high levels of antibody to streptococcal toxins.
- The most frequent and widely employed test is antistreptolysin-O titer (A.S.O.T.).
- Higher levels are generally found in rheumatic fever than in acute glomerulonephritis“

Group B streptococci:

- They found in oral cavity, intestinal tract and vagina.
- S. agalactiae encapsulated streptococci
- Beta haemolytic, Facultative anaerobes
- Found in 25% in pregnancy women
- Causes neonatal meningitis, neonatal sepsis, neonatal pneumonia, UTI, puerperal fever

Group D streptococci:

- Gamma haemolytic on sheep blood agar
- Intestinal origin
- Enterococcus faecalis

Chemotherapy or treatment

Penicillin with streptomycin is the treatment of choice in most cases of severe streptococcal infections.


Thank you