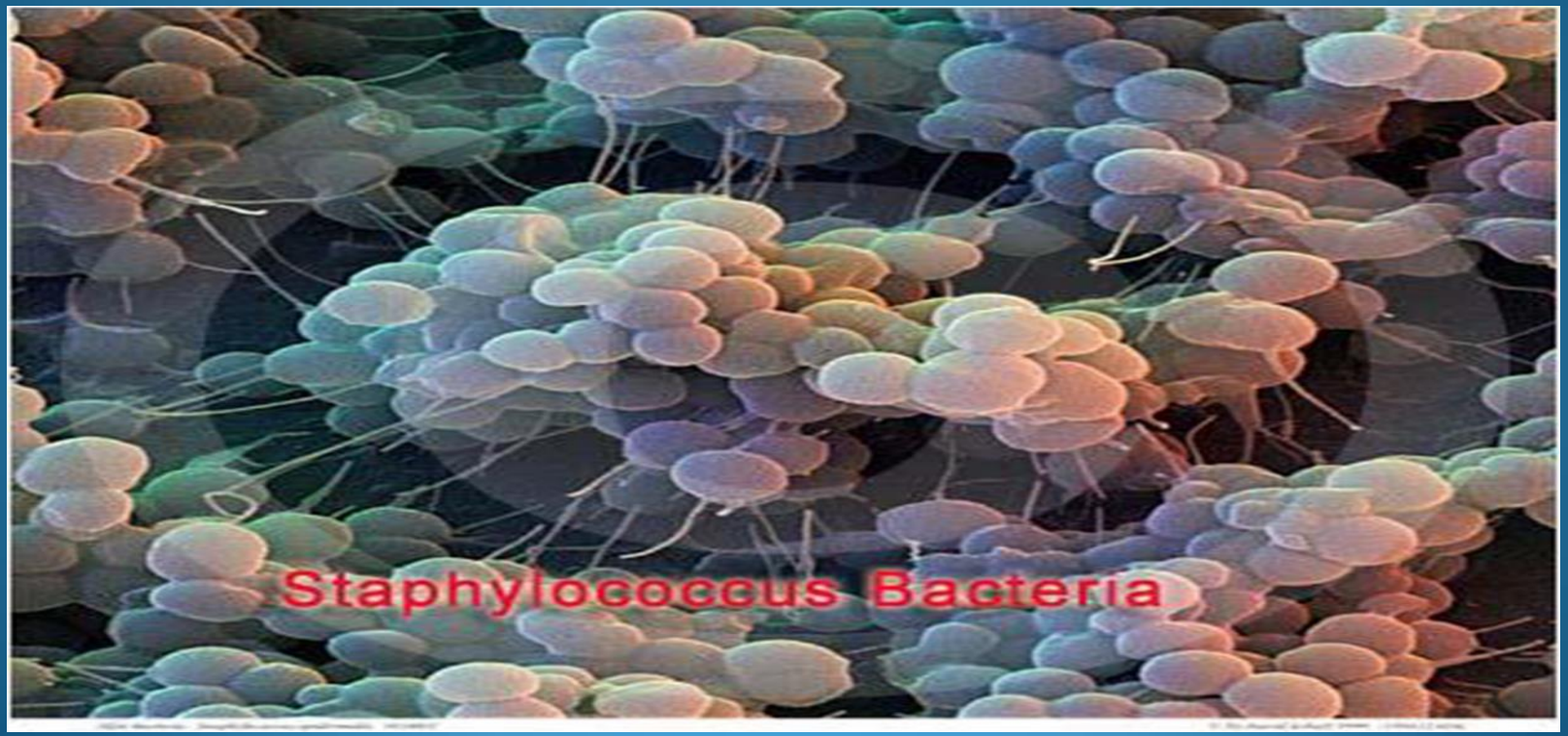
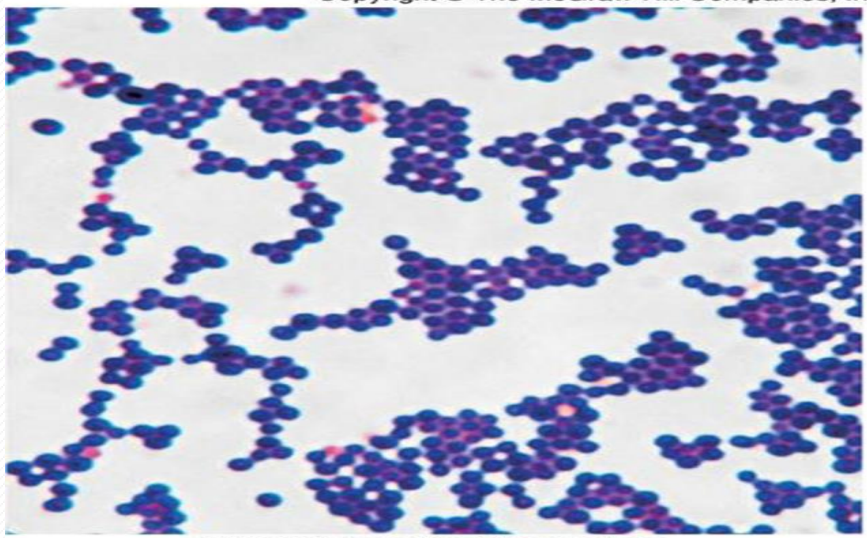
STAPHYLOCOCCI

Asst. Prof .Dr. Bara' Hamid



STAPHYLOCOCCI

Staphyloccocci - derived from Greek word: staphylē, "bunch of grapes" and kókkos, "granule“. - Staphyloccocci is a genus of Gram-positive bacteria. Under the microscope they appear round (cocci), and form in grape-like clusters.



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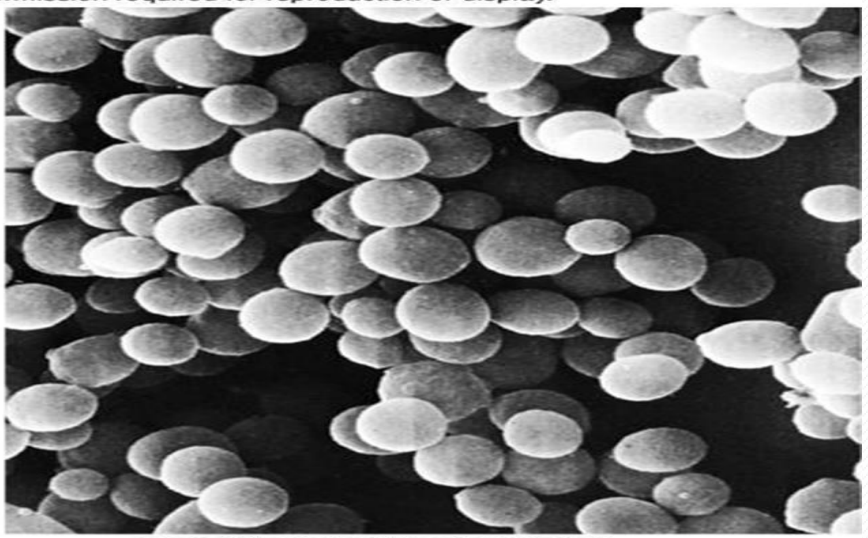

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The Staphylococcus **genus** includes at least forty species. Each species contain strains

–***Staphylococcus aureus***

–***Staphylococcus epidermidis***

–Most of these species are harmless and reside normally on the skin and mucous membranes of humans and other organisms.

-They are ubiquitous.

Classification

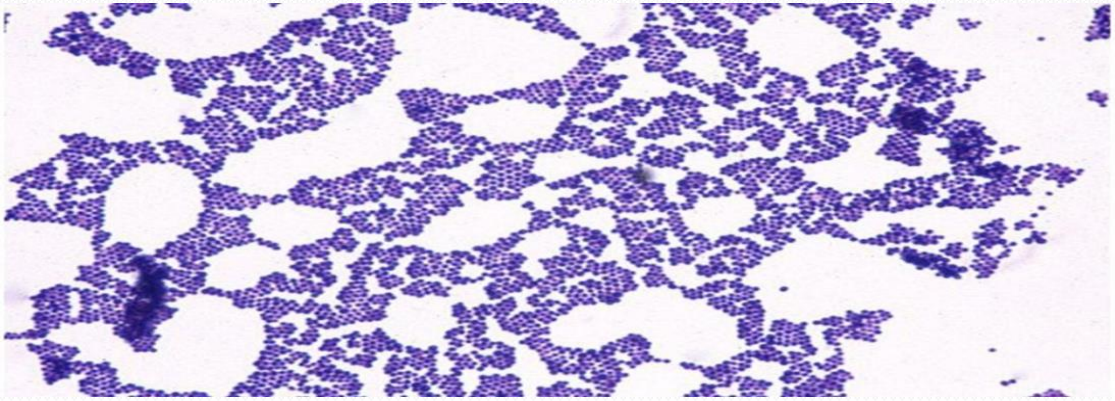
- Based on pigment production:
  - *S.aureus* :-golden-yellow pigmented colonies
  - *S.albus* :- white colonies
  - *S.citrus* :-lemon yellow colonies

S. albus , S. aureus , S. citrus on Nutrient Agar

- Based on pathogenecity:
  - Pathogenic:- includes only one i.e., *S.aureus*
  - Non-pathogenic:- includes *S.epidermidis, S.saprophyticus, S.albus, S. citrus, S.hominis,etc.*
- Based on coagulase production:
  - Coagulase positive: *S. aureus*
  - Coagulase negative: *S. epidermidis, S. saprophyticus*

Characters of Staphylococci

- Gram-positive cocci, arranged in grape-like clusters
- Non motile
- Non spore forming
- Facultative anaerobe
- Ferment glucose and produces lactic acid

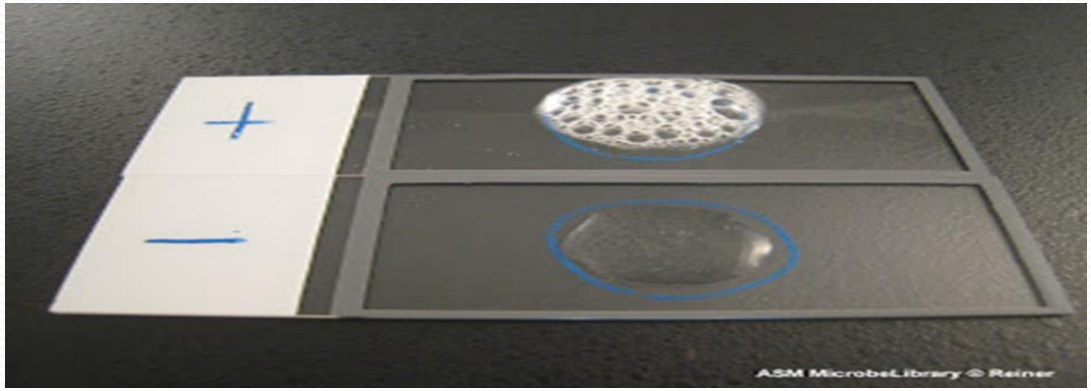


Catalase positive (meaning it can produce the enzyme catalase), so is able to convert hydrogen peroxide H2O2 to water H2O and oxygen O2.

the catalase test useful to distinguish Staphylococci from Streptococci

- Coagulase positive (some species negative)
- Oxidase-negative
- Normal flora of humans found on nasal passages, skin and mucous membranes.

The catalase test differentiates the Staphylococci, which are positive, from the Streptococci, which are negative.



Grouping of Staphylococci

•Staphylococci are divided into two groups based on the presence or absence of the enzyme **coagulase**. This enzyme converts fibrinogen into fibrin causing blood plasma to clot.

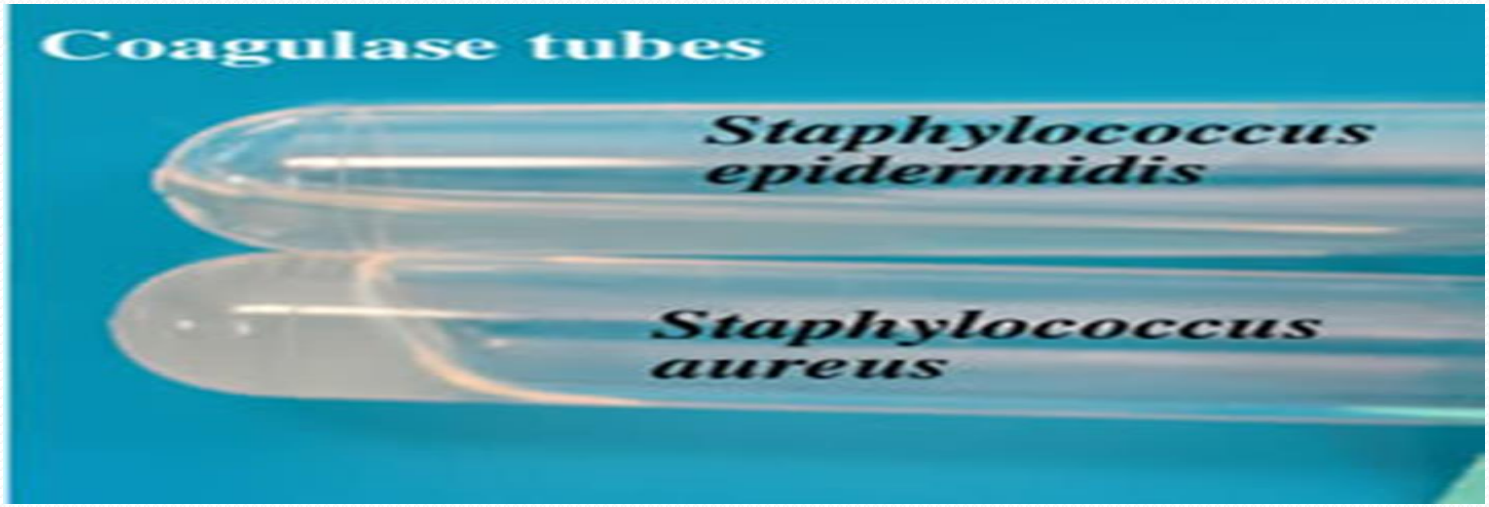
1. **Coagulase positive Staphylococci (pathogenic)**

–*Staphylococcus aureus*

2. **Coagulase negative Staphylococci (non pathogenic)**

–*Staphylococcus epidermidis*

–*Staphylococcus saprophyticus*

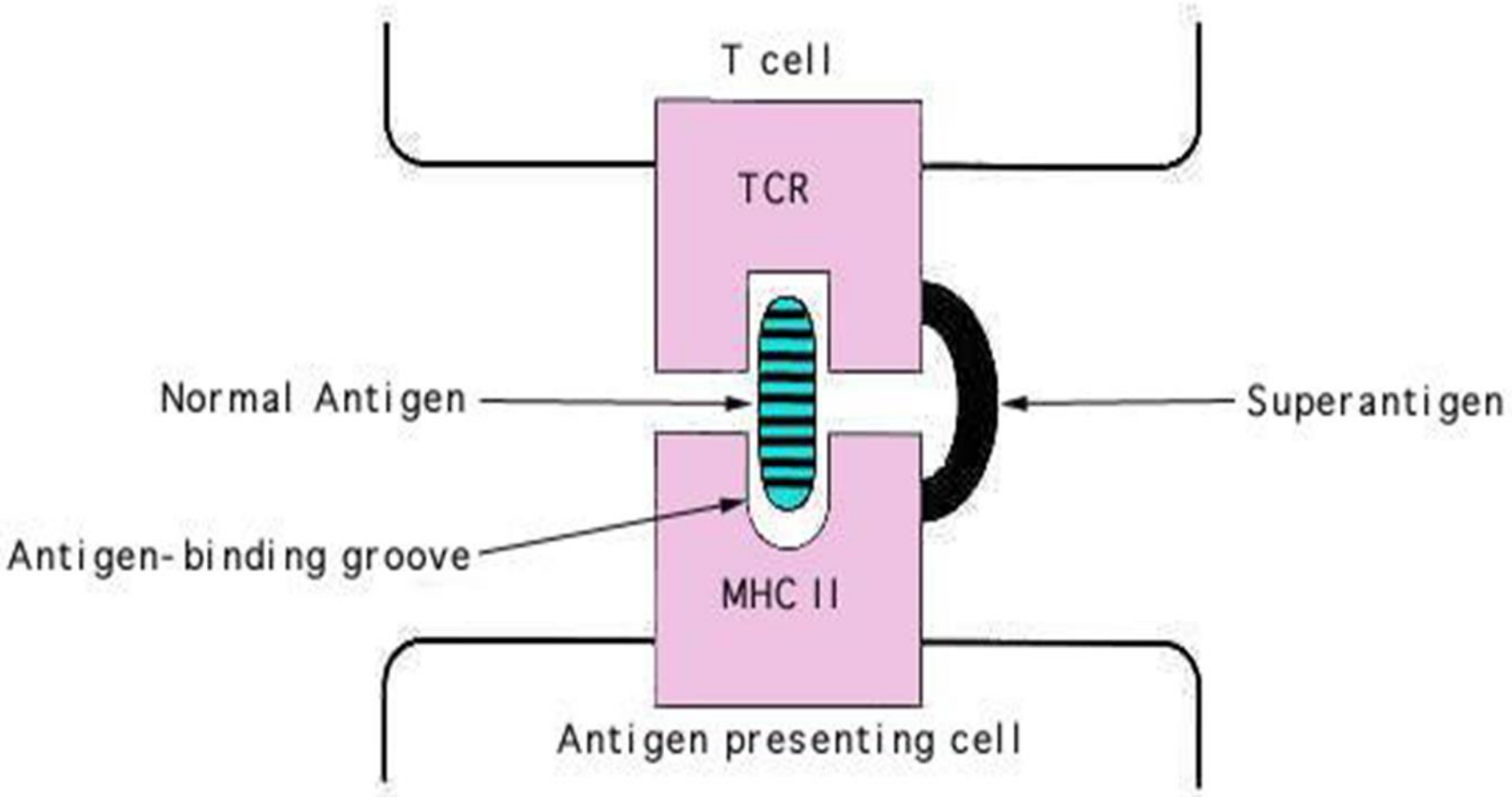


S. aureus infections

• *S. aureus* is a major cause of hospital acquired infection of surgical wounds (nosocomial infection) and infections associated with medical devices(Catheters)

Catheters : are medical devices that can be inserted in the body to treat diseases or perform a surgical procedure .

S. Aureus causes **poisoning food** by **r**eleasing enterotoxins in to food, and toxic shock syndrome by release of toxic shock syndrome toxin (superantigens) In to blood stream


T cell
TCR
Normal Antigen
Superantigen
Antigen-binding groove
MHC II
Antigen presenting cell

Virulence factors

A-Cell-Associated Virulence Factors

1. Capsule or slime layer
2. Teichoic acid
3. Protein A:
4. Clumping factor (bound coagulase)

B-Extracellular Enzymes

1. Catalase
2. Coagulase (bound or free):
3. Hyaluronidase
4. Nuclease
5. Protease
6. Lipases
7. Beta-lactamase or Penicillinase: confers antibiotic resistance

C-Exotoxins

1-Cytolytic (cytotoxins; cytolysins), they cause cytolysis as a result of plasma membrane damage.

a. Alpha toxin

b. Beta toxin

c. Gamma toxin

d. Delta toxin: Cytopathic for RBCs, macrophages, lymphocytes, neutrophils and platelets.

e. Leukocidin: Kills neutrophils

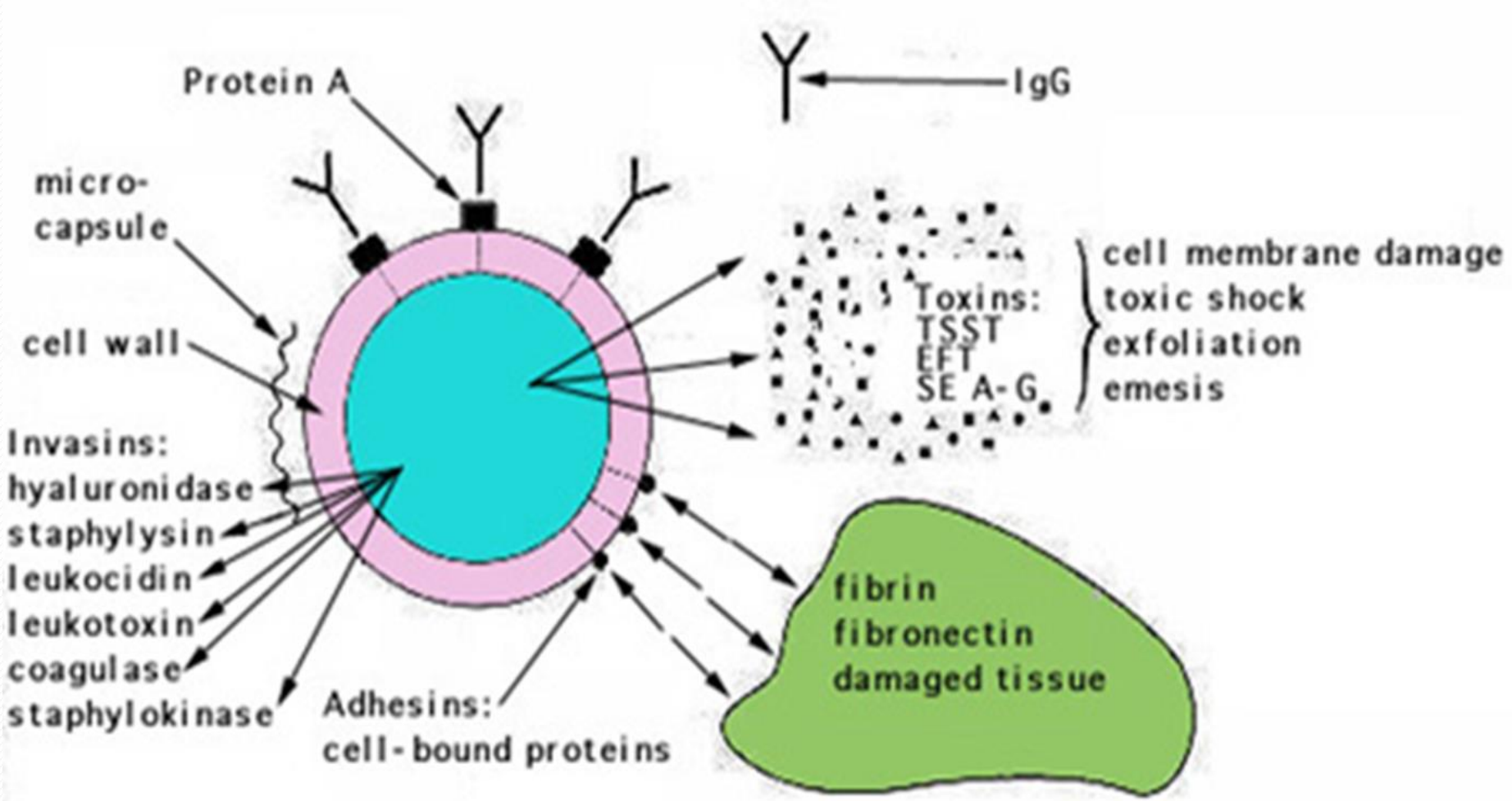
2-Enterotoxin

3-Exfoliative toxin (epidermolytic toxin)

4-Pyrogenic exotoxins

Pathogenesis of *S Aureus* Infections

Staphylococci antigenic structure, enzymes and toxins



Staphylococcal Diseases

Diseases are caused by *S. aureus* either due to direct effect of bacteria itself or due to toxins released by the bacteria.

I- Diseases caused by *S. aureus* itself

Range from localized to systemic

A. Localized cutaneous infections – invade skin through wounds, follicles, or glands

-folliculitis

-furuncle

-carbuncle

-impetigo

(a)

(b)

(c)

(d)

(e)

(f)

B. Systemic infections

- Bacteremia - primary origin of bacteria from another infected site or medical devices. *S. aureus* bacteremia can disseminate via the blood stream to other parts of the body causing disease.
- Osteomyelitis
- Pneumonia

II- Toxin mediated diseases

Food poisoning: *S. aureus* enterotoxins (A, B, C and D) cause food poisoning. Which are heat stable acts on gut. The bacteria not infect the patient, but the toxin causes the symptoms e . g., vomiting, nausea, diarrhea and abdominal pain. Because only the toxin involved, onset of symptoms occurs within a few hours and recovery occurs within a day. Enterotoxins are superantigens

Toxic shock syndrome :

TSS is caused by infection with *S. aureus* that produces toxic shock syndrome toxin.

•That cause toxic shock syndrome disease includes fever, macular rash, desquamation, vomiting and diarrhea.

•TSS toxin is Superantigen.

Scalded skin syndrome

•*S. aureus* produce exfoliative toxins (A and B), can cause scalded skin syndrome in babies and young children.

•Exfoliative toxin is superantigens.

Staphylococcus epidermidis

Characters:

1. It is a cause of nosocomial infections.
2. It is a major component of the skin normal flora and thus commonly a contaminant of cultures media.
3. Important character of *S. epidermidis* is the biofilm formation. This ability to form a biofilm on the surface of a prosthetic device is probably a significant determinant of virulence for these bacteria.

Biofilms : are a collective of one or more types of microorganisms that can grow on many different surfaces.

Staphylococcus saprophyticus

It is a significant cause of urinary tract infections, usually in young women. Symptoms include dysuria and pyuria.

Laboratory diagnosis:

A. Microscopic Examination:

1.Gram-positive cocci

2.pairs and clusters

3. Non motile and non spore forming.

B-Culture:

on nutrient agar it produces golden yellow: *S. aurues*

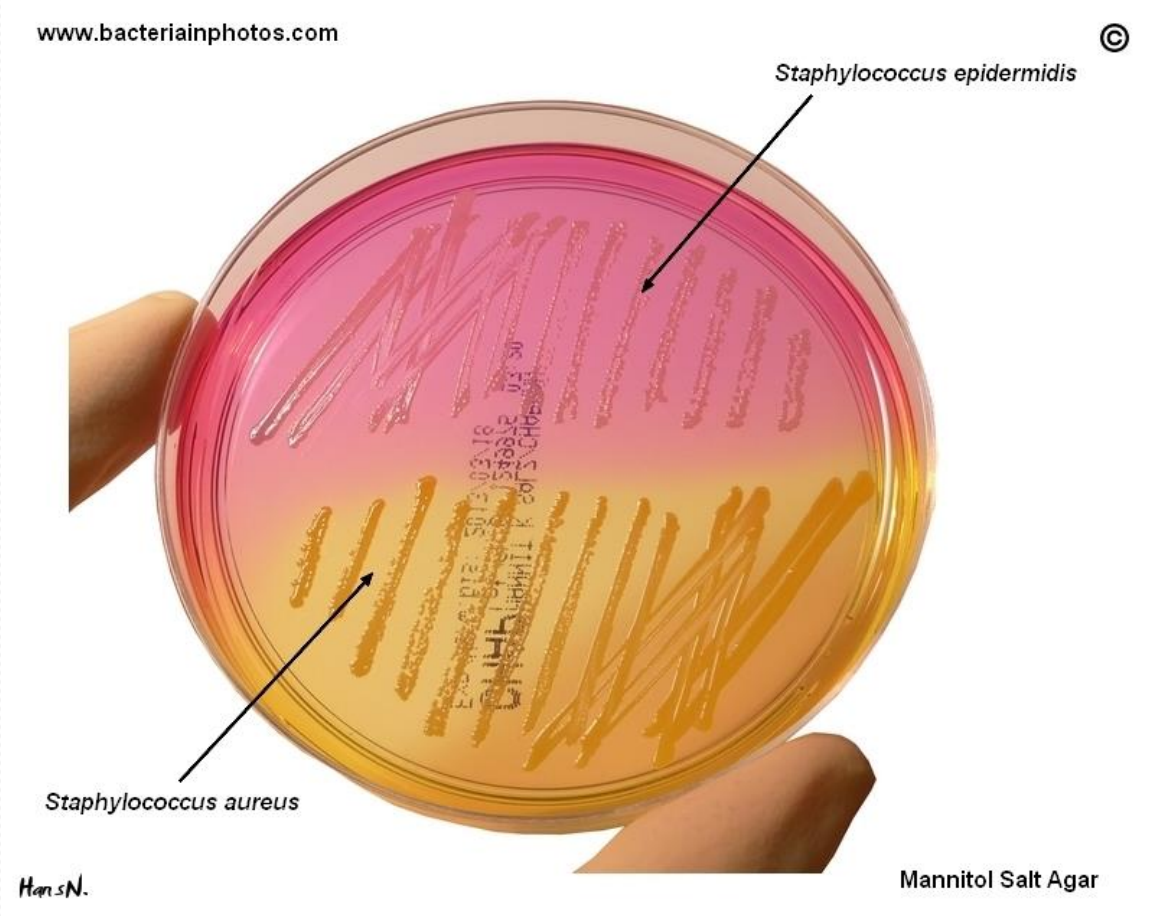
white: *S. epidermidis*

lemon yellow: *S. saprophyticus.*

on blood agar *S.aurues* produces complete hemolysis

S. epidermidis and *S. saprophyticus* No hemolysis.

Mannitol salt agar



Antibiotic Therapy

Staphylococci can produce a penicillinase (beta lactamase) that degrades beta lactam antibiotics. Some strains also have modified penicillin binding proteins. Thus, beta lactam antibiotics (including methicillin) are often ineffective. Vancomycin is the drug of choice for treatment of methicillin-resistant *S. aureus* (MRSA).

Resistance to Antimicrobial Drugs

Hospital strains of *S. aureus* are usually resistant to a variety of different antibiotics. Resistance occurs due to:

(1) Mutation in chromosomal genes.

(2) Acquisition of resistance genes as extra chromosomal plasmids.