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Popular Article

## An overview on Anthrax

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### Introduction

- Anthrax is originated from the Greek word 'Anthrakis', means 'coal', and referring to the blackened eschar skin lesion. It is an acute infectious disease of all animals and human beings. It is acute infectious septicaemic disease commonly affecting herbivorous animals characterized by high fever, rapid course, sudden death and greatly enlarged spleen.
- In animals, anthrax is characterized by septicemia and sudden death, accompanied by the exudation of tarry coloured unclotted blood from the natural orifices (mouth, nose, ear, anus) and the important findings of failure of the blood to clot, absence of rigor mortis and bloaty appearance.

### Brief history

- In 1876-1877, the absolute proof of the etiology of anthrax was established by **Robert Koch** and named it, '*Bacillus anthracis*', and the famous "**Koch's postulates**" was formulated using anthrax as the model infection.
- In 1881, Louis Pasteur produced vaccine against anthrax.
- In 1939, Stern evolved a vaccine called "**Stern's vaccine / Spore vaccine**" and still used this technique for vaccine production for animals.



## Synonyms

- In humans: Woolsorter's disease (pneumonic anthrax or pulmonary anthrax), Rag-picker's disease, Knacker's disease, Hide-porter's disease (cutaneous anthrax), Malignant edema, Malignant carbuncle, Malignant pustule, Charbon, Milz brand disease, Splenic fever.

## Type of zoonosis

- Direct anthroozoonosis
- Occupational zoonosis

## Etiology

- Gram positive capsulated rod, spore forming '**BACILLUS ANTHRACIS**'
- *Bacillus anthracis*, is a Gram-positive, endospore-forming, rod-shaped (square-ended), non-motile and facultatively aerobic bacteria.
- Pathogenicity of anthrax bacilli depends on three factors, are
  - **Factor I:** Edema factor - Inflammatory property
  - **Factor II:** Protective antigen (PA) - Antiphagocytic and immunogenic factor.
  - **Factor III:** Lethal factor - Inflammatory property

## Transmission

- Cutaneous route
- Ingestion (Oral route)
- Inhalation (Respiratory route)
- Incidence

Anthrax is worldwide in distribution. In India, it is mostly seasonal, sporadic out breaks occurring usually in rainy season

## Susceptibility

- Sheep and cattle – Most susceptible
- Buffalo, horse, mule, goat, pig, rabbit and fowls.
- Man – Contact with animal or animal products (wool, hide, bristles) - '**Wool sorters disease**'

## Pathogenesis

- Incubation period: 1 to 14 days.
- Ingested bacilli proliferate in the tonsils and subsequently reach lymphatic glands.



- Bacilli reach the stomach are killed by gastric juice but the spores resist action and develop into bacilli in the intestine, penetrate the wall, reach lymphoid follicles and multiply.
- Those entering through wounds of skin proliferate in the connective tissue
- The organisms are inhibited or not killed by the cells of reticuloendothelial system due to the presence of a capsule and resist phagocytosis by neutrophils. -The capsule has fibrinolytic property and so prevents clotting of blood. It also produces a diffusible toxin which damage brain and other nerve cells.

### Toxin

- Factor I- oedema factor
- Factor II -Protective Antigen
- Factor III - Lethal factor
- The capsule swells by absorbing fluid and so becomes gelatinous.
- The gelatinous fluid cannot be absorbed and bacteria accumulate oedematous swellings form
- The bacterial toxin injure the endothelium causes hemorrhages - Effusion of blood in organs in which circulation is slow.
- The toxin causes nerve cell degeneration leads to apoplectic form of death
- Death within 12 to 36 hours
- Death – Asphyxia may be due to toxin acting on the respiratory centre in the brain
- Spores – Do not form in living animals
- Carcass –If opened spores form when they come in contact with environment
- **“Do not open carcass”**

### Disease in animals

- It primarily affects all warm-blooded animals, especially cattle, sheep, goats, horses and pigs. Algerian sheep and dwarf pigs are naturally resistant to anthrax.
- It is also recorded in dogs, chickens, elephants, camels, tigers, cats, etc.
- The morbidity and mortality are 70 to 80 and 1 to 5% in highly susceptible and less susceptible animals, respectively. But it is fatal in swine.
- Incubation period 1-5 days. It occurs as peracute, acute, subacute and rarely chronic form. In swine, it may be pharyngeal form, intestinal form and septicemic form.



- Anthrax is characterized by septicemia and sudden death, accompanied by the exudation of tarry colored unclotted blood from the natural orifices (mouth, nose, ear, anus) and the important findings of failure of the blood to clot, absence of rigor mortis and bloaty appearance.
- Carcass suspected for anthrax **MUST NOT BE OPENED**. In accidentally opened carcasses, splenomegaly (six time enlarged than the normal spleen) was observed, with "**black-berry jam consistency**" of spleen.

### **Disease in man**

- **Cutaneous form (Malignant pustule, Hide porter's disease)**
  - Most common form of anthrax in humans.
  - Incubation period ranges from 1 to 7 days, then an erythematous papule appears on an exposed area of skin and becomes vesicular, with a purple to black centre. The center of the lesion finally forms a necrotic eschar and sloughs.
  - Regional adenopathy, fever, malaise, headache, and nausea and vomiting may be present.
  - After the eschar sloughs, haematogenous spread and sepsis may occur, resulting in shock, cyanosis, sweating and collapse.
  - Haemorrhagic meningitis may also occur.
  - Case fatality may be 20% if not treated.
- **Pulmonary form (Woolsorter's disease)**
  - It occurs following the inhalation of spores from hides, bristles or wool.
  - Incubation period ranges from 1 to 5 days.
  - It is characterized by fever, cough, dyspnea, respiratory failure and death in 24 hours.
  - Case fatality may reach 100%.
- **Intestinal form**
  - Less common form of anthrax.
  - Incubation period ranges from 12 hours to 5 days.
  - It is characterized by anorexia, vomiting and diarrhoea.
  - Case fatality may be 50% if untreated.
  - Anthrax sepsis and anthrax meningitis can be developed in severe cases



## Clinical signs

- The disease may occur in a peracute, acute, subacute or chronic form.
- Death may takes place without symptoms in peracute form
- Discharge of dark tarry blood from the natural orifices
- In acute type- Increase temperature, excitement, weakness, cyanosis, dyspnoea, subcutaneous oedematous swelling
- Sheep, Horse – Subcutaneous oedema common
- Pigs – swelling on the throat and cervical lymph node enlargement is very characteristic

## Gross lesions

- Postmortem examination of anthrax carcass should not be conducted
- Oedema and haemorrhages may be seen in any part of the body, particularly in serous membrane.
- The spleen is greatly enlarged and engorged with dark unclotted blood
- Lymph nodes are swollen, oedematous and occasionally haemorrhagic

## Diagnosis

- History of the patient and clinical symptoms.
- **McFadyean's reaction:** Staining and identification of anthrax bacilli from the vesicular fluid or skin lesions, exudates of respiratory tract, blood by polychrome methylene blue staining or Giemsa's staining or Wright's staining.
- Culture and identification.
- On nutrient agar with aerobic condition, it produces virulent or rough bacilli with "**medusa-head appearance**" / "**curled-hair appearance**" / "**bamboo-rod like appearance**" / "**spiked appearance**" / "**judge-wig appearance**"
- On gelatin stab culture, it grows like "**inverted-fir tree**" (because, it is facultatively anaerobic)
- Animal inoculation (in guinea pigs or mice).
- **Ascoli's thermos-precipitation test** to detect antigen in the suspected materials.



## Treatment

- Cutaneous anthrax: Procaine penicillin - 1 million units i/m injection for every 12 to 24 hrs for 5 to 7 days.
- Pulmonary anthrax: Penicillin G - 2 million units i/v injection or Penicillin G - 500000 units i/v injection slowly for every 4 to 6 hrs until temperature returns to normal or Streptomycin - 1 to 2 g / day.
- Gastrointestinal anthrax: Ciprofloxacin 400 mg, every 12 hrs i/v injection and ampicillin - 500 mg i/v injection, every 8 hrs for five days, followed by injections ciprofloxacin - 500 mg twice a day and ampicillin - 500 mg at every 8 hrs interval for two weeks.
- Chloramphenicol, tetracycline, doxycycline and erythromycin can also be effective for anthrax.

## Prevention and Control

- Carcass disposal involves incineration or deep burial. Barns and fences should be disinfected with 10% sodium hydroxide or 3% peracetic acid.
- Protective measures to be taken while handling of infected wool and hide.
- Prevent the contact and ingestion of infected animal products.
- People handling dead carcasses suspected for anthrax must not have skin abrasions, should wear face mask, gum boots and protective clothing.
- In animals:
  - Using anthrax spore vaccine in animals can prevent the disease.
  - Disinfect wool or hair from animals in endemic areas with 10% formalin, 5% lye or 3% peracetic acid.
  - Two to three days before and after vaccination of animals, antibiotics should not be administered.
  - Pregnant animals should not be vaccinated.

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