BACILLUS

There are two medically important *Bacillus* species: *Bacillus anthracis* and *Bacillus cereus*.

Bacillus* anthracis*:

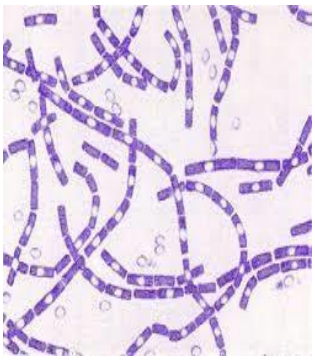
Important Properties

1- *B. anthracis* is a large gram-positive rod with square ends, frequently found in chains.

2- Its antiphagocytic capsule is composed of D-glutamate.

3- It is non motile , whereas other members of the genus are motile.

4-Anthrax toxin is encoded on one plasmid, and the polyglutamate capsule is encoded on a different plasmid.



Transmission

Spores of the organism persist in soil for years. Humans are most often infected cutaneously at the time of trauma to the skin, which allows the **spores on animal products,** such as hides, bristles, and wool, to enter. Spores can also be inhaled into the respiratory tract. Pulmonary (inhalation) anthrax occurs when spores are inhaled into the lungs. Gastrointestinal anthrax occurs when contaminated meat is ingested. Inhalation anthrax is not communicable from person to person, despite the severity of the infection. After being inhaled into the lung, the organism moves rapidly to the mediastinal lymph nodes, where it causes hemorrhagic mediastinitis. Because it leaves the lung so rapidly, it is not transmitted by the respiratory route to others.

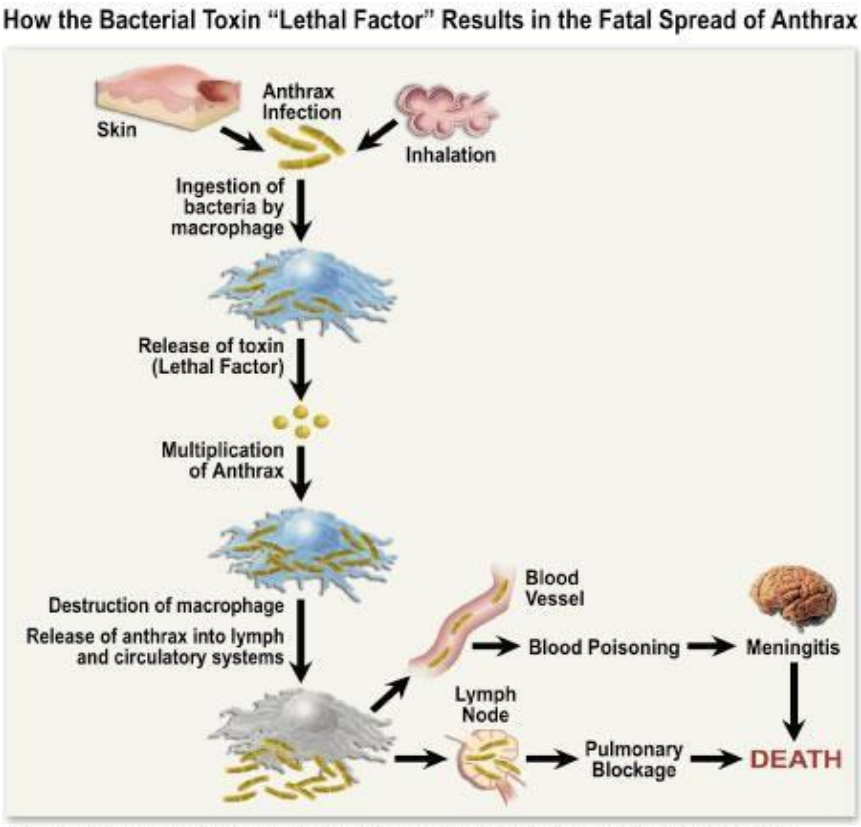
Pathogenesis:

Pathogenesis is based primarily on the production of two exotoxins, collectively known as anthrax toxin.

The two exotoxins:1- **edema factor** and 2- **lethal factor,** each consist of two proteins in an A–B subunit configuration. The B, or binding, subunit in each of the two exotoxins is **protective antigen**. The A, or active, subunit has enzymatic activity.

Edema factor: an exotoxin, is an **adenylate cyclase** that causes an increase in the intracellular concentration of cyclic adenosine monophosphate (AMP). This causes an outpouring of fluid from the cell into the extracellular space, which manifests as edema.

Lethal factor: is a protease that cleaves the phosphokinase that activates the mitogen-activated protein kinase (MAPK) signal transduction pathway. This pathway controls the growth of human cells, and cleavage of the phosphokinase inhibits cell growth. Protective antigen forms pores in the human cell membrane that allows edema factor and lethal factor to enter the cell.



Source: Dixon et al., Anthrax. New England Journal of Medicine 341:815-826, 1999.

The name protective antigen: refers to the fact that antibody against this protein protects against disease.

Clinical Findings

1- The typical lesion of cutaneous anthrax is a painless ulcer with a black eschar (crust,scab). Local edema is striking. The lesion is called a **malignant pustule**. Untreated cases progress to bacteremia and death.

2- Pulmonary (inhalation) anthrax, also known as "wool-sorter's disease," begins with nonspecific respiratory tract symptoms resembling influenza, especially a dry cough and substernal pressure. This rapidly progresses to hemorrhagic mediastinitis, bloody pleural effusions, septic shock, and death.

3- The symptoms of gastrointestinal anthrax include vomiting, abdominal pain, and bloody diarrhea.

Laboratory Diagnosis

1- Smears show large, gram-positive rods in chains .

2- Nonhemolytic colonies form on blood agar aerobically.

3- In case of a bioterror attack, rapid diagnosis can be performed in special laboratories using polymerase chain reaction (PCR)–based assays. 4- Another rapid diagnostic procedure is the direct fluorescent antibody test that detects antigens of the organism in the lesion.

5- Serologic tests, such as an enzyme-linked immunosorbent assay (ELISA) test for antibodies.

Treatment:

1- Ciprofloxacin is the drug of choice.

2- Doxycycline is an alternative drug.

Q1-Fill in the blanck?

1-There are two medically important *Bacillus* species: ---------- and ----------.

2- *B. anthracis* is a large gram---------- rod with square ends.

3-Anthrax toxin is encoded on one ----------.

4- The Pathogenesis of *B. anthracis* is based primarily on the production of two ----------, collectively known as ----------.

Q2- Define the following?

1- edema factor 2- lethal factor