



Lecture 9. Staphylococci

Learning objectives

Upon completion of this lecture, student should be able to:

1. List characteristics of *S. aureus* strains.
2. List and describe toxins and enzymes of *S. aureus*.
3. Describe staphylococcal diseases.

Introduction

Family **Micrococcaceae** consists of Gram-positive cocci.

Micrococcaceae consists of four genera, *Staphylococcus*, *Micrococcus*, *Planococcus*, and *Stomatococcus*.

The genus *Staphylococcus* consists of 32 species, three of which are of medical importance:

- *Staphylococcus aureus*
- *Staphylococcus epidermidis*
- *Staphylococcus saprophyticus*

Bacteria	Disease
<i>Staphylococcus aureus</i>	Skin infections —impetigo, folliculitis Systemic infections —bacteremia, endocarditis Toxin-mediated infections —food poisoning, toxic shock syndrome
<i>Staphylococcus epidermidis</i>	Opportunistic infections —intravenous catheter infections, CSF infections in “immunocompromised” patients
<i>Staphylococcus saprophyticus</i>	Urinary tract infection particularly in sexually active young women

Staphylococcus aureus

S. aureus is an important human pathogen that causes a spectrum of clinical diseases.

These range from **superficial skin lesions** like folliculitis to deep-seated abscess and various **pyogenic infections** like endocarditis, osteomyelitis, etc.

Morphology

Staphylococci show the following features:

- They are **Gram-positive cocci**, measuring around 1 µm in diameter
- They are **nonmotile, nonsporing**
- They are **noncapsulated**

The cocci are typically arranged in irregular **grape-like clusters** when grown in solid media.

Virulence factors

S. aureus produces several **virulence factors**, which include the following:

Virulence factors	Biological functions
1. Cell wall associated polymers and proteins	
Peptidoglycan	Inhibits chemotaxis of inflammatory cells
Capsular polysaccharide	Inhibits phagocytosis and chemotaxis
Teichoic acid	Mediates attachment of staphylococci to mucosal cell
Protein A	Chemotactic, anticomplementary, and antiphagocytic; causes platelet injury; and elicits hypersensitivity reactions
2. Enzymes	
Coagulase	The enzyme coats the bacterial cells with fibrin, rendering them resistant to phagocytosis
Catalase	Causes oxidative damage to host tissue
Hyaluronidase	Hydrolyzes hyaluronic acids in the connective tissues, thereby facilitating the spread of bacteria in the tissues
Penicillinase	Inactivates penicillins
Nuclease	Hydrolyzes DNA
Lipases	Hydrolyzes lipids
3. Toxins	
Toxic shock syndrome toxin	Superantigen, stimulates the release of large amount of interleukins
Enterotoxin	Superantigen, acts by producing large amounts of interleukins
Exfoliative toxin	Splits intercellular bridges in the epidermis of the skin
Leukocidin toxin	Causes lysis of leukocytes
Hemolysin	Causes lysis of erythrocytes

Clinical syndromes

The diseases caused by *S. aureus* can be divided into two groups:

1. **Inflammatory staphylococcal diseases**
2. **Toxin-mediated staphylococcal diseases**

Inflammatory staphylococcus diseases

Staphylococcal skin infections include; **impetigo, folliculitis, furuncles (boils), carbuncles, surgical wound infection, blepharitis, and postpartum breast infection.**

Other inflammatory staphylococcus diseases include; **bacteremia, endocarditis, osteomyelitis, pneumonia, and deep-seated abscesses.**

Toxin-mediated staphylococcal diseases

I. **Staphylococcal food poisoning**

It is caused by **preformed enterotoxin**, which act by stimulating the release of large amounts of **interleukins** in the body.

When contaminated **milk, milk products** and **animal products** like **fish** and **meat** kept at room temperature after cooking, the staphylococci multiply and produce toxin adequate to cause food poisoning.

Often a **food handler is the source of infection.**

The onset of symptoms is sudden, appearing within 2–6 hours of ingestion of food. It is a self-limiting condition characterized by **nausea, vomiting, abdominal cramps, and watery, nonbloody diarrhea.**

II. **Staphylococcal toxic shock syndrome**

The STSS is an acute and potentially life-threatening condition caused by **TSST**, which act by stimulating the release of large amounts of **interleukins** in the body.

STSS is a **multisystem** disease characterized by: **fever, hypotension, myalgia, vomiting, diarrhea, mucosal hyperemia**, and an **erythematous rash** followed by **desquamation of the skin**, particularly on palms and soles.

III. **Staphylococcal scaled skin syndrome**

SSSS is caused by the **exfoliative toxin**, (**exfoliatin**) which causes an **extensive exfoliation of the skin**, in which the outer layer of the epidermis is separated from the underlying tissue and is characterized by the appearance of extensive **bullae** which when ruptured may leave behind **scalded, red, tender skin**.

Complications of staphylococcal diseases

It include **bacterial pneumonia, septicemia, arthritis, meningitis**, etc.

These complications are frequently seen in persons with **extreme of age, debilitated persons**, and **immunosuppressed hosts**.