Clinical Anthrax

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Anthrax: Basics

- Caused by the spore-forming bacterium, *Bacillus anthracis*
- Zoonotic disease in herbivores (e.g., sheep, goats, cattle), follows ingestion of spores in soil
- Human infection acquired through contact with anthrax-infected animals or animal products or through intentional exposure
- Three clinical forms
  - Cutaneous
  - Inhalational
  - Gastrointestinal
Anthrax: Etiology

- *B. anthracis*
  - Gram positive, spore forming, non-motile bacillus
Anthrax: Clinical Forms

Cutaneous:

- Begins as a papule, progresses through a vesicular stage, to a depressed black necrotic ulcer (eschar)
- Edema, redness, and/or necrosis without ulceration may occur
- Form most commonly encountered in naturally occurring cases
Anthrax: Clinical Forms

Inhalational:
- A brief prodrome resembling a “viral-like” illness, characterized by myalgia, fatigue, fever, with or without respiratory symptoms, followed by hypoxia and dyspnea, often with radiographic evidence of mediastinal widening.
- Meningitis in 50% of patients
- Extremely rare in U.S. (20 reported cases in last century)
Anthrax: Clinical Forms

Gastrointestinal:

– Abdominal distress, usually accompanied by bloody vomiting or diarrhea, followed by fever and signs of septicemia
– Gastrointestinal illness sometimes seen as oropharyngeal ulcerations with cervical adenopathy and fever
– Develops after ingestion of contaminated, poorly cooked meat.
Bacillus anthracis: Virulence Factors

- Capsule inhibits phagocytosis
- pX01
- pX02
- Edema Factor
- Protective Antigen
- Lethal Factor
Pathogenesis of Anthrax

Spores

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

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

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

TNF-$

+ interleukin-1$

+ other cytokines

Shock
Death

Regional lymph node
Regional hemorrhagic lymphadenitis

Bacterial virulence factors
Capsule
Exotoxins
Other factors

Meningitis
Septicemia, toxemia
Pulmonary edema
Pulmonary lymphatic blockage

Death
Shock

Lymphatic or hematogenous spread

CDC

NEJM 1999; 341: 815-826
Anthrax: Cutaneous

Vesicle development
Day 2

Day 4

Eschar formation

Day 6

Day 10
Left, **Forearm lesion on day 7** - vesiculation and ulceration of initial macular or papular anthrax skin lesion. Right, **Eschar of the neck on day 15** of illness, typical of the last stage of the lesion. From Binford CH, Connor DH, eds. *Pathology of Tropical and Extraordinary Diseases*. Vol 1. Washington, DC: AFIP; 1976:119. AFIP negative 71-1290-2.
Anthrax: Cutaneous
Anthrax: Cutaneous

Ulcer and vesicle ring

Black eschar, Redness remains
Anthrax: Cutaneous

Notice the edema and typical lesions
Inhalational Anthrax

- Inhalation of spores
- Incubation, 2-3 days (range up to 60 days)
- Spores engulfed by macrophages and transported to mediastinal and peribronchial lymph nodes
- Insidious onset: malaise, low grade fever, nonproductive cough
- Abrupt development of respiratory distress
- Hemorrhagic mediastinitis
- Hematogenous spread
- Meningitis in 50%, usually fatal
Anthrax: Inhalational
Mediastinal Widening and Pleural Effusion on Chest X-Ray in Inhalational Anthrax
Differential Diagnosis of Cutaneous Anthrax

- Spider bite
- Ecthyma gangrenosum
- Ulceroglandular tularemia
- Plague
- Staphylococcal or streptococcal cellulitis
Differential Diagnosis of Inhalational Anthrax

- Mycoplasmal pneumonia
- Legionnaires’ disease
- Psittacosis
- Tularemia
- Q fever
- Viral pneumonia
- Histoplasmosis (fibrous mediastinitis)
- Coccidioidomycosis
Anthrax: Diagnosis

Cutaneous:

- Eschar
- Culture of vesicular fluid or exudate
- Blood culture
- Biopsy
- PCR
- Immunofluorescence and immunohistochemistry
Anthrax: Diagnosis

Inhalational:

- CXR - widened mediastinum, pleural effusions
- Blood or CSF culture and Gram stain
- PCR
- Immunofluorescence and immunohistochemistry
Anthrax: Reminders

- Individuals must be exposed to *B. Anthracis* spores.
- To cause disease, *B. anthracis* spores must enter the skin, be swallowed, or inhaled.
- Disease can be prevented after exposure to anthrax spores by early treatment with appropriate antibiotics.
- Anthrax is NOT spread from person to person.