MEDICAL MICROBIOLOGY

LEC. 6
GRAM-POSITIVE COCCI
STAPHYLOCOCCUS

By:

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Movie 1

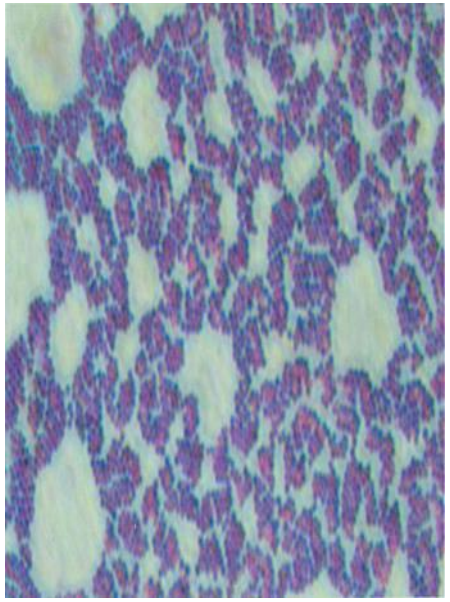
Classification

- **Family** **Micrococcaceae**
- **Genus** ***Micrococcus and Staphylococcus***
- **Species**
  - ***S. aureus***
  - ***S. saprophyticus***
  - ***S. epidermidis***
  - ***M. luteus***

more than 30 species

Staphylococci

- **Morphology:** Gram-positive, spherical bacteria, about 1 μm in diameter, usually arranged in grape-like irregular clusters, but single or pairs may also found, non motile, non spore-forming and occasionally capsulated.
- **Culture:** They grow readily on many types of media under aerobic or microaerophilic conditions at 37°C, and produce pigments that vary from white to golden yellow, ferment carbohydrates Colonies on solid media are entire, smooth and glistening.
- **Biochemical:** All are **catalase-positive** which can differentiate them from Streptococci which are catalase-negative.
- **Pathogenicity:** Some are normal flora of the skin and mucous membrane of human. Other causes suppuration, abscesses formation and a variety of pyogenic infections and even fatal septicemia.



- The main 3 medically important species of staphylococci are:

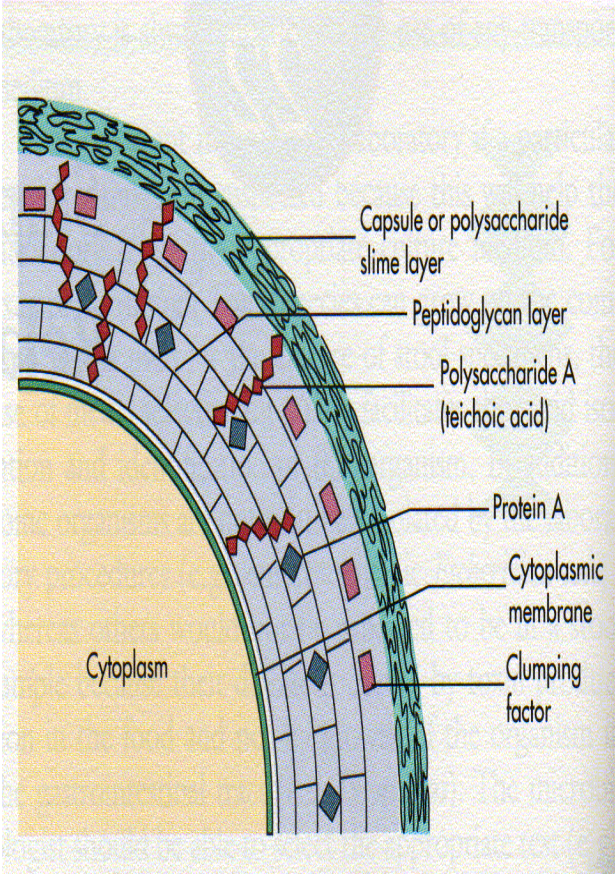
Staphylococcus aureus

Staphylococcus epidermidis (albus)

Staphylococcus saprophyticus

S. aureus is coagulase positive which differentiate them from other species.

Staphylococcus aureus



❑ ***Staphylococcus aureus:*** It is the major pathogen for human.

- **Pathogenicity :** *S. aureus* has three features that make it distinct among most other clinically important bacteria:

1. It can express a variety of virulence factors
2. It has the ability to develop and expand resistance to a broad spectrum of antimicrobial drug classes
3. Its wide distribution in human, animal and environment.

Movie 2

- **Antigenic structure:**

  1. Teichoic acid

  2. Protein A: cell wall component, binds to the fc portion of IgG molecules at the complement binding site it considered as a virulence factor, the Fab portion is still free to bind to a specific antigen **(Coagglutination).**

  3. Polysaccharide capsule

  4. peptidoglycan

- **Virulence factors:**

  1. Toxins and enzymes*:*

  Staphylococci can produce many extracellular enzymes and toxins. These substances enable the bacteria for multiplying and spread widely in the tissues.

  - Catalase: which convert hydrogen peroxide into water and oxygen.

  - Coagulase: May deposit fibrin on the surface of staphylococci and thus protect them from phagocytosis.

  - Leukocidin: kill WBCs

  - Toxic shock syndrome toxin: superantigen.

S. aureus virulence factors

- **Exfoliative toxins:** superantigen, causes the generalized desquamation of the staphylococcal scalded skin syndrome by dissolving the mucopolysaccharide matrix of the epidermis.
- **Enterotoxin:** It is a heat-stable toxin responsible for food intoxication of *S. aureus*
- **Other enzymes:** Hyaluronidase, Lipase, Nuclease.

S. aurus virulence factors

2- Capsule: inhibit phagocytosis, Promote adherence

3-Peptidoglycan: leukocyte chemoatractant, decomplementation.

4- B-lactamase production: The majority of *S. aureus* isolates produce the B-lactamase enzyme which break down the B-lactam ring, & thus it is responsible for the resistance of *S. aureus* against penicillins & cephalosporines.

5- Biofilm formation: A biofilm is an aggregate of microbes in which cells adhere to each other and/or to a surface. It protects the microbe from the immune response & increase the antimicrobial resistance. High percentage of *S. aures* are biofilm former

Movie 3

Clinical infections caused by *S. aureus*:

S. aureus can cause a wide range of medical illnesses, from minor skin infections to life-threatening generalized. It is still one of the five most common causes of hospital-acquired infections, and is often the cause of postsurgical wound infections.

Clinical findings can be divided to:

- Cutaneous infections:

– impetigo, acne, folliculitis and furuncles (boils), mastitis.

- Invasive infections:

– bacteremia, meningitis, endocarditis, and osteomyelitis, hospital-acquired pneumonia.

- Toxin mediated infections:

– Staphylococcal scalded skin syndrome (SSSS),

– Toxic Shock Syndrome (TSS),

– Food intoxication (in 1-8hr, vomiting ,diarrhea, nausea, self limited)

clinical findings

S. aureus Infections in human

1. Skin & soft tissue infection (impetigo in children)
2. Upper & lower respiratory tract infection
3. Urinary & genital tract infections
4. Food intoxication
5. Bone & joint infections
6. Septicemia
7. Eye infection
8. CNS infections
9. Nosocomial infections
10. Burn infections

Staphylococcus epidermidis & *Staphylococcus saprophyticus*

- Do not produce exotoxins.
- ***S. epidermidis*** infections are almost always are hospital-acquired:

. Infect intravenous catheters and prosthetic devices

. Major cause of sepsis in neonates and peritonitis in patients with renal failure

- ***S. saprophyticus*** infections are almost always community-acquired:

. Causes UTI in sexually active women

it is the second major cause of community-acquired UTI in young women

Epidemiology

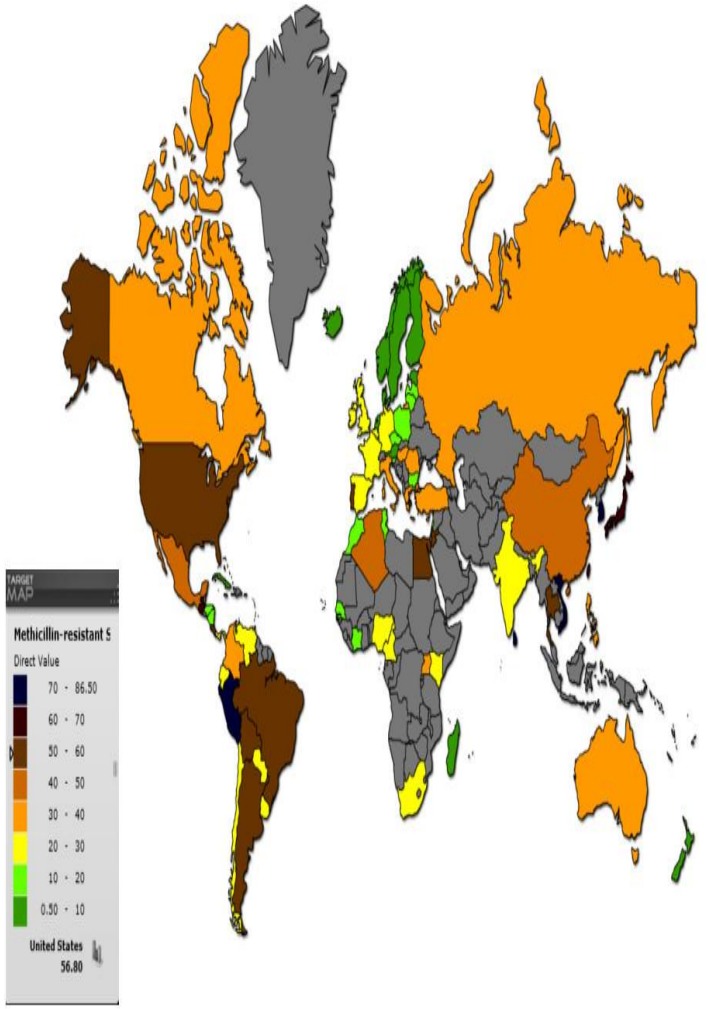
S. aureus is widely distributed in the nature and causing a wide range of pyogenic infections. Furthermore it is responsible for **community acquired as well as nosocomial infections** (Hospital infections particularly among immunocompromised patients) due to its wide distribution in hospital settings including health care workers. On the other hand, *S. aureus* is one of the well-known bacteria that develop multiple antibiotic resistance.

Methicillin resistant *S. aureus* (MRSA):

According to its susceptibility to Methicillin, *S. aureus* was divided into:

1. **Methicillin resistant (MRSA):** which is highly prevalent in the community (CA-MRSA) causing a wide range of infection including community acquired pneumonia . Beside that it is highly distributed in the hospitals Hospital environment and fomites) causing (HA-MRSA) infections among patients. MRSA isolates usually multi-drug resistant. High prevalence of MRSA was found among HCWs

2. Methicillin sensitive *S. aureus* (MSSA).



Movie 5


Thank you