

Anbar University

Science College

Biotechnology Department

Staphylococcus

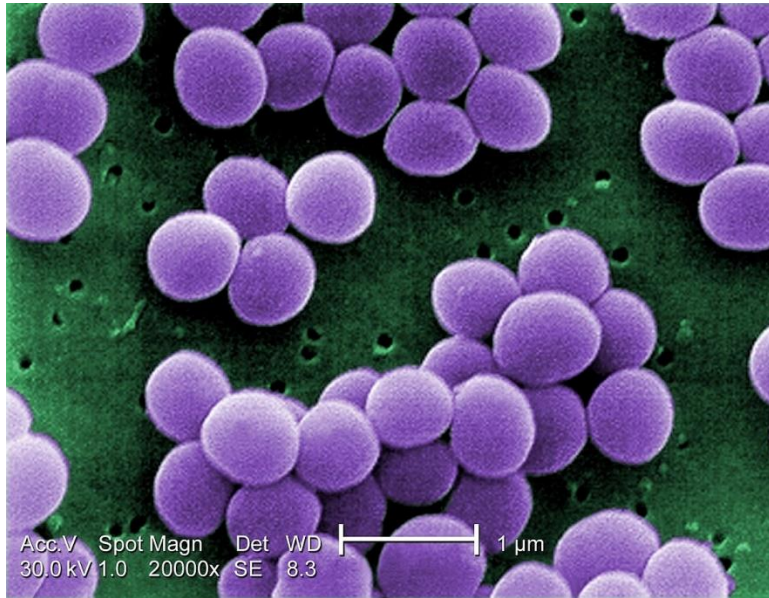
Lecturer.D.Al-Moghira Khairi Al-Qaysi

Textbook of Diagnostic Microbiology (Mahon, Textbook of Diagnostic Microbiology), Connie R. Mahon MS, Donald C. Lehman EdD
MLS(ASCP)cm SM(NRCM), George Manuselis Jr. MA
MT(ASCP)

Jawetz Melnick & Adelbergs Medical Microbiology, Stefan Riedel (Author), Stephen Morse (Author), Timothy Mietzner (Author), Steve Miller.

Mims' Medical Microbiology and Immunology, International Edition, Goering.

Staphylococcus



Staphylococci are Gram-positive spherical bacteria that occur in microscopic clusters resembling grapes. Only *Staphylococcus aureus* and *Staphylococcus epidermidis* are significant in their interactions with humans. *S. aureus* colonizes mainly the nasal passages, but it may be found regularly in most other anatomical locales. *S. epidermidis* is an inhabitant of the skin.

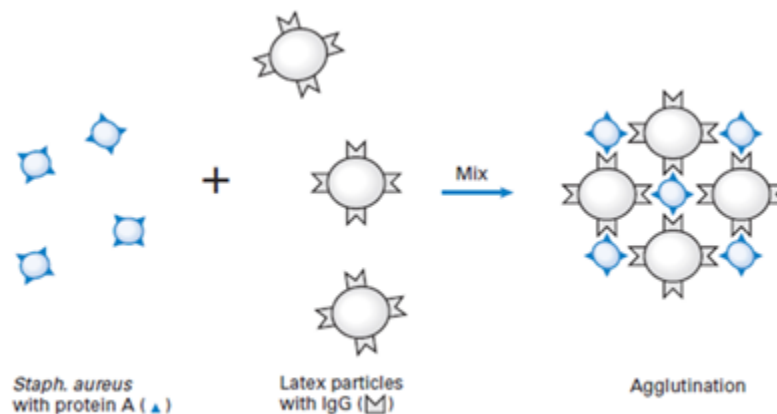
Staph. are facultative anaerobes that grow by aerobic respiration or by fermentation that yields principally lactic acid. The bacteria are catalase-positive and oxidase-negative. *S. aureus* can grow at a temperature range of 15 to 45 degrees and at NaCl concentrations as high as 15 percent. Nearly all strains of *S. aureus* produce the enzyme coagulase: nearly all strains of *S. epidermidis* lack this enzyme. *S. aureus* should always be considered a potential pathogen; most strains of *S. epidermidis* are nonpathogenic and may even play a protective role in their host as normal flora. *Staph. epidermidis* may be a pathogen in the hospital environment.

The catalase test is important in distinguishing *Streptococci* (catalase-negative) from *Staphylococci*.

Staph. cause a variety of both common and uncommon infections, such as abscesses of many organs, endocarditis, gastroenteritis (food-poisoning) and toxic shock syndrome.

Antigenic structures of *Staphylococcus aureus*:

.Protein A is a cell wall component and a highly stable cell surface receptor produced by several strains of *Staph. aureus*. This protein is capable of binding to the Fc portion of immunoglobulins, especially IgGs, from a large number of species.



.Peptidoglycan: a polysaccharide polymer provides rigid exoskeleton of the cell wall, The peptidoglycan has endotoxin activity.

. Teichoic acids: Teichoic acids are polymers, these polymers are linked to the peptidoglycan and can be antigenic. Antiteichoic acid antibodies may be found in patients with active endocarditis caused by *Staph. aureus*.

.Extracellular substances: (enzymes and toxin)

Most extracellular substances produced by *Staph. aureus* are antigenic (stimulate the production of antibodies). These are:-

•**Catalase** : Is an enzyme that breaks hydrogen peroxide into O_2 and H_2O so the benefit of catalase is that H_2O_2 is toxic to bacteria so they need catalase enzyme to get rid of H_2O_2 . It's useful in differentiation between members of genus *Staph. aureus* and genus *Streptococcus*.

•**Coagulase**: It's an enzyme like protein; it clots citrated or oxalated human or rabbit plasma in the presence of serum factors. The serum factor reacts with coagulase generating clotting activity. The enzyme converts fibrinogen (soluble) into fibrin (insoluble). Fibrin can be deposited on the surface of bacteria forming a wall around the bacteria which has an important role in:

A)Protection of bacteria from phagocytosis.

B)Preventing the action of antibiotics.

This test used to differentiate the more virulent *Staphy. aureus* from the less pathogenic *Staph. epidermidis*.

•**Proteinase**: Is an enzyme which breaks down proteins.

•**Lipase**: Is an enzyme which breaks down lipid in the skin, lipoprotein in blood

•**Hyaluronidase**: Enzyme breaks down hyaluronic acid (spreading factor).

• **β - Lactamase**: break down β -lactam ring of penicillin.

TOXINS

•**Hemolysins (exotoxins)**: Include several toxins act on cell membrane of RBCs of Varsity of animal species.

•**Leukocidin** : Toxic substance causes degradation of WBC leading to cell death.

•**Exfoliative toxins**: Produced by certain strains of *Staph. aureus*. It includes at least two proteins that yield the generalized desquamations of the skin in (scaled skin syndrome) this syndrome is common among small children.

Specific antibodies for the exfoliative toxin product against the exfoliative action of the skin (it's antigenic, stimulate production of antitoxins).

•**Enterotoxins:**

- *they are 6 soluble toxins (A, B, C, D, E, and F).
- * Heat stable.
- * Resistant to the gut enzymes and acidity.
- * are the proteins that cause nausea, vomiting and diarrhea.
- * an important cause of food poisoning.
- * produced by *Staphylococcus aureus* growing in meat and dairy products.

•**Toxic shock syndrome toxin 1 (TSST-1):**Associated with toxic shock syndrome TSS. Produced by some strains of *Staph. aureus* in human this toxin cause TSS which is a systemic infection characterized by high fever, hypotension and shock with multisystem involvement.

Pathogenicity

Staph. aureus cause many diseases:

- Superficial infections: common agent of boils, carbuncles, pustules, abscesses, conjunctivitis and wound infections; rarely causes oral infections; may cause angular cheilitis (together with the yeast *Candida*) at the angles of the mouth.
- Food poisoning (vomiting and diarrhoea) caused by enterotoxins
- Toxic shock syndrome, also caused by an enterotoxin
- Deep infections: osteomyelitis, endocarditis, septicaemia, pneumonia.

Antibiotic resistance in *staphylococci*

This is a global problem of much concern and falls into several classes.

- Resistance to β -lactam drugs.
- Resistance to methicillin (and to nafcillin and oxacillin) independent of β -lactamase. The spread of methicillin-resistant *Staphy. aureus* (**MRSA**) worldwide is posing problems in many community and hospital settings.
- Resistance to vancomycin, one of the last-line defences against *Staph.* and the emergence of vancomycin-resistant *Staph. aureus* (**VRSA**).

The mechanism of resistance here is due to alterations in the cell wall tolerance', where the organism is inhibited but not killed by the antibiotic.

Staphylococcus epidermidis

It is part of the normal human flora, typically the skin flora, and less commonly the mucosal flora. It is a facultative anaerobic bacteria. Although *S. epidermidis* is not usually pathogenic, patients with compromised immune systems are at risk of developing infection.

Pathogenicity

Being a normal commensal of the skin, this bacterium causes infection only when an opportunity arises (it is an opportunist pathogen). Common examples are catheter related sepsis, infection of artificial joints and urinary tract infections.

Virulence factors is production of an exopolysaccharide "slime" The slime layer around the bacterial cell wall:

- promotes adherence to plastic surfaces
- increase resistance to phagocytosis
- inhibits entrance of antibiotics to the cell.

Staphylococcus saprophyticus

Normal flora when become pathogenic, it causes upper and lower urinary tract infection in young women. This organism causes urinary tract infections in women, an infection especially associated with intercourse. It has the ability to colonize the periurethral skin and the mucosa.