**University of Mosul**
**Lecture No.: 1**
**College of Veterinary Medicine**
**Date: 10/9/2024**
**Unit of Scientific Affairs**
**Website:**

**Lecture title:** **Anthrax**

**Lecturer Affiliation:** **College of Veterinary Medicine**

**Summary:**

***Etiology:***

*Bacillus anthracis*
Gram-positive, rod-shaped, square-ended, aerobic, immobile, capsulated, spore forming.
The bacteria produce spores on contact with oxygen. These spores are extremely resistant and survive for years in soil, or on wool or hair of infected animals.

**Epidemiology:**

- Occurrence
  - In tropical and subtropical climates with high annual rainfalls, the infection

persists in the soil, so that frequent, serious outbreaks of anthrax are commonly present.

- In temperate, cool climates
  - only sporadic outbreaks derive from the soil-borne infection
  - Accidental ingestion of contaminated bone meal or pasture contaminated by tannery effluent are more common sources

**Source of the infection:**

*B. anthracis* can infect animals directly from the soil or from fodder grown on infected
soil, from contaminated bone meal or protein concentrates, or from infected excreta, blood, or other discharges from infected animals.
Spread of the organism within an area may be accomplished by streams, insects, dogs, feral pigs, and other carnivores, and by fecal contamination from infected animals and birds

Introduction of infection into a new area is usually through contaminated animal products such as bone meal, fertilizers, hides, hair and wool, or by contaminated concentrates or forage.

## Transmission of the Infection:

Infection gains entrance to the body by ingestion, inhalation, or through the skin. It is generally considered that most animals are infected by the ingestion of contaminated food or water. Abrasions and wounds of the mucous membrane of the digestive are thought to serve as portal of entry for *B. anthracis.* Inhalation infection is thought to be of minor importance in animals.

"Woolsorter's disease" in humans is due to the inhalation of anthrax spores by workers in the wool and hair industries.
Biting flies, mosquitoes, ticks, and other insects have often been found to harbor anthrax organisms, and the ability of some to transmit the infection has been demonstrated experimentally.

## Risk Factors:

- **Host risk factors**

The disease occurs in all vertebrates but is most common in cattle and sheep and less frequent in goats and horses.

- Humans are less susceptible than animals mentioned above
- The relatively resistant animals are pigs, dogs, and cats

- Algerian sheep are considered to be resistant to the infection

- **Environment risk factors**

- Heavy rain after a prolonged drought, or dry summer months after prolonged rain, and always in warm weather when the environmental temperature is over 15°C.
- Close grazing of tough, scratchy feed in dry times, which results in abrasions of

the oral mucosa.

- Confined grazing on heavily contaminated areas around water holes.
- Some genotypes appear to persist better in calcium-rich soils and organic soils and poorly drained soils have risk in endemic areas.

## Pathogen risk factors:

Pathogenic strains of *B. anthracis* possess two important virulence factors: the **capsule** and the **toxin complex,** consisting of **three proteins known as protective antigen (PA)**, **lethal factor (LF),** and **edema factor (EF)**.

- The spores are resistant to most external influences including the salting of hides, normal environmental temperatures and standard disinfectants.

## Zoonotic Potential:

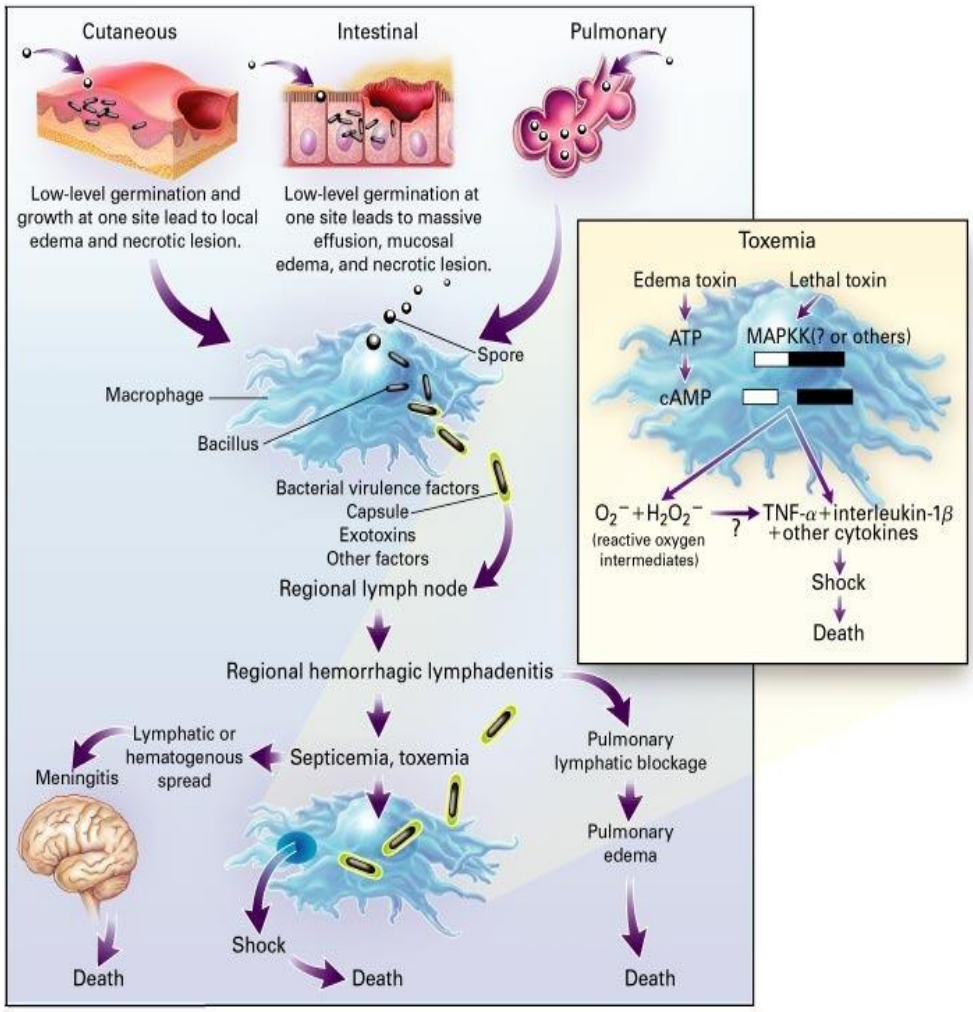
Anthrax has been an important cause of fatal human illness in most parts of the world. Humans can be infected through:

1. The alimentary form of this disease due to meat from infected animals or handle infected carcasses
2. Cutaneous anthrax
3. inhalational (pulmonary) anthrax
4. Meningitis (haemorrhagic leptomeningitis)

- It is a major concern as an agent of bioterrorism

## Pathogenesis:

Upon ingestion of the spores, infection may occur through the intact mucous membrane, through defects in the epithelium.
The organisms are resistant to phagocytosis and proliferate in regional draining lymph nodes, subsequently passing via the lymphatic vessels into the bloodstream; septicemia, with massive invasion of all body tissues. After that, *B. anthracis* produces a lethal toxin that causes edema and tissue damage, death resulting from shock and acute renal failure and terminal anoxia.



## Clinical Findings:

The incubation period is about 1-2 weeks.

## Cattle and sheep

The disease can occur in two forms:

## The peracute and acute forms

- **In peracute form:**

1. The animals are usually found dead without premonitory signs
2. The course being probably only 1-2 hours
3. Fever, muscle tremor, dyspnea, and congestion of the mucosae may be observed
4. The animal soon collapses, and dies after terminal convulsions.
5. After death, discharges of blood from the nostrils, mouth, anus, and vulva are common.

## Cattle and sheep:

- **The acute form:**

1. Runs a course of about 48 hours
2. Severe depression and listlessness are usually observed first
3. The body temperature is high, up to 42°C and the respiration rapid and deep
4. The mucosae congested and hemorrhagic, and the heart rate much increased.
5. Loss of appetite and ruminal stasis is evident.
6. Pregnant cows may abort. In milking cows the yield is very much reduced and the milk may be bloodstained or deep yellow in color.
7. Alimentary tract involvement is usual and is characterized by diarrhea and dysentery
8. Local edema of the tongue and edematous lesions in the region of the throat, sternum, perineum, and flanks may occur.

## Horses:

Anthrax in the horse is always acute and the course is usually 48-96 hours

- When infection is **by ingestion**: septicemia with enteritis and colic
- When infection is **by insect transmission**: hot, painful, edematous, subcutaneous swellings appear about the throat, lower neck, floor of the thorax and abdomen, prepuce, and mammary gland
- There is high fever and severe depression and there may be dyspnea due to swelling of the throat or colic due to intestinal irritation.

✓ **Anthrax is a reportable disease in many countries**

## Clinical Pathology:

### - Samples for Confirmation of Diagnosis

• **Bacteriology**—unopened carcass: blood or edema fluid in sealed, leakproof container

opened carcass: previously described samples plus spleen (local lymph nodes in horses) in sealed, leakproof containers (direct smear, culture, bioassay)

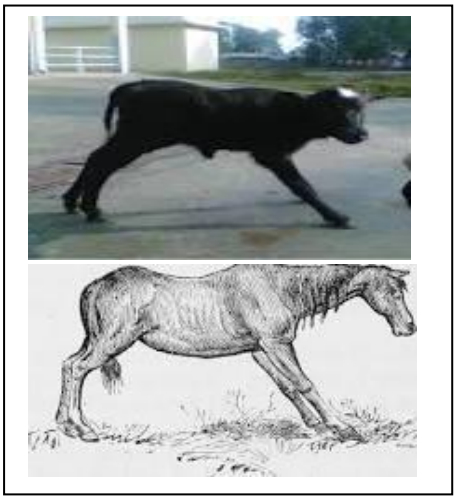
• **Histology**—formalin-fixed spleen/local lymph nodes if carcass has been opened (light microscopy).

1. The blood should be carefully collected in a syringe to avoid contamination of the environment.
2. Metachromatic capsule on square-ended bacilli (often in chains) in a blood smear stained with polychrome methylene blue
3. Fluorescent antibody techniques
4. Immunochromatographic test
5. Real-time quantitative PCR
6. Inoculation of experimental animals

## Necropsy Findings:

There is a striking absence of rigor mortis, and the carcass undergoes gaseous decomposition, quickly assuming the characteristic “sawhorse” posture. All natural orifices usually exude dark, tarry blood that does not clot

- In case of suspect diagnosis of anthrax **the carcass should not be opened.**



**At necropsy:**

The failure of the blood to clot, widespread ecchymoses, bloodstained serous fluid in the body cavities, severe enteritis and splenomegaly are strong indications of the presence of anthrax

**Differential Diagnosis:**

**Causes of sudden death:**

- Lightning strike
- Peracute blackleg
- Malignant edema
- Bacillary hemoglobinuria
- Hypomagnesemic tetany

**Treatment:**

1. Penicillin (20 000 IU/kg twice daily)
2. Streptomycin (8-10g in two doses intramuscularly)
3. Antiserum can be administered for at least 5 days in doses of 100-250 ml/ daily

## Control:

1. The carcass should not be opened, since exposure to oxygen will allow the bacteria to form spores
2. Premises are to be quarantined until all susceptible animals are vaccinated and all carcasses disposed of preferably by incineration or alternatively by deep burial with quick lime.
3. The carcass should be buried, and the burial should be at least (2 m) deep with an ample supply of quicklime
4. Cleaning and disinfection are important as is control of insects and rodents.