

Lecture-7-

1. *Corynebacterium diphtheriae*
2. *Listeria*
3. *Bacillus anthracis*
4. *Propionibacterium acnes*

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Corynebacterium diphtheriae

Corynebacteria are small, slender, pleomorphic, gram-positive rods & Chinese letters. They are non motile, un encapsulated, and do not form spores, containing chromatin granules called volutin granules or Babes-Ernest granules present in cytoplasm and aggregated in the poles of the cells (staining by Albert stain).

Pathogenesis:

Diphtheria is caused by the local and systemic effects of a **single exotoxin that inhibits eukaryotic protein synthesis**. Diphtheria, caused by *C. diphtheriae*, is an acute **respiratory or cutaneous disease** and may be a life-threatening illness, diphtheria is a serious disease throughout the world, particularly in those countries where the population has not been immunized.

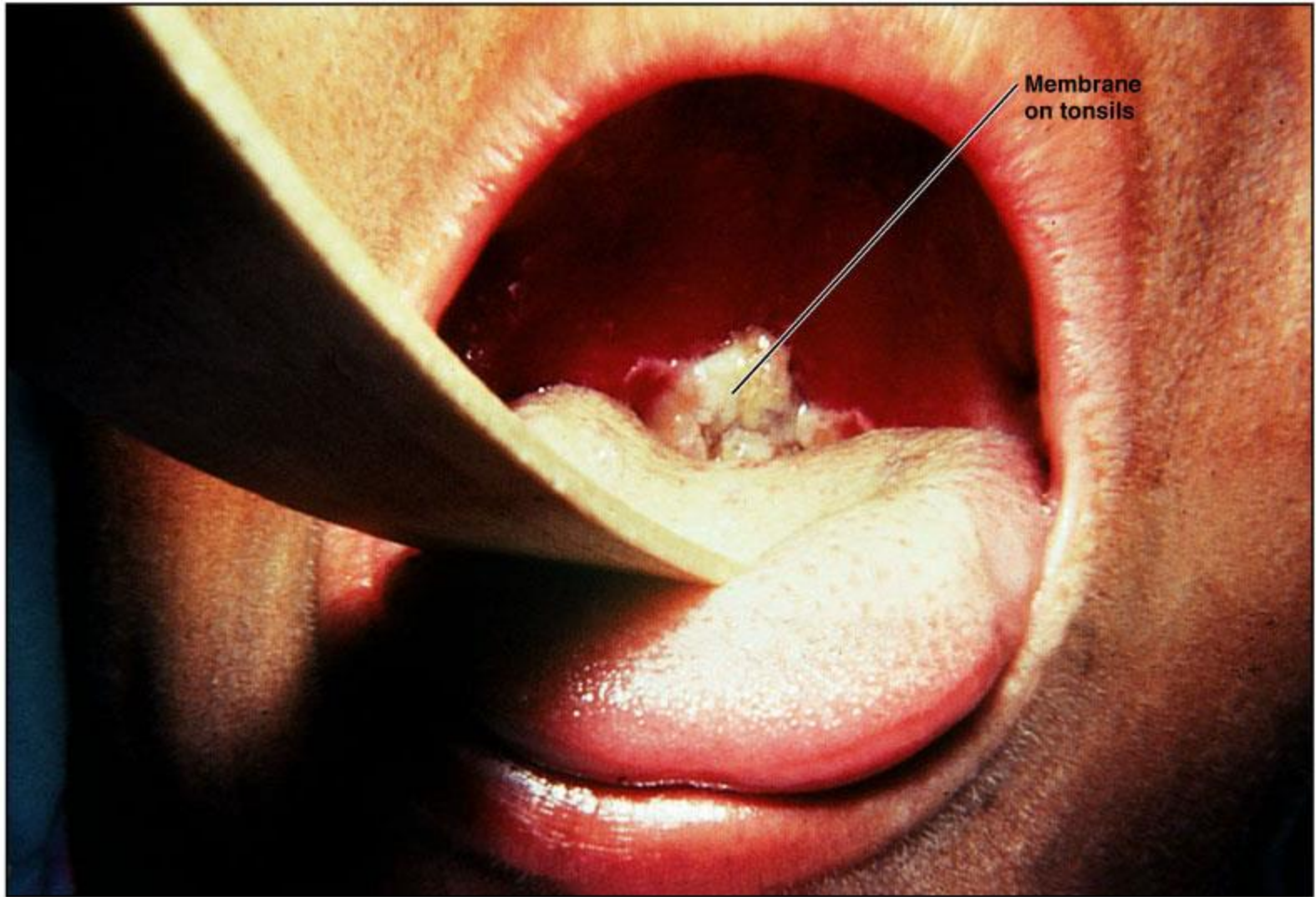


Clinical significance

Infection may result in clinical disease which has two forms respiratory and cutaneous or in an asymptomatic carrier state.

Upper respiratory tract infection: Diphtheria consists of a strictly local infection, usually of the throat. The infection produces a distinctive thick, grayish, adherent exudate (pseudomembrane) that is composed of cell debris from the mucosa and inflammatory products

Cutaneous diphtheria: A wound or cut in the skin can result in introduction of *C. diphtheriae* into the subcutaneous tissue, leading to a chronic, non healing ulcer with a gray membrane.



Membrane
on tonsils

- **Laboratory identification:**

Gram-positive rods & Chinese letters. They are containing chromatin granules called volutin granules or present in cytoplasm and aggregated in the poles of the cells (staining by Albert stain). Most species are facultative anaerobes, grow aerobically on standard laboratory media such as Chocolate & blood agar

- **Prevention:**

diphtheria prevention is immunization with toxoid, usually administered in the DPT triple vaccine, together with tetanus toxoid and pertussis antigens. The initial series of injections should be started in infancy. Booster injections of diphtheria toxoid (with tetanus toxoid) should be given at approximately ten-year intervals throughout life. The control of an epidemic outbreak of diphtheria involves rigorous immunization and a search for healthy carriers among patient contacts.

Antibiotics: Early administration of specific antitoxin against the toxin formed by the organism. 20000-100000 units are injected intramuscularly or intravenously . **Antimicrobial drugs :penicillin, erythromycin** inhibit the growth of diphtheria bacilli . Antibiotics reduce to just a few days the length of time that a person with diphtheria is contagious.

Listeria monocytogenes

- *Listeria* species are slender, short, gram-positive rods. They do not form spores. Sometimes they occur as diplobacilli or in short chains. *Listeria* species are catalase-positive, and display a distinctive tumbling motility. It has toxin called listeriolysin O. *L. monocytogenes* is the only species that infects humans.

- **Pathogenesis**

L. monocytogenes is intracellular parasite may be seen within host cells in (phagocytosis or macrophages). The organism attaches and enters of mammalian cells, apparently by normal phagocytosis; once internalized, it escapes from the phagocytic vacuole by elaborating listeriolysin O (a membrane-damaging) & it produced phospholipases (membrane degrading) then mediate the passage of the organism directly to a neighboring cell, allowing avoidance of the immune system.

• Clinical significance

L. monocytogenes enters the body through the gastrointestinal tract after ingestion of contaminated foods such as cheese or vegetables. Listeriosis – neonates Intrauterine infection may cause prematurity, early onset sepsis or granulomatosis infantiseptica can be: **Early-onset sepsis** (infection during pregnancy) **Late-onset sepsis** (infection at delivery, or later, hospital-acquired) Granulomatosis (cutaneous and visceral micro-abscesses), high mortality. Adults can develop listeria meningoencephalitis, Septicemia, bacteremia especially in immunosuppressed or immunocompromised patients

Listeria infections are most common in pregnant women, fetuses or newborns

Laboratory identification

The organism can be isolated from blood, cerebrospinal fluid, On blood agar, *L. monocytogenes* produces a small colony surrounded by a narrow zone of hemolysis.

Treatment Ampicillin with erythromycin or with intravenous trimethoprim-sulphamethoxazole. .

Gram (+) rods

Listeria species

Listeria monocytogenes in cerebrospinal fluid (Gram stain)

Listeria monocytogenes on blood agar

- Gram-positive, staining darkly
- Slender, short rods, sometimes occurring as diplobacilli or in short chains
- Intracellular parasites
- Catalase-positive
- Distinctive tumbling motility in liquid medium
- Grow facultatively on various enriched media

Listeria monocytogenes

- Listeriosis

Penicillins Ampicillin

Cephalosporins
Tetracyclines
Aminoglycosides
Macrolides
Fluoroquinolones

Other Trimethoprim/sulfamethoxazole

Bacillus is spores forming

It is gram-positive rods, nonmotile, encapsulated, and facultative aerobes. There 3 types: *B. anthracis*, *B. subtilis*, *B. ceseus*.

B. anthracis

Pathogenesis:

B. anthracis possesses a capsule that is antiphagocytic and is essential for full virulence. The organism also produces three exotoxins;

edema factor is responsible for the severe edema usually seen in *B. anthracis* infections;

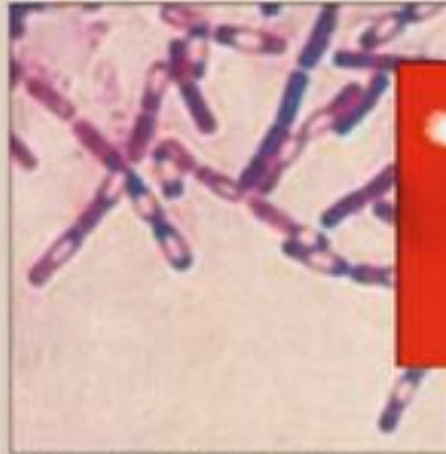
lethal toxin is responsible for tissue necrosis;

protective antigen mediates cell entry of edema factor and lethal toxin



Gram (+) rods

Bacillus species



Gram stain of *Bacillus anthracis* culture smear showing typical bacilli with highly refractile unstained spores



Usual nonhemolytic culture on blood agar

● Gram-positive

- Blunt-ended bacilli that occur singly, in pairs, or frequently, in long chains
- Form endospores—oval and centrally located
- Non-motile; have capsule that is antiphagocytic
- Facultative or strictly aerobic organisms
- Culture on blood agar

Bacillus anthracis

● Cutaneous anthrax

PENICILLINS
CEPHALOSPORINS

Tetracyclines 1 Doxycycline

AMINOGLYCOSIDES

Macrolides 1 Erythromycin

Fluoroquinolones 1 Ciprofloxacin

OTHER

● Pulmonary anthrax (wool sorter's disease)

Multidrug therapy (ciprofloxacin plus rifampin plus vancomycin) is recommended.



Cutaneous anthrax



Chest radiograph of a patient with pulmonary anthrax, showing widening of the mediastinum.



Clinical significance

- 1. Cutaneous anthrax:** About 95% of human cases of anthrax are cutaneous. Upon introduction of organisms or spores that germinate, a papule develops. It rapidly evolves into a painless, black, severely swollen malignant pustule, which eventually crusts over. The organisms may invade regional lymph nodes and then the general circulation, leading to fatal septicemia. Although some cases remain localized and heal, the overall mortality in untreated cutaneous anthrax is 20%.
- 2. Pulmonary anthrax** (wool sorter's disease) is caused by inhalation of spores. It is characterized by progressive hemorrhagic lymphadenitis (inflammation of the lymph nodes), and has a mortality rate approaching 100 percent if left untreated.
- 3. Gastrointestinal anthrax (rare):** the infection is acquired by ingestion of contaminated meat

Laboratory identification:

B. anthracis is easily recovered from clinical materials.

Microscopically, the organisms appear as blunt-ended bacilli that occur singly, in pairs, or frequently in long chains. They do not sporulate often in clinical samples, but do so in culture. The spores are oval and centrally located. On blood agar, the colonies are large, grayish, and nonhemolytic, with an irregular border.

Treatment:

Cutaneous anthrax responds to doxycycline, ciprofloxacin, or erythromycin. Multidrug therapy (ciprofloxacin + rifampin + vancomycin) is recommended for inhalation anthrax.

• Vaccines

- (AVA BioThrax) In the United States, the current FDA-approved vaccine (AVA BioThrax) is made from the supernatant of a cell free culture of an encapsulated but toxigenic strain of *B. anthracis*.
- Raxibacumab is a human monoclonal antibody against *Bacillus anthracis* protective antigen PA
- *Bacillus subtilis*, known also as the hay bacillus or grass bacillus, found in soil and the gastrointestinal tract of ruminants, humans and marine sponges

Bacillus cereus


- **Produces emetic toxin and enterotoxins.**
- **Food poisoning** caused by B cereus has two distinct forms,
- Emetic type, which is associated with cooked rice.
- nausea, vomiting, abdominal cramps, and occasionally diarrhea
- Incubation period of 1–24 hours
- Other infections; Eye infections, Endocarditis, meningitis, osteomyelitis, and pneumonia.
- Treatment: Vancomycin or Clindamycin with or without an aminoglycoside

• **Propionibacterium acnes**

P. acnes are members of the normal microbiota of the skin, oral cavity, large intestine, conjunctiva, and external ear canal. They are anaerobic or aerotolerant nonmotile Gram-positive bacillus arranged in short chains or clumps. Their metabolic products include propionic acid, from which the genus name derives. *Propionibacterium acnes*, often considered an opportunistic pathogen, causes the disease acne vulgaris in adolescents and young adults and is associated with a variety of inflammatory conditions. It causes acne by producing lipases that split free fatty acids off from skin lipids. These fatty acids can produce tissue inflammation that contributes to acne formation. This bacterium also produces array of enzymes that contribute to pathogenesis: like proteases and hyaluronidase. *P. acnes* colonize follicles of sebaceous glands which stimulate host inflammatory response and lead to rupture of follicles

Treatment: 1. Topical cleansing agent like benzoyl peroxide.
2. Antibiotic: erythromycin, tetracycline and clindamycin.



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- B 502 Q1 :draw the growth curve of the bacteria
 - C 503 Q1: enumerate the Koch postulates
 - A 501 Q1: draw the cell wall of G-ve and G+ve bacteria
 - D 504 Q1: enumerate the function of cell membrane