Streptococci

General characters: They are Gram positive cocci arranged in chains, non-motile and non-sporing. They require media enriched with blood, serum or ascitic fluid for their growth. They are important human pathogens causing pyogenic infection with a characteristic tendency to spread. They are also responsible for non-suppurative lesions like acute rheumatic fever and glomerulonephritis.

Classification of streptococcus: Several systems of classification have been employed:

I. Morphological classification.
II. Classification based on cultural characteristic.
III. Classification based on biochemical reactions.
IV. Classification based on antigenic structure

Lancefield groups

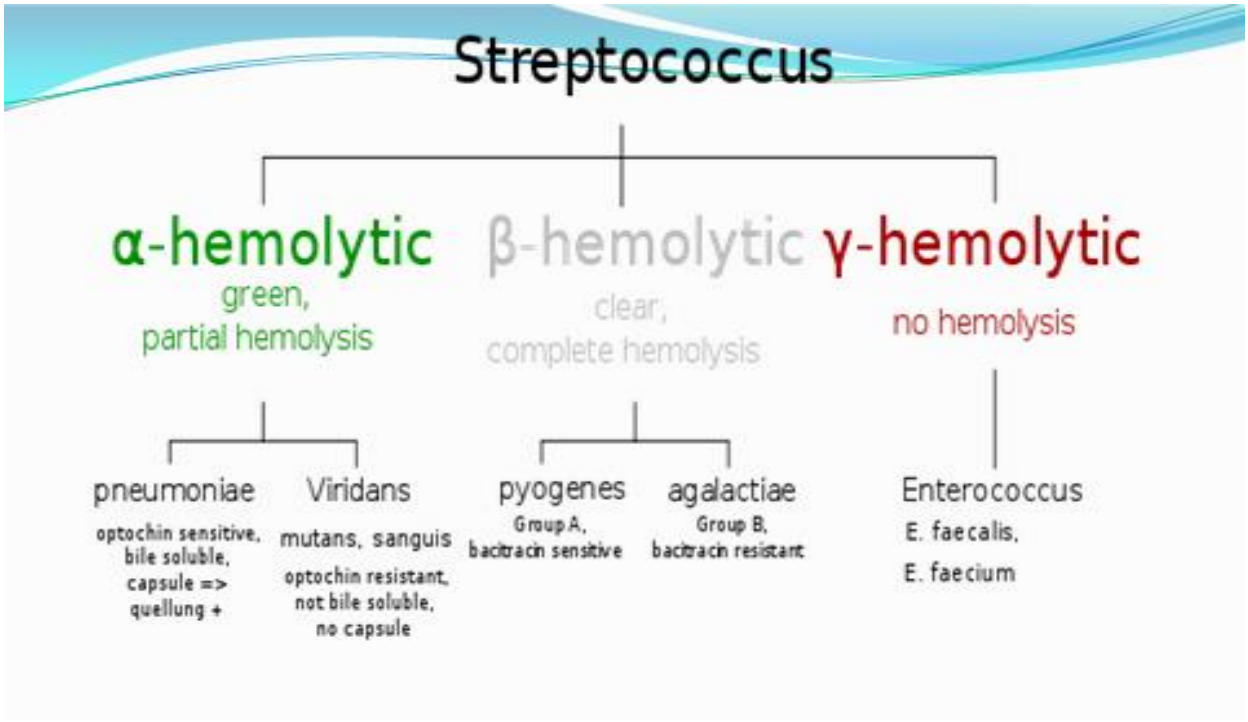
groups Th is carbohydrate is contained in the cell wall of many streptococci

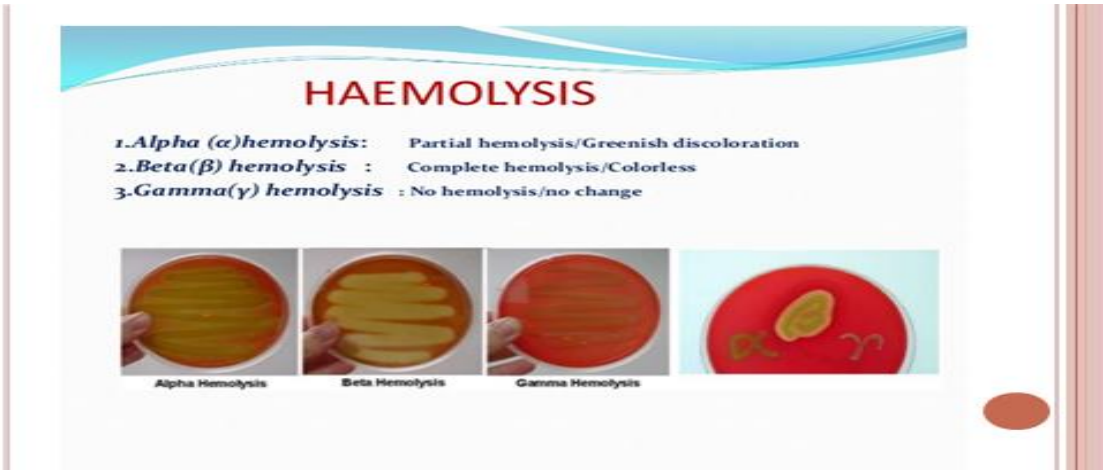
and forms the basis of serologic grouping into **Lancefi eld groups A** – **H** and **K** – **U.** Th e serologic specifi city of the groupspecifi c carbohydrate is determined by an amino sugar Th ese extracts contain the carbohydrate group-specifi c substance that yields precipitin reactions specifi c antisera. Th is permits arrangement of many streptococci into groups A–H and K–U. Typing is generally done only for groups A, B, C, F, and G (see Table 14-1), which

cause disease in humans and for which reagents are available that allow typing using simple agglutination or color reactions.

There are 20 described serotypes assigned the letters A to V (excluding E, I and . Bacteria of the genus *Enterococcus*, formerly known as group D streptococci, were classified as members of the genus *Streptococcus* until 1984 and are included in the original Lancefield grouping Many—but not all—species of streptococcus are beta-hemolytic. Notably, enterococci and *Streptococcus bovis* (Lancefield group D) are not beta-hemolytic. Though there are many groups of streptococci, the principal organisms that are known to cause human disease belong to group A (*Streptococcus pyogenes)*, group B (*Streptococcus agalactiae*), group C/G (*Streptococcus dysgalactiae)* both

members of group D (*Streptococcus gallolyticus* and *Streptococcus infantarius*, both members of the *Streptococcus bovis* group), and two alpha-haemolytic groups that lack the Lancefield carbohydrate antigen: *Streptococcus pneumoniae* and viridans streptococci.





Epidemiology

Many of these organisms are commonly found as part of the normal human microbiome of the pharynx, mouth, lower gastrointestinal (GI) tract, and vagina.

When other normal microbiota is depleted, when bacterial inoculum is increased, when virulence factors are heightened, and/or when adaptive immunity is impaired, the bacteria can cause disease.

When these organisms gain access to normally sterile sites (blood, cerebrospinal fluid [CSF], pleural fluid, peritoneal fluid, pericardial fluid, bone, joint fluids, organs, vitreous fluid, and vascular tissue), they can cause life-threatening infections.

The upper respiratory tract and skin lesions serve as a primary sites of infection and transmissions of *S. pyogenes.*

S. pyogenes can cause pharyngitis, scarlet fever, streptococcus toxic shock, puerperal fever, infection of skin, and poststreptococcal disease, and a severe invasive infection sometimes called the “flesh-eating bacteria.”

Although ***S. pneumoniae*** can be found as part of the normal upper respiratory microbiota in about half the population, if it invades the lower respiratory tract it can cause pneumonia *S. pneumoniae* causes 95% of all bacterial pneumonias. In addition,
S. pneumoniae is the leading cause of bacterial meningitis in infants, young children, and adults in the United States, followed by *Neisseria meningitidis* and *Haemophilus influenzae.* Similarly, *S. pyogenes* may be carried in the upper respiratory tract of humans; it should be deemed clinically important whenever it is encountered.

S. agalactiae **(group B)** is a common cause of pneumonia in 0- to 2-month-old patientscaused by inhalation of organisms as neonates pass down the birth canal. It can also cause meningitis and sepsis in neonates.

Pathogenesis and Spectrum of Disease

Beta-Hemolytic Streptococci

Beta-hemolytic streptococci are characterized by Lancefield groups based on carbohydrates in the cell wall. Beta-hemolytic streptococci are considered opportunistic bacteria. However, some Lancefield groups are clinically significant, such as *S. pyogenes* (group A) and *S. agalactiae* (group B). The betahemolytic group includes the large colony-forming pyogenic
strains of streptococci

Group A *S. pyogenes*, the most clinically important Lancefield group A,

produces several factors that contribute to its virulence;
it is one of the most aggressive pathogens encountered in clinical microbiology laboratories. Among these factors are

Streptolysin S is an oxygen-stable, nonimmunogenic hemolysin capable of lysing erythrocytes, leukocytes, and platelets in the presence of room air.

Streptolysin O is immunogenic, capable of lysing the same cells and cultured cells, is broken down by oxygen, and will produce hemolysis only in the absence of room air.

Streptolysin O is also inhibited by the cholesterol in skin lipids, resulting
in the absence of the development of protective antibodies associated with skin infection. The infections caused by *S. pyogenes* may be localized or systemic; other problems

Localized infections include acute pharyngitis, for which *S. pyogenes* is the most common bacterial cause, and skin infections, such as impetigo and erysipelas for more information on skin and soft tissue infections).
S. pyogenes infections are prone to progression with involvement of deeper tissues and organs, a characteristic that

has earned the designation in general publications as the "**flesh-eating bacteria.**" Such systemic infections are life threatening. In addition, even when infections remain localized,

streptococcal pyrogenic exotoxins (SPEs) may bereleased and produce scarlet fever, which occurs in association with streptococcal pharyngitis and is manifested by a rash of the face and upper trunk. The SPEs are erythrogenic toxins produced by lysogenic strains. The SPEs act as superantigens activating macrophages and T-helper and inducing the release of powerful immune mediators, including interleukin (IL)-1, IL-2, IL-6, tumor necrosis factor (TNF)-alpha, TNF-beta, interferons, and cytokines, which induce shock and organ failure. Streptococcal toxic shock syndrome, typified by multisystem involvement including renal and respiratory failure, rash, and diarrhea, is a serious disease mediated by production of potent SPE. Other complications that result from *S. pyogenes* infections are the poststreptococcal diseases rheumatic fever and acute glomerulonephritis.

Class 1M protein is associated with rheumatic fever, and class I or II is typically associated with glomerulonephritis. Rheumatic fever, which is manifested by fever, endocarditis (inflammation of heart muscle),

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Viridans streptococci

The viridans group includes a large and complex group of human streptococci that are not groupable by Lancefield serology. The viridans group of streptococci includes five groups, each containing several species. The groups include the *mutans* group, *salivarius* group, *bovis* group, *anginosus* group (previously *S. milleri* group), and *mitis* group. Organisms in the streptococcus viridan group typically demonstrate no hemolysis or alpha-hemolysis (greening) on sheep blood agar and smell like butterscotch, especially on chocolate agar. .

Viridan streptococci are not highly invasive; however, they enter tissue during dental or surgical procedures, which could lead to tooth abscesses, abdominal infections, bacteremia, or valve endocarditis and late-onset prosthetic valve endocarditis.

Prevention

A single-dose, 23-valent vaccine (Pneumovax, Merck & Co., Inc., West Point, PA) to prevent infection by the most common serotypes of *S. pneumoniae* is available in the United States. CDC recommends pneumococcal conjugate vaccine (PCV13) for all children younger than 5 years old, all adults 65 years or older, and people 6 years or older with risk factors.

Pneumococcal polysaccharide vaccine (PPSV23) is recommended for all adults 65 years or older and adults 19 years or older with medical conditions that put them at high risk for pneumococcal pneumonia. Vaccination is recommended for children 2 years and older with medical conditions such as sickle cell disease, diabetes, cochlear implants, damaged spleen, cerebrospinal fluid leaks, diseases that affect the immune system, or chronic heart or lung failure and for individuals older than 65 years. The vaccine is not effective in children younger than 2 years of age. The serotypes included in this vaccine account for the majorityof cases of bacteremia, meningitis, and otitis media in children younger than 6 years of age. Lifetime chemoprophylaxis with penicillin, given either monthly (intramuscular administration) or daily (oral administration), is recommended for patients with rheumatic heart disease to prevent the development of bacterial endocarditis on a damaged heart valve. Likewise, penicillin may be indicated to control outbreaks of *S. pyogenes* in individuals in close physical contact, such as in households, military populations, or newborn