# Bacteria

# Gram positive

| Name | Shape | Motility | Features | Structure | Location | Examples | Note |
|---|---|---|---|---|---|---|---|
| Staphylococci | Spherical Irregular cluster (grape ) | Not | Catalase (+) | Peptidoglycan:<br>-activate immune system + complement<br>-chemoattractant For PMN<br>-(endotoxin-like activity<br>Adhesion :<br>MSCRAMM<br>Virulence :<br>Protein A + clumping factor<br>- teichoic acid :<br>Act as antigen | Found in clothing, bed linens, and other fomites | Staphylococcus<br>-aureus<br>-epidermidis<br>-lugdunensis<br>-saprophyticus | |
| Staphylococcus aureus | Spherical Irregular cluster (grape | Not | Coagulase (+)<br><br>Pigment: gray to deep golden yellow colonies<br><br>has different hemolytic activity | Has the clumping factor A :<br>FIBRONEGIEN – binding protein which coat the surface of bacteria with it to complicate the recognition process | Anterior nares<br>( nasal carriage) | Methicillin-resistant Staphylococcus aureus (MRSA) :<br>People with compromised immune systems are More susceptible | Higher incidence in the hospitalized patients, medical personnel ‘ eczematous skin diseases. |
| Staphylococcus epidermidis | Spherical Irregular cluster (grape | Not | Coagulase (-)<br><br>Pigment: gray to white | | Normal microbiota found in the skin and in the GI | | |

# Clinical cases

## Staphylococci / Clinical correlations

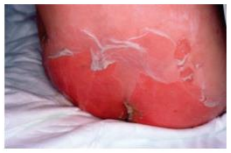
A localized staphylococcal infection appears as a **"pimple," hair follicle infection, or abscess**. There is usually an intense, localized, painful inflammatory reaction that undergoes central suppuration and heals quickly when the pus is drained.

**Impetigo:** localized cutaneous infection characterized by pus-filled vesicle on an erythematous base
**Folliculitis:** impetigo involving hair follicles
**Furuncles or boils:** large, painful, pus-filled cutaneous nodules
**Carbuncles:** Coalescence of furuncles with extension into subcutaneous tissues and evidence of systemic disease (fever, chills, bacteremia)

## Staphylococci / Clinical correlations / Toxin mediated

- Staphylococcal food poisoning, one of the most common foodborne illnesses, is an **intoxication** rather than an infection, Disease is caused by **heat stable bacterial toxin** present in food rather than from a direct effect of the organisms on the patient. With a **short incubation period (1–8 hours**); violent nausea, vomiting, and diarrhea; and **rapid convalescence**.
- **Staphylococcal scalded skin syndrome** is a condition which predominantly affects **infants** and **children** and causes a spectrum of skin lesions.

**Toxin-Mediated Diseases**
**Scalded skin syndrome:** Disseminated desquamation of epithelium in infants; blisters with no organisms or leukocytes
**Food poisoning:** After consumption of food contaminated with heat-stable enterotoxin, rapid onset of severe vomiting, diarrhea, and abdominal cramping, with resolution within 24 hours
**Toxic shock:** multisystem intoxication characterized initially by fever, hypotension, and a diffuse, macular, erythematous rash; high mortality without prompt antibiotic therapy and elimination of the focus of infection



## Staphylococci / Clinical correlations / Coagulase negative

- ***S epidermidis*** infections are difficult to cure because they occur in **prosthetic devices** where the bacteria can sequester themselves in a **biofilm**. staphylococci are a major cause of **endocarditis of artificial valves.**
- More than 50% of all infections of **catheters and shunts** are caused by **coagulase-negative staphylococci**. These infections have become a major medical problem because long-dwelling catheters and shunts are used commonly for the medical management of critically ill patients.

**Coagulase-Negative *Staphylococcus* Species**
**Wound infections:** Characterized by erythema and pus at the site of a traumatic or surgical wound; infections with foreign bodies can be caused by *S. aureus* and coagulase-negative staphylococci
**Urinary tract infections:** Dysuria and pyuria in young sexually active women (*S. saprophyticus*), in patients with urinary catheters (other coagulase-negative staphylococci), or following seeding of the urinary tract by bacteremia (*S. aureus*)
**Catheter and shunt infections:** Chronic inflammatory response to bacteria coating a catheter or shunt (most commonly with coagulase-negative staphylococci)
**Prosthetic device infections:** Chronic infection of device characterized by localized pain and mechanical failure of the device (most commonly with coagulase-negative staphylococci)

# streptococcus

streptococcus categorized depending on : 1- serologic properties (: Lancefield) 2- hemolytic activity (β,α,Y) 3- biochemical properties

| Name | Shape | motility | Feature | Structure | location | Ways of Transmission | Disease |
|---|---|---|---|---|---|---|---|
| Streptococcus pyogenes | - Spherical shape (arranged in chains | | - B hemolytic<br>- Group A<br>- produce streptococcal pyrogenic exotoxins (Spe) (erythrogenic toxins) which act as superantigens | By these structures it can avoids the phagocytes:<br>-Hyaluronic capsule:<br>Poor immunogen<br>- M protein:<br>Block the binding of c3b.<br>Other function:<br>- M protein: adhesion<br>- M+F protein : invade the epithelial cells<br>- C5 peptidase | Colonize in the oropharynx of healthy children and young adults | person to person through respiratory droplets<br><br>day-care facilities especially during winter season | Pharyngitis + pyoderma |

S. pyogenes disease is caused by recently acquired strains that can establish an infection of the pharynx or skin before specific antibodies are produced or competitive organisms are able to proliferate

Examples of the toxins :

- **Streptolysin S** is an oxygen-stable, nonimmunogenic, cell-bound hemolysin that can lyse erythrocytes, leukocytes, and platelets, and is responsible for the characteristic β-hemolysis seen on blood agar media.
- **Streptolysin O** is an oxygen-labile hemolysin capable of lysing erythrocytes, leukocytes, platelets, and cultured cells. Antibodies are readily formed against streptolysin O **(antistreptolysin O [ASO] antibodies),** and are useful for documenting recent group A streptococcal infection (**ASO test**). patients with **cutaneous infections do not develop ASO** antibodies.
- **Streptokinase** lyse blood clots and fibrin deposits and facilitate the rapid spread of *S. pyogenes* in infected tissues.
- **DNases A to D** can depolymerize free deoxyribonucleic acid (DNA) present in pus.

| Name | Example | location | Diseases | Suspectable |
|---|---|---|---|---|
| Group B streptococcus (GBS) | Streptococcus agalactiae | - lower GI tract<br>-genitourinary tract( ( 10-30%) Transient vaginal carriage) | - pneumonia<br>- bone + joint infection<br>- skin + soft tissue infection<br>- bacteremia | older and have debilitating underlying conditions |

Note: GBS detected by : 1- GBS antigen

2- resistance to bacitracin

- neonatal infection to Streptococcus agalactiae:

Early infection (7 days>)

Late infection (7days ≤)

Both are characterized by bacteremia or meningitis.

| Name | Shape | Features | Structure | location | Disease | Suspectable |
|---|---|---|---|---|---|---|
| Streptococcus pneumoniae | -Encapsulated - oval bacteria with (0.5-1.2 µm in diameter)<br>- appear as pairs ( diplococci) | - α-hemolytic by ( pneumolysin which degrade hemoglobin into green product ) | -Virulent factor : polysaccharide capsule<br>- IgA protease<br>- pneumolysin<br>- Amidase<br>-Phosphorylcholine | inhabitant of the throat and nasopharynx in healthy people | Can spread to :<br>1-lungs (pneumonia)<br>2-paranasal sinuses (sinusitis)<br>3-ears (otitis media)<br>4-meninges (meningitis) | common in children + adults living in a household with children |

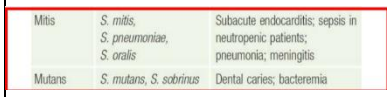
Note : The most commonly isolated serotypes are used in a polyvalent vaccine which decrease the incidence of pneumonia

Pathogenesis :

The disease happened primarily by the host response to infection rather than the production of organism-specific toxic factors

Let`s explain it :

The bacteria migrate to the lower respiratory tract " so it attached to IgA and to the mucus , but the bacteria has the IgA protease which degrade IgA , pneumolysin which destroy the ciliated epithelial cells and phagocytic cells , Amidase enhances release of the cell wall components (Teichoic acid and the peptidoglycan fragments) which can activate complement and initiate an immune response, Phosphorylcholine bind to receptors for platelet-activating factor , helps in host cell invasion , important for amidase function

| Name | Shape | Features | Location | Disase | Suspectable |
|---|---|---|---|---|---|
| Viridans | - | Variable hemolytic activity :<br>1- α-hemolytic ( green color )<br>2- non hemolytic | Oropharynx gastrointestinal tract genitourinary tract |  | |
| Enterococci | - pairs or short chains | Grow in :<br>1- aerobically and anaerobically<br>2- broad temperature range (10° C to 45° C)<br>3- wide pH range (4.6 to 9.9)<br>4- presence of high concentrations of sodium chloride (NaCl) and bile salts<br><br>- Variable hemolysis pattern.<br><br>Virulence is mediated by two general properties: (1) ability to adhere to tissues and form biofilms and (2) antibiotic resistance | E. faecalis is found in the **large intestine** in high concentrations (e.g., 10^5 to 10^7 organisms per gram of feces) and in the **genitourinary tract**<br><br>- urinary tract is the most common site of enterococcal | | -nosocomial infection frequently associated with urinary catheterization or instrumentation |

# Clinical cases

## Streptococcus pyogenes / Clinical correlations

***Streptococcus pyogenes* (Group A)**

**Suppurative Infections**

**Pharyngitis:** reddened pharynx with exudates generally present; cervical lymphadenopathy can be prominent

**Scarlet fever:** diffuse erythematous rash beginning on the chest and spreading to the extremities; complication of streptococcal pharyngitis

**Pyoderma:** localized skin infection with vesicles progressing to pustules; no evidence of systemic disease

**Erysipelas:** localized skin infection with pain, inflammation, lymph node enlargement, and systemic symptoms

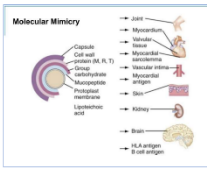
**Cellulitis:** infection of the skin that involves the subcutaneous tissues

**Necrotizing fasciitis:** deep infection of skin that involves destruction of muscle and fat layers

**Streptococcal toxic shock syndrome:** multiorgan systemic infection resembling staphylococcal toxic shock syndrome; however, most patients are bacteremic and with evidence of fasciitis

## Streptococcus pyogenes / Clinical correlations

- **Post-streptococcal glomerulonephritis (PSGN)** is an immunologically-mediated sequela of pharyngitis or skin infections caused by nephritogenic strains of Streptococcus pyogenes.
- **Rheumatic fever (RF)** is an inflammatory disease that can involve the heart, joints, skin, and brain. The disease typically develops two to four weeks after a streptococcal throat infection.




**Nonsuppurative Infections**

**Rheumatic fever:** characterized by inflammatory changes of the heart (pancarditis), joints (arthralgias to arthritis), blood vessels, and subcutaneous tissues

**Acute glomerulonephritis:** acute inflammation of the renal glomeruli with edema, hypertension, hematuria, and proteinuria