Ministery of Higher education and scientific research

University of Tikrit

College of science

Department of Biology

Lectures of Pathogenic Bacteria

For Diploma students – Pathological analyses - 2025-2026

Assistant professor Dr. Bushra Ali Kadhim

bushraa.ali@tu.edu.iq

Reservoir of infection:

From the French reservoir, from reserve. Mean the primary habitat of the organism. Any person, animal, plant ,water, soil or substance (part of a device) in which an infectious agent normally lives and multiplies.

The reservoir typically harbors the infectious agent without injury to itself and serves as a source from which other individuals can be infected. The infectious agent primarily depends on the reservoir for its survival. It is from the reservoir that the infectious substance is transmitted to a human or another susceptible host .

Epidemiological markers

Biological markers which are used to characterize microorganisms or discriminate between genomes based on genetic variation among microbial isolates. Which are include:

1- Genotype : Genetic constitution of an organism as assessed by a molecular method such as plasmid typing . SNP typing

2- Phenotype :Observable characteristic of an isolate such as serotyping ,bacteriocin typing ,antibiotic typing Stability epidemiological marker should remain stable for each isolate after its primary isolation & during laboratory storage & subculture across generations.

How Do Infectious Diseases Spread?

Microbes invade the host body and begin multiplying using the host body resources. Thus, this causes problems in the normal functioning of the infected part, organ or tissue. Microbes can enter the body by the following mode of entry:

Respiratory Tract Illnesses: through inhalation of airborne droplets ontaining microbes by sneezes or coughs.

Food Borne Illnesses: Infections can spread through contaminated food and drinks.

Vector Borne Illness: Infections that spread by a vector who serves as an intermediate host to a healthy person is called as vector borne illness\ Diseases such as malaria

Person-To-Person Contact: Many illnesses spread by direct contact with the infected person. Body fluids that contain microbes can enter the body through saliva, blood, semen, pus or an open wound.

Venereal/Sexual Transmission : like gonorrhea, syphilis, HIV/AIDS, etc. spread through unsafe intercourse with an infected person.

Vertical Transmission: When an infected woman gets pregnant or acquires an infection during pregnancy, it results in vertical transmission. This means, the infection can spread from the mother to her embryo, fetus

or child during pregnancy or childbirth.

Iatrogenic transmission: Infection that spreads due to medical error or lapse, that is injection or transplantation of an infected material into a healthy individual.

Animal to person: infections that can be transmitted between vertebrate animals and humans. The natural host is the animal is called as zoonotic diseases. Rabies is an example of such an infectious disease.

Bacterial Infections characterized by following signs: Redness, swelling, and heat on the infected part ,Pain at the site of infection , Pus .

Some of the common diagnostic methods to detect infection include: *Blood tests * X-rays *Microbial culture *Stool samples *Urinalysis *Microscopically tests *Biochemical tests *Molecular diagnostic tests *Biopsy

Bacterial antigenic structures :

There are three different antigenic structures found in bacteria which

are

1- O antigen which is represent to a somatic bacterial antigen (Ag) such as lipopolysaccharide (LPS) .

2- K antigen which is represent to capsular part of bacteria

3- H antigen which is represent to bacterial flagella .

Several terms are predominantly related with infection

Infectious disease is an infection that can be transmitted between humans (or organisms/animals, etc.).

Acute infections will be those that arise quickly (e.g. tonsillitis) and

progress rapidly

Chronic infections which have a longer course (e.g. tuberculosis), lasting for weeks up to years without resolution.

Latent infections are those in which the microbe is able to persist for years within a site in the host and cause minimal clinical disease for most of the time the organism is present.

Generalized infections are often more severe. The involvement of numerous organs throughout the body will lead to more complications.

systemic infection is 'multi-organ infection'.

Localized infections: simply infecting a site such as on the skin.

Nosocomial infections : People often acquire an infection during their stay in hospital.

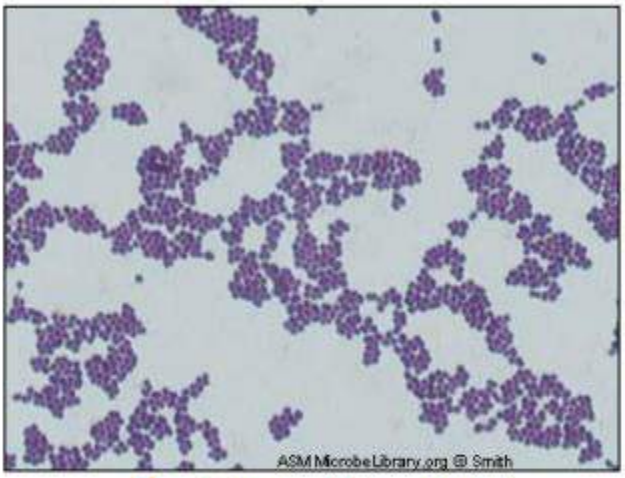
Important pathogenic bacteria

Staphylococcus genus

Staphylococcus (from the Greek: staphylē, "grape" and coccus, "granule") is a genus of dark Gram-positive bacteria. Under the microscope, they appear round (cocci), and form in grape-like clusters. produces catalase which is one feature that distinguishes them from catalase negative Streptococcus , has an appropriate cell wall structure (including peptidoglycan type and teichoic acid presence) and G + C content of DNA in a range of 30–40 mol%.

The Staphylococcus genus includes at least 40 species. Most are harmless and reside normally on the skin and mucous membranes of humans and other organisms. Found worldwide, they are a small component of soil microbial flora. are facultative anaerobes (capable of growth both aerobically and anaerobically). All species grow in the presence of bile salts. The most virulence species is S. aureus , almost all isolates of which secrete coagulase , an enzyme that causes citrated plasma to clot.

Staphylococci are hardly ,being resistant to heat and drying ,and thus can present for longtime on inurement objects , thus serve as source of infection



Staphylococcus Gr+ve cocci
grape-like irregular clusters

Taxonomy of staphylococcus

The taxonomy is based on 16s rRNA sequences, and most of the staphylococcal species fall into 11 clusters, a twelfth group has now been moved to a new genus Macrococcus, the species of which are currently the closest known relatives of the Staphylococci. Staphylococcus aureus A- Epidemiology : IS frequently carried by healthy individuals on the skin and mucous membrane carriers serve as a source of infection to them . B- Pathogenesis : Virulence factors are the genetic , biochemical , or structural

features that enable an organism to produce disease .Staphylococcus aureus expresses many potential virulence factors

1- Coagulase : Activity results in localized clotting , which restricts access by polymorphonuclear neutrophils (PMNS) and other immune defenses.

2- Cell wall virulence factors :

a- Capsule : Most clinical isolates express a polysaccharide "microcapsule" of type 5 or 8 , its very thin , but has been associated with increased resistance to phagocytosis .

b- Protein A: Is a major component of the S. aureus cell wall . It act as anti-phagocytic factor . c- Fibronectin – binding protein : Its one of surface proteins promote binding to mucosal cells and tissues matrices .

3- Cytolytic exotoxins: α ,β ,γ , and δ toxins attack mammalian cell (including RBC) membranes . , and often referred to as hemolysis .

4- Panton – Valentine leukocidin : Its pore forming toxin lyses PMNS .

5- Super antigens exotoxins : Which are responsible for causing toxic shock syndrome .

a- Enterotoxins : there are six types (A,B,C,D,E,and G), these enterotoxins cause food poisoning . Enterotoxins are super antigens that are even more heat – stable than S . aureus b- Toxic shock syndrome toxin (TSST-1): This is a classic cause of toxic shock syndrome (TSS). Because of similarities in molecular structures , its sometime reffered to as staphylococcal enterotoxin F although it does not cause food poisoning when ingested.

c- Exfoliatin (Exofoliative toxin, (ET)): Is also a super antigen , it causes Scalded skin syndrome in children .

Clinical significance :

1- Localized skin infections are small, superficial abscesses involving hair follicles (folliculitis) or sweat or sebaceous glands.

2- Deep, localized infections or skin carriage or may result from trauma.

3- Acute endocarditis: Generally associated with intravenous drug abuse , acute endocarditis is caused by injection of contaminated preparations or by needles contaminated with S. aureus .

4- Septicemia: Is a generalized infection with sepsis or bacteremia that may be associated with a known focus.

5- Pneumonia : S . aureus is a couse of sever necrotizing pneumonia .

6- Nosocomial infections: S . aureus is one of the most common causes of hospital- associated with catheters.

7- Toxinoses : These are diseases caused by the action of a toxin , frequently when the organism that secreted the toxic is undetectable . Toxinoses caused by S . aureus include

a- Toxic shock syndrome .

b- Staphylococcal gastroenteritis : caused by ingestion of food contaminated with enterotoxin-producing S . aureus , these food tend to be protein rich. Its heat resistance toxins are able to withstand subsequent reheating . the short incubation period of staphylococcal food poisoning occurs between the toxin in the food has already been formed by staphylococcal before the food is ingested .

c-Scalded skin syndrome.

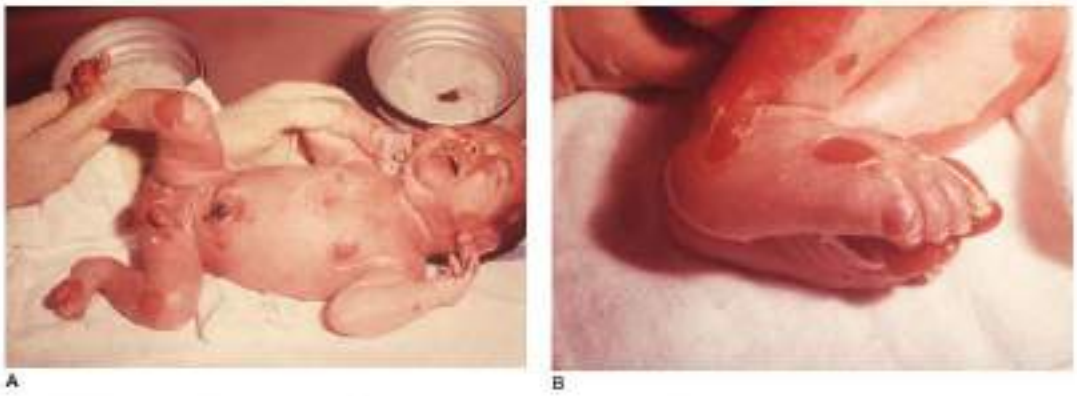


FIGURE 24-7. Staphylococcal scalded skin syndrome in a neonate. A. This infant has a small focal staphylococcal breast abscess and looks as if he has been sunburned or dipped in boiling water. **B.** Note the peeling of the superficial layers of the skin as a result of the action of circulating exfoliatin.

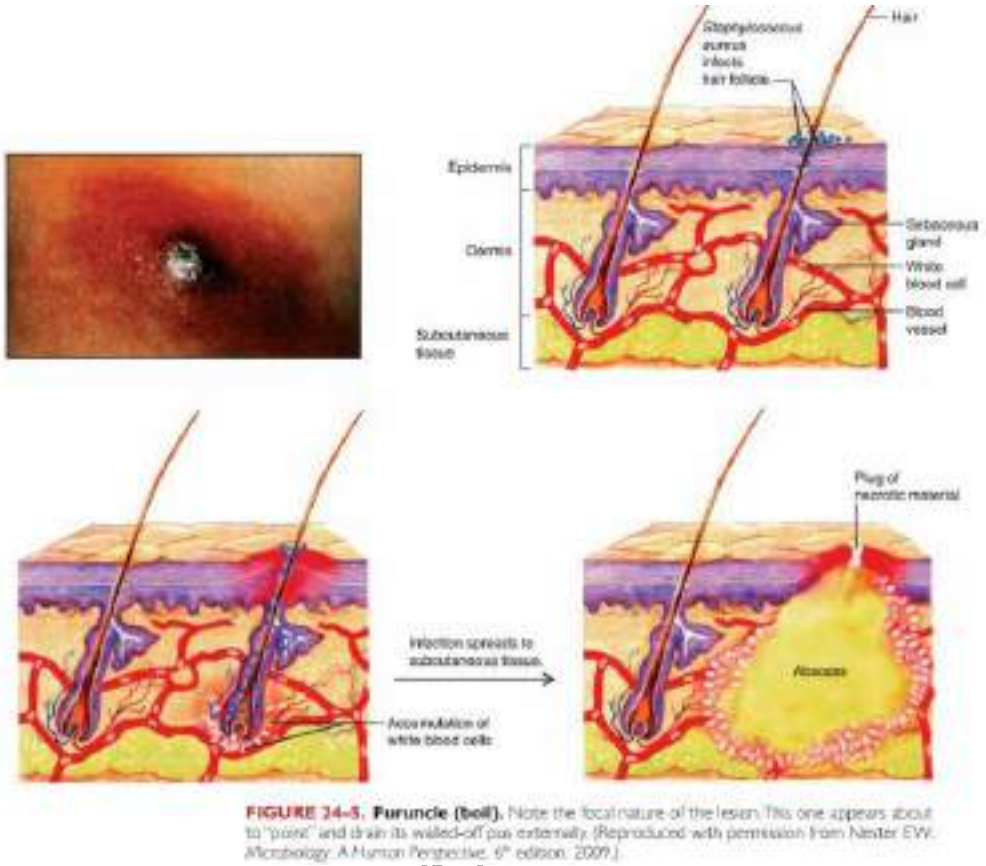


FIGURE 34–5. **Furuncle (boil).** Note the focal nature of the lesion. This one appears about to "point" and drain its walled-off pus externally. (Reproduced with permission from Nester EW: Microbiology: A Human Perspective, 6th edition, 2009.)

Laboratory identification:

1- Microscopic identification (G+) in grape like cluster . 2- Colony morphology 3- Catalase positive. 4- Mannitol positive. 5- Coagulase positive.

Treatment:

By using antibiotics . Because S . aureus become resistant to pencillin G , thus its need to replacement of initial agent (pencillin G) by β- lactamase – resistant pencillins , such as methicillin or oxacillin . However , increased use of methicillin and related antibiotics has resulted in S . aureus that is resistant to the number of β- lactam antibiotics , these strains are known as methicillin – resistant S . aureus .

1- Hospital – acquired methicillin resistant S . aureus (MRSA).

2- Community- acquired MRSA.

3- Vancomycin resistance : vancomycin has been the agent of choice for empiric treatment of life – threatening MRSA. S . aureus infections several MRSAs were isolated that had also acquired low- level vancomycin resistance .

4- Coagulase – negative Staphylococcus: that have been recovered as normal commensals of human skin and anterior nares , the most abundant and important is S. epidermidis , the second most important coagulase- negative staphylococcus is S. saprophyticus , both bacterium are important agents for hospital-acquired infections

A- S. epidermidis : Is present in large numbers as part of the normal flora of the skin , it is frequently recovered from blood cultures, generally as a contamination from skin .Its produces an extracellular polysaccharide material called polysaccharide intercellular adhesion (sometime called slime) that 16 facilitates adherence to bioprosthatic material surface such as intravenous catheters.

B- S.saprophyticus This organism is a frequently cause of cystitis in women , probably related to its occurrence as part of normal vaginal flora it tend to be sensitive to most antibiotics, even pencillin G . But we can distinguished from S. epidermidis by its natural resistance to novobiocin

S. epidermidis & *S. aureus* on Mannitol salt agar

S. aureus on Mannitol salt agar