

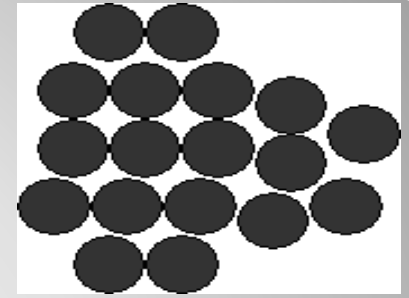
Lecture-6-

Gram-positive cocci

**Two pathogenic bacteria are G+ve B:
Staphylococci and Streptococci.**

Prof. Dr.Nada Khazal K. Hindi

1. Staphylococci:



I- General features:

- Staphylococci are G+ve cocci (spherical or grapes shape).
- Are non motile, non capsulated, non spore forming.
- Staphylococci are oxidase negative & catalase positive which one feature that distinguishes from Streptococci.
- Staphylococci are part of normal flora of human skin, nose, respiratory and gastrointestinal tracts. Are also found in air, dust and other in human environments.
- *Staphylococcus* has at least 30 spp., three spp of clinical importance are *Staphylococcus aureus* (*S. pyogenes*), *S. epidermidis* (*S. albus*), *S. saprophyticus* (*S. citrus*).

Species	Frequency of disease	Coagulase	Color of colonies	Mannitol fermentation
<i>S. aureus</i>	Common	+	Golden yellow	+
<i>S. epidermidis</i>	Common	-	White	-
<i>S. saprophyticus</i>	Occasional	-	Variable	-

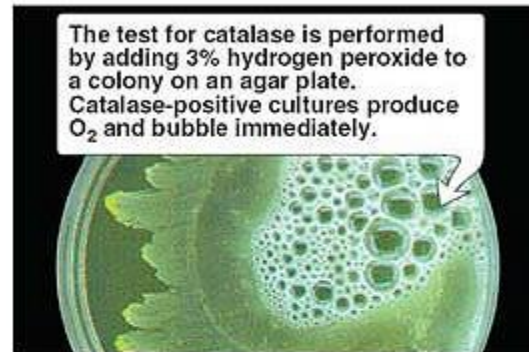
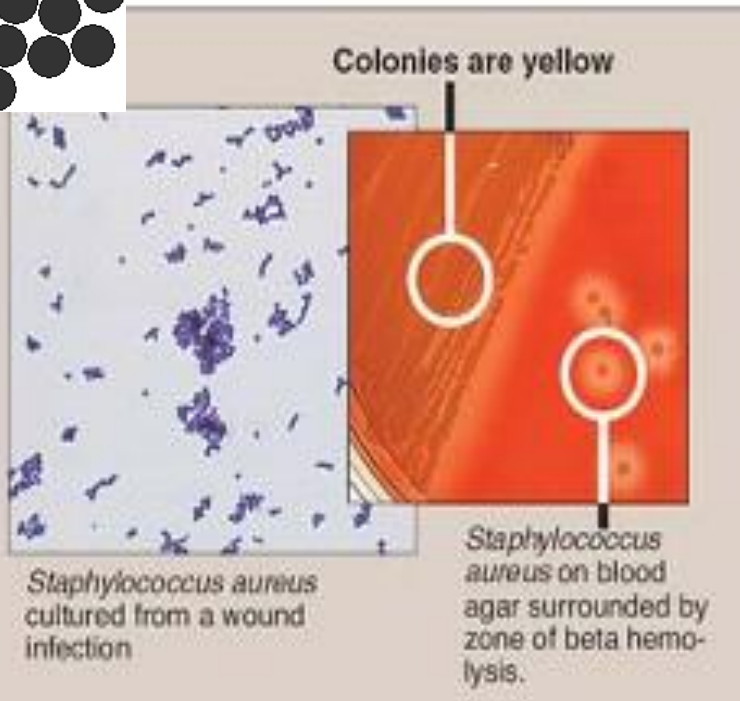
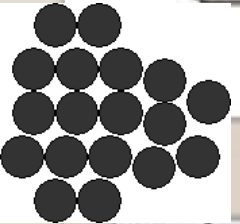


Figure 8.7 Catalase-positive culture of *Staphylococcus aureus*.

II- Transmission:

S. aureus is major pathogenic spp for human.

Transmission of bacteria from human to human by inhalation of respiratory secretion or consumption of contaminated food.

III- Pathogenicity & clinical features:

A: Pathogenesis

Pathogenic virulence factors are enable an organism to produce disease. The clinical outcome of an infection depends on the virulence of the pathogen and the opposing effectiveness of the host defense mechanisms.

Pathogenesis of *S. aureus* depends on the combined actions of several virulence factors, so it is difficult to determine precisely the role of any given factor.

S. aureus expresses many potential **virulence factors**:

- Cell wall virulence factors (Protein A and protein F).
- Cytolytic exotoxins or hemolysins (α , β , γ , δ toxin).
- Superantigen exotoxins: {Enterotoxins (six major antigenic types: A, B, C, D, E, and G) and Toxic shock syndrome toxin (TSST-1)}

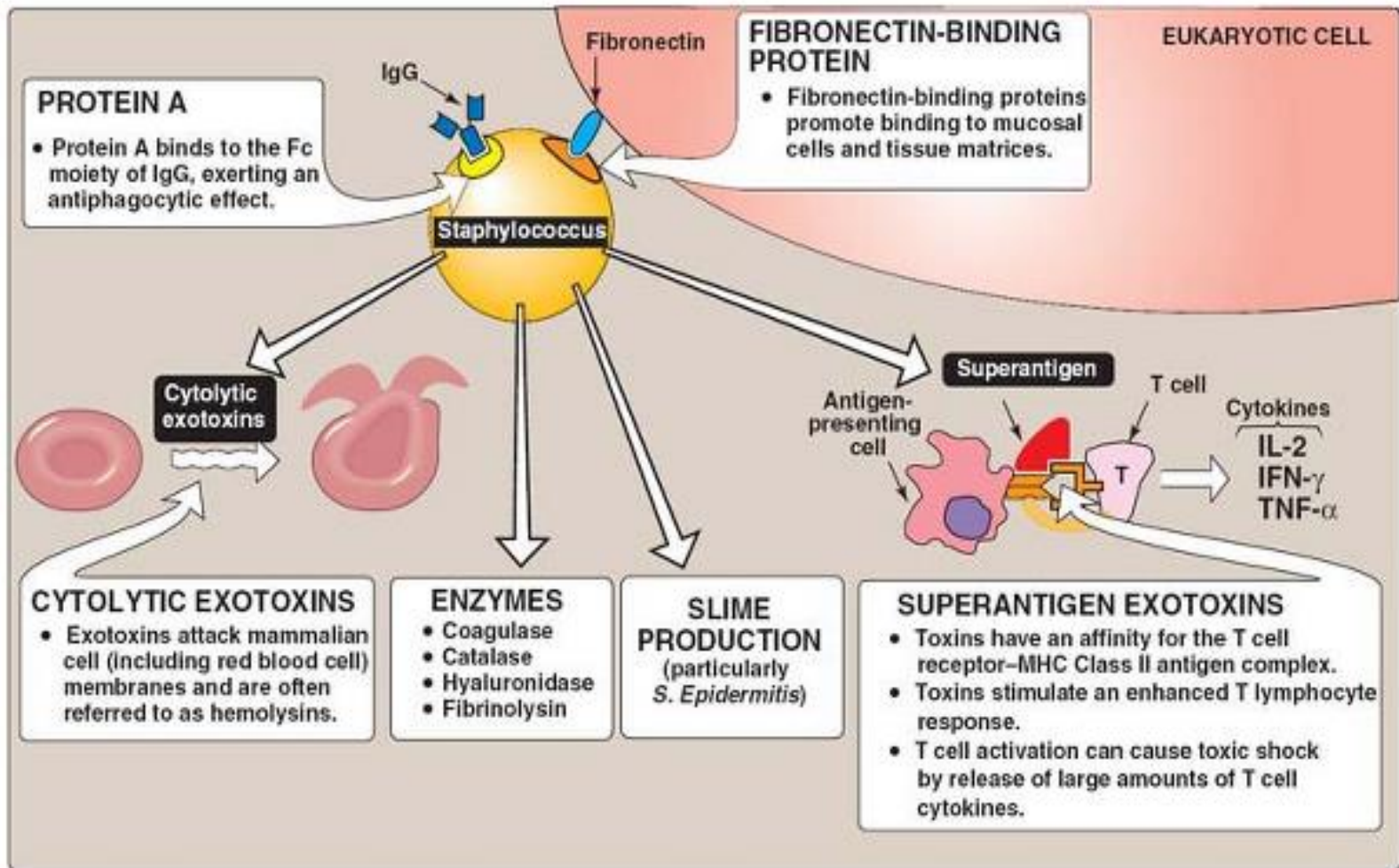


Figure 8.4 Virulence factors that may play a role in the pathogenesis of staphylococcal infections.

B: Clinical significance, Staphylococcal infections are classified as:

- **Skin infections;** such as abscess, pyoderma (impetigo), furuncles, carbuncles, styes, boils, folliculitis, cellulites, toxic shock syndrome, and scalded skin syndrom.
- **Respiratory tract infections;** such as tonsillitis, pharyngitis, sinusitis, pneumonia, and Otitis media.
- **Other infections;** endocarditis, osteomyelitis, meningitis, and nosocomial infections.
- **Food poisoning (Staphylococcal gastroenteritis)** is due to enterotoxin, which characterized by short incubation period (1-6 hr.) after consumption contaminated food. Vomiting, diarrhea, nausea, never fever are most symptoms.

Toxic shock syndrome is characterized by fever, hypotension, multisystem organ dysfunction, and an erythematous rash with desquamation occurring during convalescence.

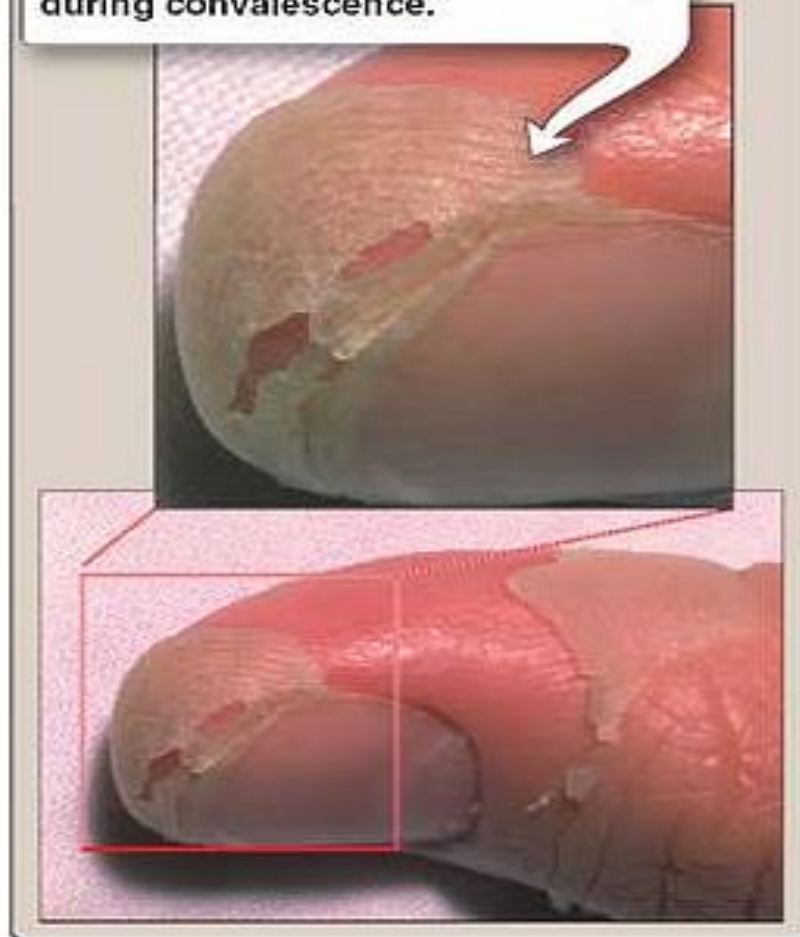


Figure 8.6 Desquamation of skin in toxic shock syndrome.



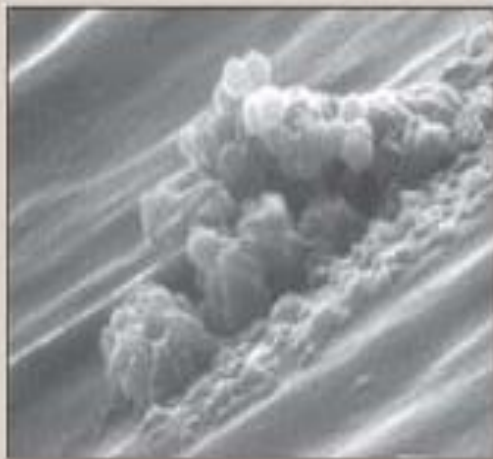
Folliculitis caused by *Staphylococcus aureus*



Carbuncle caused by *Staphylococcus aureus*



Furuncle caused by *Staphylococcus aureus*



Scanning electron micrograph of cardiac pacemaker lead colonized by *S. aureus*



Staphylococcal scalded skin syndrome



Superficial impetigo

IV- Laboratory diagnosis:

A: smear examination, stained smear shows G+ve cocci arranged in cluster.

B. culture of *S. aureus*, the sample is plated on blood agar, showing yellow colonies with Beta hemolytic. Identifications of bacteria is confirmed by catalase positive, coagulase test positive, mannitol fermentation, and grow in high concentration (7.5%) of NaCl.

V- Control

Treatment: oxacillin, vancomycin, cephalosporins, and ciprofloxacin

2. Streptococci

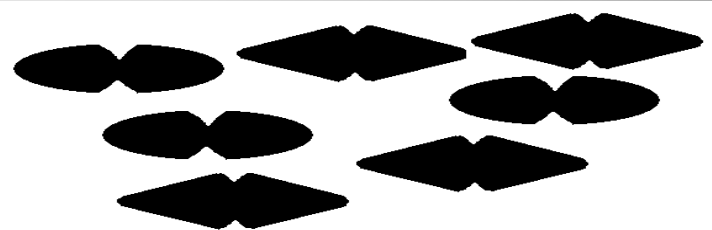


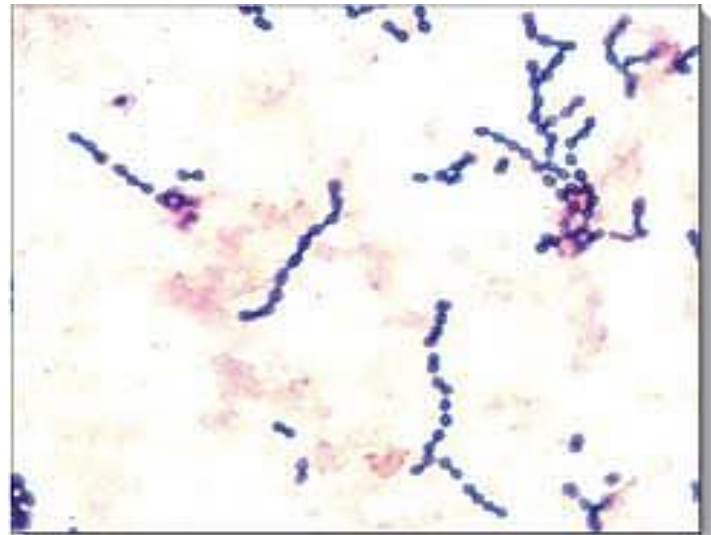
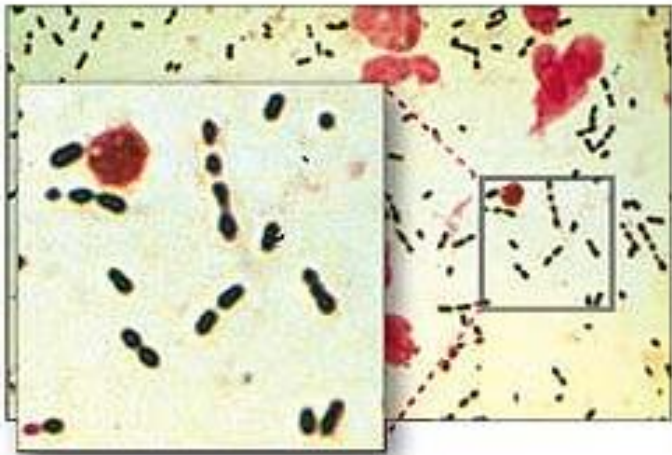
I- General features:

1. Streptococci are G+ve cocci (spherical, chain or pairs shape).
2. Are non motile, non spore forming and non capsulated (some strain have capsule).
3. Streptococci are oxidase & catalase negative which one feature that distinguishes the Streptococci from Staphylococci.
4. Streptococci are member of normal flora skin, respiratory tract and some are normal flora of enteric and genital tracts of human.

A streptococcus has at least 20 spp. *S. pyogenes*, and *S. pneumoniae* are clinical

Importance for human.



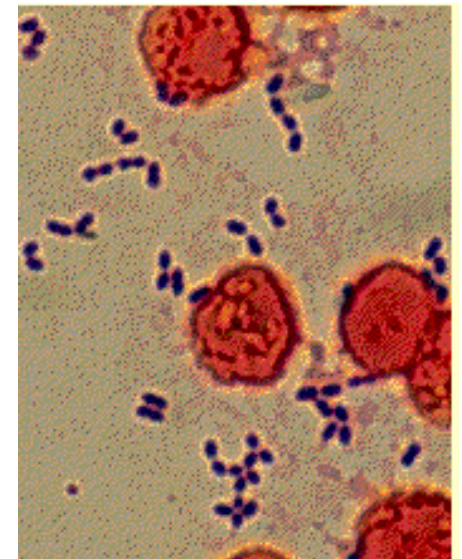


This composite image illustrates different hemolytic patterns and Gram staining of streptococci. It includes two petri dishes at the top showing alpha-hemolytic and beta-hemolytic streptococci on blood agar, and three micrographs below showing alpha-hemolytic streptococci, a Gram-stained *Streptococcus pyogenes*, and beta-hemolytic streptococci.

α -Hemolytic streptococci on blood agar

Streptococcus pyogenes (Gram stain)

β -Hemolytic streptococci on blood agar



II- Transmission:

Respiratory tract infections (*S. pyogenes*) are transmitted by inhalation of respiratory droplets. Skin infection occurs after direct contact with infected individuals or contaminated fomites.

III- Pathogenicity & clinical features:

A: Pathogenesis

S. pyogenes cells, perhaps in an inhaled droplet, attach to the pharyngeal mucosa via actions of protein F and M protein. The bacteria may simply colonize. Alternatively, bacteria may grow and secrete toxins, causing damage to surrounding cells, invading the mucosa, and eliciting an inflammatory response with attendant influx of white cells, fluid leakage, and pus formation. The patient then has streptococcal pharyngitis.

Occasionally, there is sufficient spread that the bloodstream is significantly invaded, possibly resulting in septicemia and/or seeding of distant sites, where cellulitis (acute inflammation of subcutaneous tissue), fasciitis (inflammation of the tissue under the skin that covers a surface of underlying tissue), or myonecrosis (death of muscle cells) may develop rapidly or insidiously.

S. pyogenes expresses many potential **virulence factors**:

- Capsule (hyaluronic acid).
- Cell wall virulence factors (Protein M, and protein F).
- Extracellular products; hemolysins or (streptolysin O, S), streptokinase, streptodornases, and hyaluronidase.
- Superantigen exotoxins: { Streptococcal shock syndrome toxin (SSST) }

B: Clinical features Streptococcal infections are classified as:

1. pyogenic infections (skin & respiratory tract infection)

- **Skin infections;**

A: Erysipelas: red area has rapid spread to give a butterfly distribution with blister on skin of face.

B: Puerperal sepsis: this infection is following the delivery of newborn.

C: Cellulitis: erythema, swelling, pain lesion of skin and subcutaneous tissues. The infection is associated with burns, wound or surgical incisions.

Respiratory tract infection;

A: Sore throat (tonsillitis) after incubation periods (1-3 days), or it may invade pharynx and cause pharyngitis.

B: It may cause severe **pneumonia** with fever and cough.

Toxigenic infections:

A: Scarlet fever; it is caused by ethrogenic toxin; the lesion is associated with pharyngitis or skin or soft tissues infection. The lesion is characterized by fever, vomiting, rash, peeling of skin, and straw berry tongue. The rash appears on trunk after 24hr. of illness.

Immunogenic disorder; the infections occur after (1-3 weeks) from acute infections.

A: Rheumatic fever (RF): is occurs after upper respiratory tract infection (URTI) with sore throat not after skin infection. RF is caused by autoantibodies that react with heart muscle due to similarity in structure.

B: Acute Glumerulonephritis (AGN); is one of most common complications of URTI and skin infection. AGN is immune complex disease, which lead damage of kidney.



Facial erysipelas



Impetigo



Streptococcal pharyngitis

1

Day 0: Right lower leg was edematous with an erythematous area below the knee.



2

Day 2: Initial debridement revealed necrotic tissue with many layers of thrombosed blood vessels.



3

Day 6: Radical debridement was performed because the infectious process was progressing toward the knee. Subsequent skin grafts (not shown) took well and the wound healed without complications.



IV- Laboratory diagnosis:

A: Microscopic smear: smear shows G+ve cocci arranged in chains or pairs.

B. culture of *S. pyogenes*, the sample is plated on blood agar, showing small colonies with Beta hemolytic. Identifications of *S. pyogenes* is confirmed by Bacitracin sensitivity test.

C: Serological test: are a rise in titer of antibodies against group A streptococci can be estimated such as antistreptolysin-O (ASO), if ASO titer in streptococci serum is excess of 160-200 units is indicate streptococcal infection especially RF.

V- Control

1. Treatment: penicillin G, aminoglycoside, erythromycin and ciprofloxacin. Antimicrobial drug have no effect on AGN and RF.