

Pathogenic Microorganisms

3rd Class Module

Lecture

Bacillus Anthracis

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Bacillus Anthracis

General Features

- Genus bacillus consists of aerobic bacilli forming heat resistant spores
- Gram-positive but tend to be decolorized easily
- Generally motile with peritrichous flagella(exception *Anthrax bacillus*)
- Most form catalase and produce acid but not gas from glucose.
- The genus includes psychrophilic, mesophilic, and thermophilic species(25 to 75 °c and minimum from 5 °c)
- Spores are ubiquitous, being found in soil, dust, water and air, commonest
- contaminants in bacteriological culture media)
- Pathogenic species *B. anthracis* and *B. cereus*



- When conditions are not conducive to growth and multiplication of vegetative bacilli, *B. anthracis* tends to form spores.
- Sporulation requires a nutrient poor environment and the presence of free oxygen.
- The spore form is the predominant phase in the environment, can survive for decades in soil, and it is through the uptake of spores that anthrax is contracted.
- Heavy rains, alternating with dry periods, may concentrate the spores and result in outbreaks among grazing animals.
- The spore form of anthrax is markedly resistant to biological extremes of heat, cold, pH, desiccation, and chemicals (and thus to disinfection).
- Spores are not produced in the unopened carcass (within the anaerobic environment of an infected host the organism is in the vegetative form).
- It is estimated that 2,500 to 55,000 spores represent the lethal inhalation dose for humans.

Virulence Factors and Pathogenesis

-The pathogenesis depends on two important virulence factors:

- **Capsule:** (poly d-glutamic acid) interfere with phagocytosis, loss of plasmid which control capsule production leads to loss of virulence.

- **Anthrax Toxin:** Three component protein exotoxin
 1. Edema factor - Active fragment, induced by physiologic temperature, CO₂, and bicarbonate concentrations found in mammalian hosts

 2. Protective antigen - Binding fragment. Binds to the host cell receptors and facilitates the entry of other fragments into the host cells.

 3. Lethal factor - Causes cell death - Acts by cleaving host cell MAPK (mitogen-activated protein kinases).

The anthrax toxins are believed to play roles in two stages of infection. Early during infection, they target the immune response to allow survival in the host and to facilitate dissemination. In systemic disease, they target tissues and induce lethality.

Clinical Manifestations

Transmission: based on mode of infection human anthrax presents one of the three ways:

- Cutaneous mode—spores entering through the abraded skin.
- Inhalation of spores.
- Ingestion of carcasses of animals dying of anthrax containing.

Clinical Types

1. Cutaneous anthrax
2. Pulmonary anthrax
3. Intestinal anthrax – rare, occurs due to ingestion of spores.

1- Cutaneous anthrax: is the most common form of anthrax infection, and it is also considered to be the least dangerous. Infection usually develops from 1 to 7 days after exposure.

When anthrax spores get into the skin, usually through a cut or scrape, a person can develop cutaneous anthrax. This can happen when a person handles infected animals or contaminated animal products like wool, hides, or hair. Cutaneous anthrax is most common on the head, neck, forearms, and hands. It affects the skin and tissue around the site of infection.

2-Inhalation anthrax is considered to be the most deadly form of anthrax. Infection usually develops within a week after exposure, but it can take up to 2 months.

When a person breathes in anthrax spores, they can develop inhalation anthrax. People who work in places such as wool mills, slaughterhouses, and tanneries may breathe in the spores when working with infected animals or contaminated animal products from infected animals. Inhalation anthrax starts primarily in the lymph nodes in the chest before spreading throughout the rest of the body, ultimately causing severe breathing problems and shock.

3-Gastrointestinal anthrax has rarely been reported in the United States. Infection usually develops from 1 to 7 days after exposure.

When a person eats raw or undercooked meat from an animal infected with anthrax, they can develop gastrointestinal anthrax. Once ingested, anthrax spores can affect the upper gastrointestinal tract (throat and esophagus), stomach, and intestines, causing a wide variety of symptoms.