Streptococci

G^+ spherical bacteria forming pairs or chains during growth. They are widely distributed in the nature. Facultative anaerobes, catalase negative, non-spore forming. Some are members of the normal human flora. Others are associated with important human diseases.

Culture characteristics:

Most streptococci grow on solid media as descoid colonies, usually 1-2 mm in diameter. Strains that produce capsule give rise to mucoid colonies. Most strptococci are facultative anaerobes. Growth and hemolysis is aided by incubation at 10% CO_2 . Most pathogenic streptococci grow at 37 ^{0}C. Group D enterococci grow well at 15-45 ^{0}C. Enterococci also can grow at 6.5% Nacl.

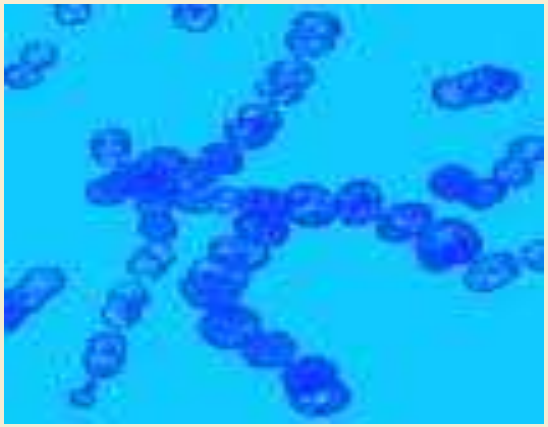
Different streptococci produce different colony forms:

B-hemolytic sreptococci produce matte, glossy, mucoid , translucent colonies (*S. pyogenes, S. agalactiae, S.dysagalactiae)*

Non-B- hemolytic streptococci produce small, mucoid, some are discoid (*S. pneumoniae*)

Non-hemolytic streptococci produce entire, circular, convex colonies (Enterococci)

Sreptococci



Colony morphology of streptococci, alpha & beta hemolysis

Classification of streptococci

Streptococci are a heterogeneous group of bacteria that no single classification system is sufficient to classify them. So classification based on many features including:

Hemolysis:

1. alpha-hemolytic: partial or incomplete hemolysis of RBCs (e.g. *St. viridance,* pneumococci)

2.Beta-hemolytic: complete hemolysis of RBCs (e.g. *St. pyogenes*).

3. Non-hemolytic: No hemolysis of RBCs (e.g. Enterococci).

Group specific substance (Lancefield grouping): It depend on surface group-specific carbohydrate cell wall antigens.

A-H and K-V (animal pathogenic streptococci are in groups (A,B,C,D,E,G,L, & V)

Capsular polysaccharide: used in classification of pneumococci (84 types) and *St.agalactiae.*

Biochemical reactions: including sugar fermentation, presence of certain enzymes, susceptibility or resistant to certain chemical agents.

Toxins and enzymes of streptococci

More than 20 extracellular products are elaborated by group A streptococci including the followings:

*** Streptokinase (Fibrinolysin):**

It is a proteolytic enzyme that digest fibrin & other proteins produced by many strains of group A beta-hemolytic streptococci.

*** Streptodornase:**

Liquefy purulent exudates & facilitate spread of bacteria.

*** Hyalurondase:**

It split hyluronic acid which is an important component of the connective tissues, thus it aid in spread of bacteria.

***Erythrogenic toxin (Pyrogenic exotoxin):**

Produced by group A streptococci. Three antigenic types A,B, and C. The streptococcal pyrogenic exotoxin are associated with streptococcal toxic shock syndrome and scarlet fever.

***Hemolysin:**

Hemolyze RBCs in vitro in varying degree.

-Beta-hemolysis: complete hemolysis of RBCs

-Alpha-hemolysis: partial hemolysis of RBCs.

-Beta-hemolytic group A *s. pyogenes* produce two type of hemolysins, Streptolysin O and streptolysin S.

***Streptococcus pyogenes*:** are associated with different medical conditions:

Diseases attributable to B-hemolytic streptococci (*st. pyogenes*):

The portal of entry determines the principal clinical picture. There was a diffuse and rapidly spreading infection to adjacent tissues and extended along the lymphatic with minimal suppuration.

Erysipelas: massive skin inflammation and browny edema.

Cellulitis: Acute & rapidly spreading infection of the skin and subcutaneous tissues.

Puerperal fever: When *St.pyogenes* enters the uterus after delivery (Septicemia after endometritis).

Sepsis: infection of traumatic or surgical wounds.

Streptococcus pyogenes

Diseases attributable to local infection with B-hemolytic streptococci:

1. Streptococcal sore throat:

Streptococcus pyogenes

Virulent B-hemolytic streptococci adhere to pharyngeal epithelium by means of lipoteichoic acid covering pili. In infants & children sore throat occurs as a subacute nasopharyngitis with serous discharge & low grade fever with high tendency for otitis media and meningitis. In older children & adults the disease is more acute characterized by intense nasopharyngitis, tonsilitis, redness & edema of the mucous membrane with high fever (20% of cases are asymptomatic). The most similar clinical pictures are **IMN & diphtheria**. If infecting streptococci produce erythrogenic toxin Scarlet fever rash occurs. Massive peritonsilar swelling may block the air passages. Pneumonia with B-hemolytic streptococci is less common & usually following Influenza or measles viral infection.

2. Streptococcal pyoderma: Local infection of the upper layer of the skin, especially in children called impetigo which is highly communicable.

3. Infective endocarditis:

a. Acute endocarditis

b. Subacute endocarditis

Streptococcus pyogenes

Post-streptococcal diseases: usually there was a latent period of 1-4 weeks, suggested that these conditions are not attributable to disseminated bacteria rather than to a hypersensitivity response.

1. Acute glomerulonephritis:

Is more commonly following *st. pyogenes* skin infection by 3 weeks. It may be initiated by deposition of Ag-Ab complexes on the glomerular membrane. In acute nephritis there was blood & protein in urine, edema , elevated blood urea and high blood pressure. Some patients die and other may develop chronic glomerulonephritis.

2. Rheumatic fever:

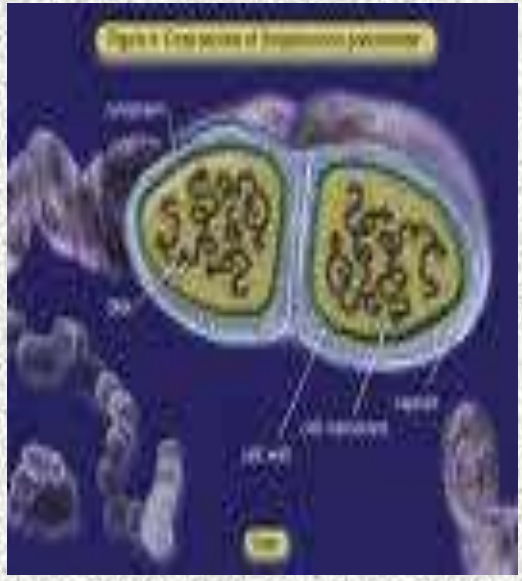
Is more common following *st. pyogenes* respiratory infection (even sometimes may be mild or undetected); However, patients with more severe sore throat have a greater chance to develop rheumatic fever. Certain strains of B-hemolytic streptococci contain cell membrane Ags cross react with heart tissues. It is a serious complication, because it results in damage to heart muscle and valves. It is more common in tropical counties. Clinically, it is characterized by fever, malaise, migratory nonsuppurative polyarthritis and evidence of inflammation of heart. ESR, Transaminases (ALT, AST), ECG & other tests are used to monitor the RF. RF has marked tendency to be reactivated by subsequent streptococcal infections whereas glomerulonephritis does not. The heart damage increase with each subsequent attack..

Laboratory diagnosis:

- Specimens: It depends on the nature of streptococcal infection, include; pus, Throat swab, blood, vaginal swab, sputum,etc.
- Direct smear: using Gram's stain, G+ cocci arranged in chains
- Culture: usually on blood agar plates or chocolate agar under 5-10% CO_2.
- Direct antigen detection test: It is a rapid agglutination test using specific antisera.
- Serological tests: e.g. Anti-streptolysin O titer (ASOT).

Streptococcus pneumoniae (Diplococcus pneumoniae) or Pneumococci

G + lancet-shape diplococci possess polysaccharide capsule. On culture, a small round colonies at first dome-shape and later develop a central plateau with an elevated rim. It produce alpha-hemolysis on blood agar. Growth is enhanced by 10% CO_2 . More than 80 antigenic types according to capsular polysaccharide.



St. pneumoniae produce no significant toxin, the virulence factor is a function of its polysccharide capsule which prevent phagocytosis by interfering with complement binding & mediating complement inactivation. The most common pathological conditions caused by *St. pneumoniae* are Pneumonia, sinusitis, otitis media, septic arthritis and meningitis.

The onset of pneumococcal pneumonia is usually sudden with fever, chills & sharp pleural pain. The sputum is similar to alveolar exudates, sometimes bloody or rusty. Early in the disease bacteremia is present in 10-20% of cases. The mortality rate may reach up to 30% depending on age and underlying illness.

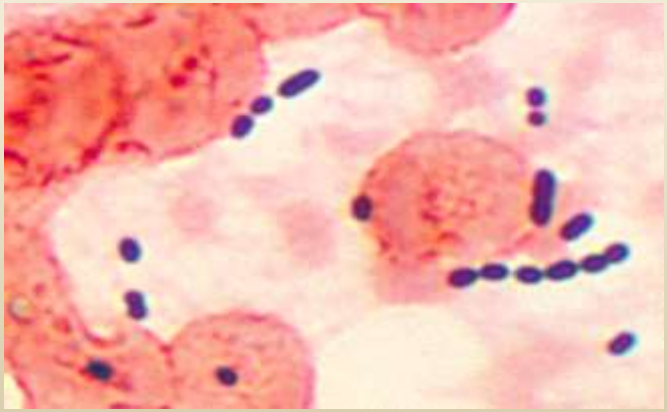
Laboratory diagnosis of pneumococci

Specimens: including sputum, blood, pus, cerebrospinal fluid.

1. Gram's stained smear: G+ diplococci
2. Capsule swelling test (Quelling reaction)
3. Culture: On blood agar or chocolate agar
4. Antigenic detection by specific antisera.

Enterococci: G+ cocci usually arranged in pair. There are at least 12 species. *St.fecalis* is the most common and causes 85-90% of enterococcal infections. It is known to cause nosocomial infections particularly among immunocompromised patients. Transmission occur through hands of health care workers & fomites. Some people carry the enterococci in their gastrointestinal tract. Enterococcal infections include urinary tract, wound infections, biliary tract and blood. Enterococci are known to develop a wide range of antibiotic resistance including vancomycin, aminoglycosides and beta-lactams due to production of beta-lactamase enzyme.

Enterococci



Colony morphology

On blood agar produce white, entire, convex colonies.

All species grow in the presence of 6.5% Nacl.

Ferment sorbitol

Bile esculin test positive