Anthrax

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Definition of Anthrax

- **Anthrax** is an *acute* disease caused by the bacterium *Bacillus anthracis*. Most forms of the disease are lethal, and it affects both humans and animals. There are now effective vaccines against anthrax, and some forms of the disease respond well to antibiotic treatment.
Cutaneous Anthrax:
An acute illness, or post-mortem examination revealing a painless skin lesion developing over 2 to 6 days from a papular through a vesicular stage into a depressed black eschar with surrounding edema. Fever, malaise and lymphadenopathy may accompany the lesion.

Inhalation Anthrax:
An acute illness, or post-mortem examination revealing a prodrome resembling a viral respiratory illness, followed by hypoxia, dyspnea or acute respiratory distress with resulting cyanosis and shock. Radiological evidence of mediastinal widening or pleural effusion is common.

Gastrointestinal Anthrax:
An acute illness, or post-mortem examination revealing severe abdominal pain and tenderness, nausea, vomiting, hematemesis, bloody diarrhea, anorexia, fever, abdominal swelling and septicemia.

Meningeal Anthrax:
An acute illness, or post-mortem examination revealing fever, convulsions, coma, or meningeal signs. Signs of another form will likely be evident as this syndrome is usually secondary to the above syndromes.
“Anthrax”

- Originates from Greek for black or coal because of black eschar (characteristic of cutaneous form of anthrax)
- It is principally disease of herbivorous e.g. cattle, goat, sheep, cow but it has the potential to affect other mammals also.
- Human infection results from direct and indirect exposure to infected animals or occupational exposure to infected or contaminated animal products/
- Also known as Wool Sorter`s Disease or Malignant pustule
- Used as a weapon of Bioterrorism.
Anthrax Global Distribution

20,000 to 100,000 cases estimated globally/year

http://www.vetmed.lsu.edu/whoccs/mp_world.htm
## Anthrax Outbreak Scenario in WB: 2011 -13

<table>
<thead>
<tr>
<th>Year</th>
<th>District/State</th>
<th>No. of Outbreaks</th>
<th>No. of cases</th>
<th>No. of deaths</th>
<th>CFR %</th>
<th>No. of sample tested</th>
<th>No. of sample detected positive</th>
<th>SPR %</th>
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<tr>
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<td>70</td>
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Causal Agent:

- **Bacillus anthracis** - Gram positive non-motile, spore forming rod with a diameter of 1.5 µm and length of 5 µm, found in soil, herbs, vegetation, etc.

- Spores can remain viable for decades so used as bio-weapon. They are also resistant to heat, UV ray, radiation and most disinfectants.

- Spores are the predominant form in the environment.
Transmission

- It is a Zoonosis.
- Human infection occur as a result of contact with the infected animal or animal products e.g.- goat hair in textile mills, animal skin and contaminated articles.
- Modes: Inoculation of spores in breaks of skin, Inhalation of spores, Ingestion of contaminated food mainly meat.
- Human to Human Transmission are extremely rare.
THE CYCLE OF INFECTION IN ANTHRAX

**Ingested grazing**

**Spores**
- Spore-laden dust
- Infected meat
- Handling infected animal products
- Shed at death in haemorrhagic exudate from nose, mouth or anus or in spilt blood

**Herbivore**
- Germination & multiplication in lymphatics & spleen
- Vegetative forms released in massive numbers into the blood in final hours of life

**Sporulate on exposure to O2**
Anthrax Pathogenesis

Spore

Cutaneous
Low-level germination and growth at one site lead to local edema and necrotic lesion.

Intestinal
Low-level germination at one site leads to massive effusion, mucosal edema, and necrotic lesion.

Pulmonary

Macrophage

Bacillus
Bacterial virulence factors
Capsule
Exotoxins
Other factors
Regional lymph node
Regional hemorrhagic lymphadenitis

Meningitis
Lymphatic or hematogenous spread
Septicemia, toxemia

Pulmonary lymphatic blockage
Pulmonary edema

Toxemia
Edema toxin
Lethal toxin
ATP
MAPKK (? or others)
cAMP

O$_2^-$ + H$_2$O$_2^-$ (reactive oxygen intermediates)

TNF-α + interleukin-1β + other cytokines

Shock
Death
Human Transmission

- **Cutaneous**
  - Contact with infected tissues, wool, hide, soil
  - Biting flies
- **Inhalational**
  - Tanning hides, processing wool or bone
  - Direct inhalation of spores from contaminated articles (used for bioterrorism)
- **Gastrointestinal**
  - Undercooked meat specially
Human Transmission

- Tanneries
- Textile mills
- Wool sorters
- Bone processors
- Slaughterhouses
- Laboratory workers
- Bio weapon
Animal Transmission

- Bacteria present in hemorrhagic exudates from mouth, nose, anus
- Inhalation:
  - Spores form
  - Soil contamination
- Sporulation does not occur in a closed carcass
- Spores viable for decades
Animal Transmission

- Ingestion
  - Most common
  - Herbivores
    - Contaminated soil
    - Heavy rainfall, drought
  - Carnivores
    - Contaminated meat
- Inhalation
- Mechanical (insects)
Types

Mainly three types :

1. Cutaneous Anthrax
2. Pulmonary Anthrax
3. Gastro – intestinal Anthrax
Cutaneous Anthrax

- Commonest form: over 95% of all cases
- Incubation period: 2 - 6 days
- Papule, Vesicle, Ulcer followed by coaled black necrotic Escher
- Lesion – painless & non purulent
- Resolution of eschar occurs over 6 weeks and is not hastened by treatment
- Self limiting – over 90% resolve without complication.
অ্যানথ্রাকসা (রোগী)
অ্যানথ্রাক্স (রোগী)
অ্যানথ্রাকস (রোগী)
Pulmonary Anthrax

- Occur due to inhalation of spores from contaminated animal hides and products.
- Common among workers exposed occupationally to high concentration of viable spores.
- Incubation period – 1 day to 8 weeks.
- Clinical Presentation – Malaise, Fever, Cough, Nausea, drenching sweats, shortness of breath,
Pulmonary Anthrax

- In severe form – rapidly developed hypotension, cyanosis and death.
- CFR – Case fatality rate in unintervention is 100%.
- Survival was reported when antibiotic was given in prodromal period & multidrug regimen used.
Gastro – intestinal Anthrax

- Following ingestion of organism in contaminated food
- Incubation Period: 2 to 5 days
- Two clinical forms - Intestinal anthrax and Oropharyngeal anthrax
- Intestinal: nausea, vomiting, fever, abdominal pain, diarrhoea, haemetemesis, ascites, may be fatal.
- Oropharyngeal – sore throat, dysphagia, fever, lymphadenopathy in neck etc
Other form

- Anthrax Meningitis:
  - it is haemorrhagic also.
  - may develop in 30-40% cases.
  - 100% Mortality.
Anthrax and Biological Warfare

Countries > 10 countries in the world
Clouds of spores of Anthrax bacilli – aerosol (war heads filled with anthrax spores)
- Through dried spores in envelops
September 9/11 WTC attack
Postal workers affected – Inhalation anthrax
US – Columbia, Florida, New Jersey, N. York
Other parts of the world
Anthrax Bioterrorism Attacks—United States, 2001

- 22 cases (11 inhalation, 11 cutaneous) in 4 states and DC
- *B. anthracis* sent through U.S. mail
- Most exposures occurred in mail sorting facilities and sites where mail was opened
Biological Terrorism: Estimated Effects

- **50 kg of spores**
  - Urban area of 5 million
  - Estimated impact
    - 250,000 cases of anthrax
    - 100,000 deaths

- **100 kg of spores**
  - Upwind of Washington D.C.
  - Estimated impact
    - 130,000 to 3 million deaths
Safe Mail Handling

- Do not open suspicious mail
  - inappropriate or unusual labeling
  - strange or no return address
  - postmark different from return address
  - excessive packaging material
- Keep mail away from face
- No not blow or sniff mail or mail contents
- Wash hands after handling
- Avoid vigorous handling (tearing, shredding)
- Discard envelopes
Diagnosis

- Clinical and History of exposure.
- Bacteriology – Gram Stain & Culture
- Serology – ELISA for anthrax antibodies,
  - Detection indicates past infection or vaccination while a four fold rise in titers indicate recent infection.
- PCR
SPECIMEN TO COLLECT (HUMAN ANTHRAX)

Cutaneous anthrax: Vesicular exudate – swabs and capillary tube aspirate

Intestinal anthrax: - Stool sample - isolate – guinea pig inoculation
    - Blood (venipuncture) smear examination for bacilli
    - Peritoneal fluid for culture
    - Paired sera for Ab

Pulmonary anthrax: If mild disease (No sample)
Severely ill – Blood, sputum, serum samples for Ab
Treatment

• Prompt and timely antibiotic therapy

• Penicillin is yet the antibiotic of choice

• Other antibiotics – Chloramphenicol, Tetracycline, Doxycycline, Fluoroquinolones, Erythromycin
During the Bioterrorism attack in 2001 in USA, it was found that using two or more antibiotics intravenously improved survival.

CDC protocols issued after the bioterrorism attacks recommend ciprofloxacin 400 mg BD or Doxycycline 100 mg BD for a total of 60 days.

Treatment remains same for pregnant women and immunocompromised individuals.
Disinfection

• Preliminary disinfection
  • 10% formaldehyde
  • 4% glutaraldehyde (pH 8.0-8.5)

• Cleaning
  • Hot water, scrubbing, protective clothing

• Final disinfection: one of the following
  • 10% formaldehyde
  • 4% glutaraldehyde (pH 8.0-8.5)
  • 3% hydrogen peroxide,
  • 1% peracetic acid
Protection of susceptible humans

- Vaccination – restricted to those who are at occupational risk.
- Vaccination by 6 subcutaneous doses at 0, 2 and 4 weeks followed by 6, 12 and 18 months.
- Chemoprophylaxis – US Army recommends Ciprofloxacin or Doxycycline for four weeks for unimmunized high risk individuals.
- A longer duration of chemoprophylaxis is required for complete clearance of spores from lung.
Prevention & Control

- Integrated plan of control activities with Health, Animal husbandry, PRI and other related sectors
- Screening of animals
- Control of the disease in animals is key to prevention of anthrax in humans
- Quarantine the area
- Vaccination of susceptible animals
- Correct disposal of infected carcasses by deep burial
- Proper disinfection, decontamination and disposal of contaminated materials.
Prevention & Control

- Early diagnosis and prompt treatment (both for human and animals).
- Chemoprophylaxis of contacts with specific antibiotics (Doxycycline, Ciprofloxacin)
- Awareness campaign (IEC and BCC)
  - prompt information sharing
  - seeking health advice
  - proper handling of animals in slaughter house, tanning industry, etc
  - not to kill sick animals for consumption, proper cooking of specially meat products, deep burial of the dead animals.
THANK YOU