Family Micrococcaceae
Staphylococcus aureus

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Family Micrococcaceae

Genera: Micrococcus, Staphylococcus, & Rothia are catalase positive. The genera: Streptococcus & enterococcus are catalase negative. Staphylococci are the most commonly isolated micrococcaceae from human & veterinary clinical specimens.

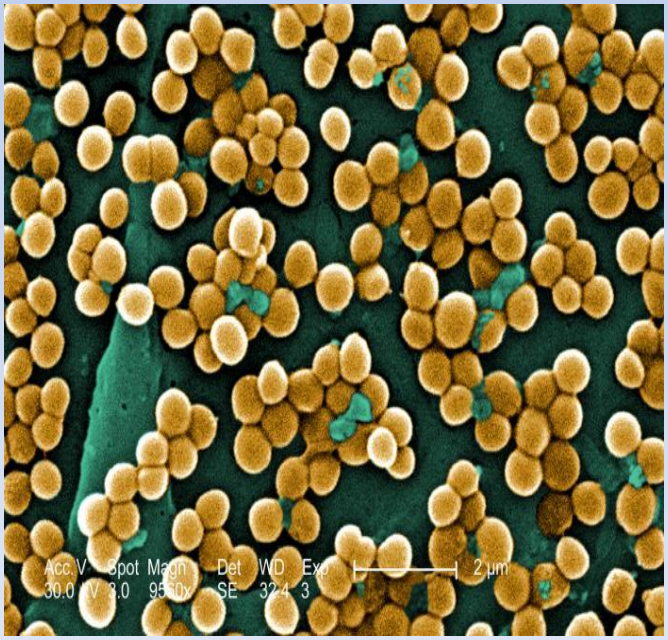
G+ bacteria. It usually arranged in grape-like clusters. Single or pairs may also found. Colonies are white to gray, and sometimes golden yellow, entire and smooth surface. They grow readily on many types of media. Some are normal flora of the skin and mucous membrane of human. Other causes suppuration, abscesses formation and a variety of pyogenic infections and even fatal . The main 3 species of staphylococci are:

Staphylococcus aureus

Staphylococcus epidermidis (albus)

Staphylococcus saprophyticus

S. aureus is coagulase positive which differentiate them from other species. It is the major pathogen for human. The coagulase negative staphylococci are normal flora and occasionally causing infection in human (Opportunistic pathogen).

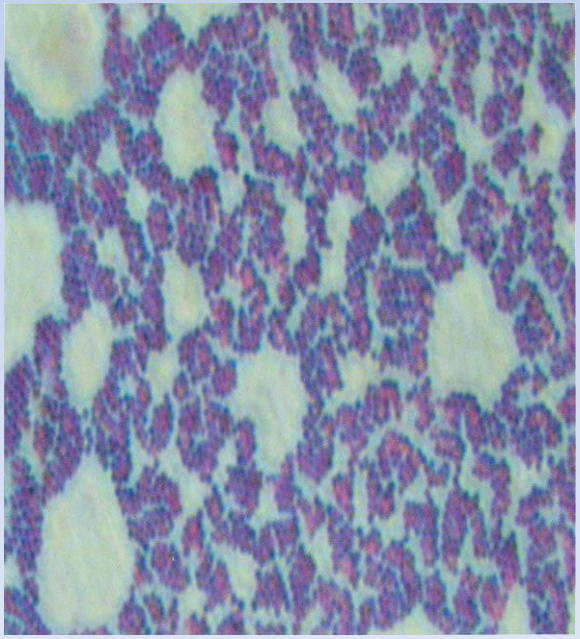


Staphylococcus aureus

Morphology: Staphylococci are spherical in shape usually arranged in clusters.

Culture: They readily grow on different media under aerobic or micraerophilic conditions. Colonies on solid media are round smooth and glistening. *S. aureus* only produce gray to deep golden yellow colonies. *S. epidermidis* produce gray to white colonies. Staphylococci are catalase positive which differentiate them from streptococci.

Pathogenesis : The nasal carriage among normal healthy population occurs in 40%-50% of humans. Nasal carriage in children is higher than in adults. While the rate of skin carriage was about 20%. 10% of normal non-pregnant women carries *S. aureus* in their vagina. *S. aureus* can enter to the body through a number of routes (mouth, nose, vagina, wounds, burns …etc). It can establish a variety of pyogenic infections as well as food intoxication. The pathogenic capacity of *S. aureus* is aided by toxins and enzymes they produced together with the invasive properties of the bacteria and their ability to resist a wide range of antibiotics. Antimicrobial resistance is chromosomal & plasmid mediated.



Pathogenicity factors of *S. aureus* : *S. aureus* has three features that make it distinct among most other clinically important bacteria. It can express a variety of virulence factors, it has the ability to develop and expand resistance to a broad spectrum of antimicrobial drug classes, and its wide distribution in human, animal and environment.

Toxins and enzymes of *S. aureus:* Staphylococci can produce many extracellular enzymes and toxins. These substances enable the bacteria for multiplying and spread widely in the tissues.

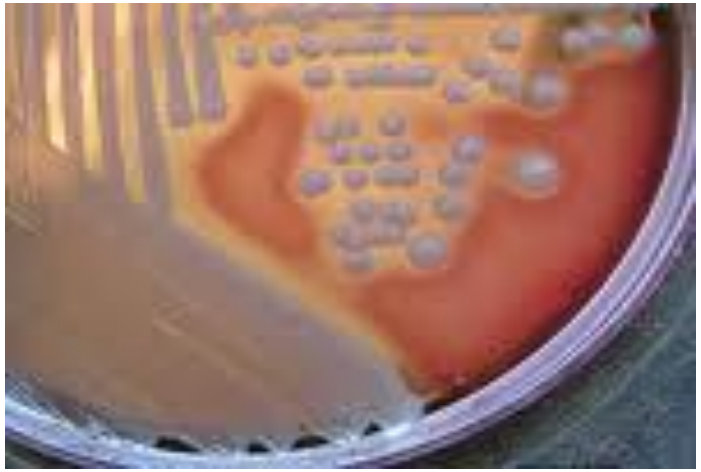
Catalase: which convert hydrogen peroxide into water and oxygen.

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

Enterotoxin: It is a heat-stable toxin responsible for food intoxication of *S. aureus.*

Exotoxins: which includes leukocidin, exfoliative toxin and toxic shock syndrome.

S.aureus **on blood agar, the complete hemolysis of RBCs is very clear**



S. aurus virulence factors:

Capsule: inhibit phagocytosis, Promote adherence
Piptidoglycan: leukocyte chemoatractant, decomplementation
Toxins: Antiphagocytic, cytotoxic
Exfoliative toxin: split cellular bridges
Enterotoxin: nauseogenic, diarrheagenic
TSST: endothelial damage
Coagulase: Convert fibrinogen into fibrin
Hyaluronidase: Hydrolyzes hyaluronic acid in connective tissues
Lipase: hydrolyzes lipids
Nuclease: Hydrolyzes DNA

Another pathogenicity factors:

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.

Biofilm formation: A biofilm is an aggregate of microbes in which cells adhere to each other and/or to a surface. These adherent cells are frequently embedded within a self-produced matrix of extracellular polymeric substance. Biofilm protect the microbe from the immune response & increase the antimicrobial resistance. High percentage of *S. aures* are biofilm former

S. aurus virulence factors

clinical infections

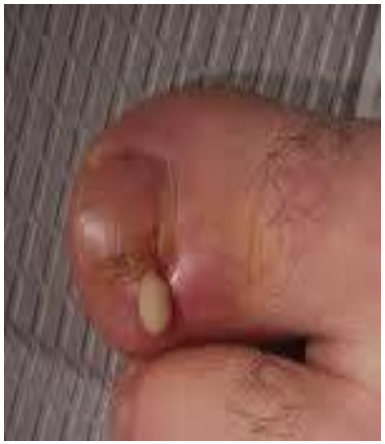
Clinical infections caused by *S. aureus*:

S. aureus is the most common species of *Staphylococcus* to cause *Staph* infections and is a successful pathogen due to a combination of nasal carriage and bacterial immunoevasive strategies. *S. aureus* can cause a range of illnesses, from minor skin infections, such as pimples, impetigo, boils, cellulitis, folliculitis, carbuncles, scalded skin syndrome, and abscesses, to life-threatening diseases such as pneumonia, meningitis, osteomyelitis, endocarditis, toxic shock syndrome, bacteremia, and sepsis. Its incidence ranges from skin, soft tissue, respiratory, bone, joint, endovascular to wound infections. It is still one of the five most common causes of hospital-acquired infections and is often the cause of postsurgical wound infections.

Atopic dermatitis:

S. aureus is extremely prevalent in persons with atopic dermatitis. It is mostly found in fertile, active places, including the armpits, hair, and scalp. Large pimples that appear in those areas may exacerbate the infection if lacerated. This can lead to staphylococcal scalded skin syndrome. A severe form of this, Ritter's disease, can be observed in neonates. The presence of *S. aureus* in persons with atopic dermatitis is not an indication to treat with oral antibiotics, as evidence has not shown this to give benefit to the patient.. The relationship between *S. aureus* and atopic dermatitis is unclear. Evidence shows that attempting to control *S. aureus* with oral antibiotics is not efficacious.

***S. aureus* food intoxication:**



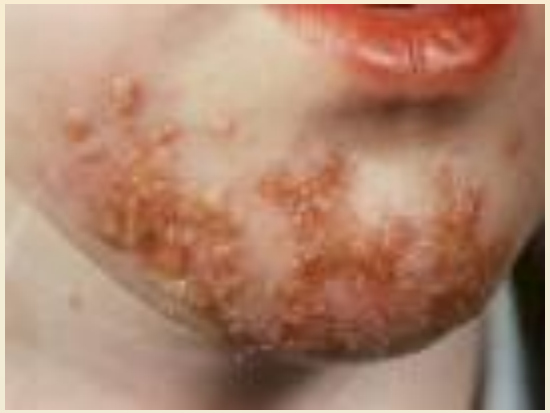
Food poisoning due to *S. aureus* enterotoxin is characterized by a short incubation period (1-8 hrs), violent nausea, vomiting and diarrhea. There is no fever. The enterotoxin is heat-stable (resist boiling for 30 minutes)and resistant to the action of Gut enzymes. The emetic effect of enterotoxin is probably result from CNS stimulation (vomiting center).

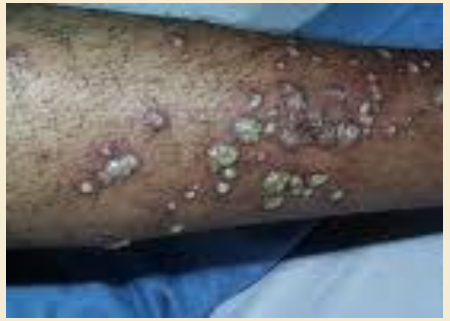
Toxic shock syndrome:

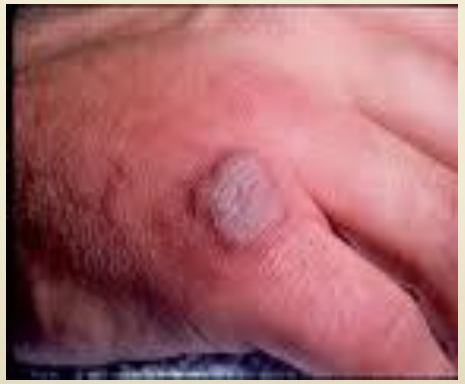
Most strains of *S. aureus* isolated from patients with toxic shock syndrome produced a toxin called toxic shock syndrome toxin (TSST). In human the toxin is associated with fever, shock and multisystem involvement, including desquamative skin rash.

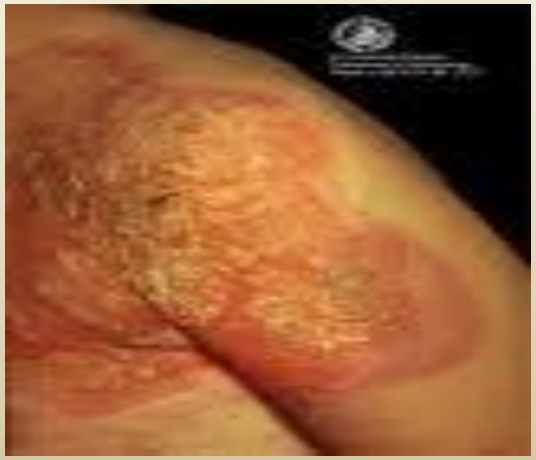
S. aureus Infections in human

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









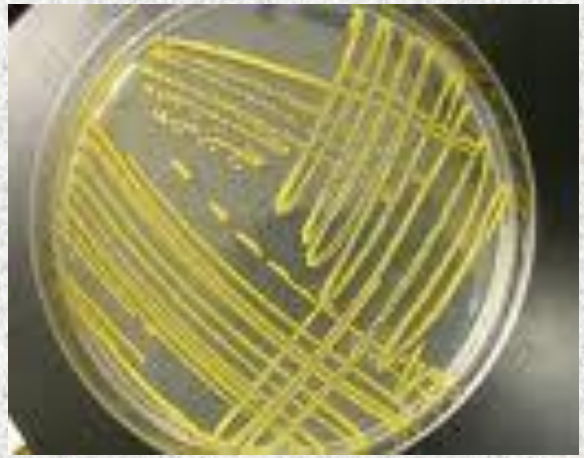
Laboratory diagnosis

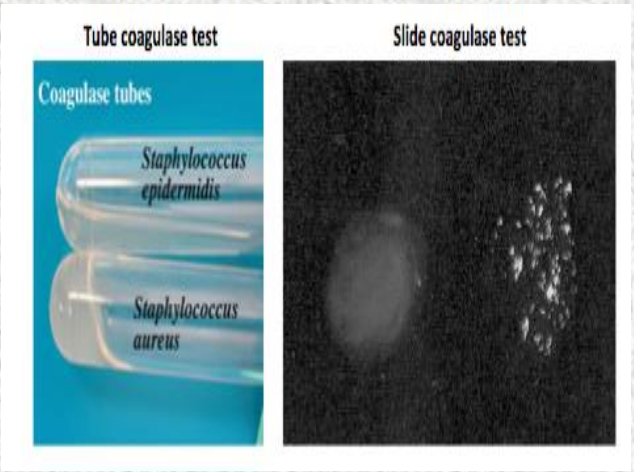
1.Specimens: Pus, blood, urine, sputum, CSF, wound swab, burn swab, seminal fluid, vaginal secretion and so on

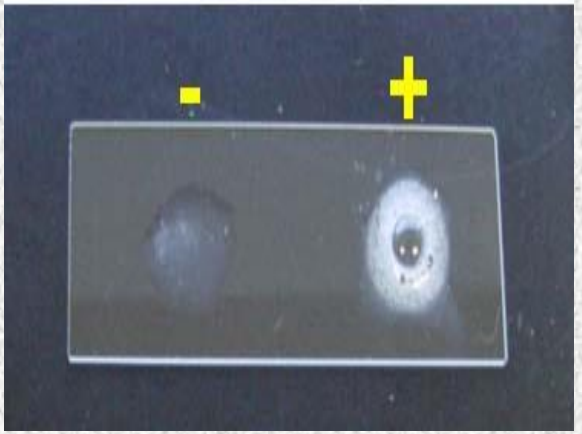
2. Smears: Stained with Gram's stain to see the typical appearance of the bacteria.

3. Culture: On blood agar plates to identify bacterial colonies and differentiate them through; Coagulase test, Catalase test, and Biochemical tests.

Culture on special media: Mannitol salt agar (with 6.5% Nacl) to differentiate *S. aureus* than other staphylococci.







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)**