



**Infectious Disease Epidemiology Section**  
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## **STREPTOCOCCAL INFECTIONS**

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Streptococci are a large group of gram positive cocci including some important agents of human disease, colonizers in the human flora, agents of animal diseases and strains which have been domesticated and used for the culture of buttermilk, yogurt and cheeses. Those known to cause human disease are in 2 broad categories:

- First are the pyogenic streptococci, including the familiar  $\beta$  hemolytic streptococci and the pneumococcus (*Streptococcus pneumoniae*). These organisms are less often part of the normal flora but cause acute, often severe, infections in normal hosts
- Second are the more diverse enteric and oral streptococci, which are nearly always part of the normal flora and which are more frequently associated with opportunistic infections.

Measured in terms of mortality, morbidity, and economic costs, streptococcal species are of major importance in human health.

- Group A streptococcus, *Streptococcus pyogenes*, produces a wide range of infections:
  - pharyngitis
  - impetigo
  - puerperal sepsis
  - erysipelas

Their non-suppurative sequelae include

- acute rheumatic fever
  - acute glomerulonephritis
- Group B streptococcus, *Streptococcus agalactiae*:
    - normal flora of the female genital tract
    - sepsis in newborn
    - postpartum infections in mothers
  - Group C and G:
    - pharyngitis
    - bacteremia
    - endocarditis
  - Group D, non enterococcal streptococci,:
    - normal enteric flora
    - occasional bacteremia, endocarditis
  - Pneumococcus, *S. pneumoniae*:
    - Most frequent cause of bacterial pneumonia in all age groups
    - Otitis media
    - Bacteremia
    - Meningitis

## Basic Bacteriology:

Streptococci are gram positive cocci. They appear in short twisted chain (hence their name).

### Antigenic structure

Capsule of hyaluronic acid	
<b>Cell Wall</b>	Cell wall protein antigen: M, T and R
	Group specific carbohydrate: Lancefield A to U
	Mucopetide
Cytoplasmic membrane	
Cytoplasm	

Group polysaccharide: They have a tough cell wall associated with polysaccharide (carbohydrate) group antigen. The Lancefield serotypes A-H and K-U are based on a cell wall carbohydrate. Typing is usually done only for groups A, B, C and G for which there are simple agglutinating antibodies

M protein: Some GAS produce a lot of M protein, the colonies are **matt**, they are virulent and fairly insusceptible to phagocytosis by human leukocytes. The M protein is a virulence factor that impairs phagocytosis. Immunity to infection with GAS is related to the presence of anti-M antibodies. There are more than 80 types of M protein. A person may have repeated infections with GAS provided they are from different M types. M proteins have also been found on group G, and group C has a protein homologous to the M protein.

A component of the cell wall of selected type M induces antibodies that react with cardiac muscle tissue and may play a role in the genesis of rheumatic fever.

Some GAS produce relatively little M protein, the colonies are **glossy**, they are much less virulent.

T & R proteins: have no relation with virulence. T protein has been used in epidemiologic investigations since there are specific antibodies.

### Toxins & Enzymes

GAS produce more than 20 extracellular products:

- Streptokinase (Fibrinolysin): produced by all  $\beta$  hemolytic strains. It transforms human plasminogen into plasmin, a potent proteolytic enzyme that digests fibrin (blood clots). Streptokinase is administered IV for treatment of coronary artery thrombosis (heart attack).
- Streptodornase: a deoxyribonuclease that uncoils (depolymerases) DNA molecules.
- Hyaluronidase: splits hyaluronic acid, an important component of connective tissue. It helps in the spread of GAS through the tissues. Hyaluronidases are antigenic and specific.
- Pyrogenic exotoxins: There are 3 pyrogenic (capable of inducing fever) exotoxins.
- Exotoxin A is produced by GAS carrying a lysogenic phage
- Exotoxin B with unclear role
- Exotoxin C may contribute to TSS

The exotoxins have been associated with streptococcal toxic shock syndrome and scarlet fever. Most GAS associated with TSS either produce exotoxin A or have the gene for exotoxin A while only 15% of GAS from other patients have exotoxin A gene.

- Diphosphopyridine nucleotidase: provides GAS the ability to kill leukocytes
- Hemolysins: Complete destruction of hemoglobin is called hemolysis  $\beta$ , incomplete lysis is  $\alpha$  hemolysis.
- Streptolysin: of interest because of the antibody induced by it. Anti-streptolysin O can be titered, a high titer meaning a recent infection.

- Streptolysin S: is elaborated in the presence of serum (S), responsible for the hemolysis seen on agar plates. It is not antigenic.