

Bioterrorist Threats: Sources, Recognition, & Safety

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This Presentation is Approved for
1 CRCE Credit Hour

Learning Objectives

- Describe the etiology, manifestations, management, & safety precautions related to likely bioterrorist threats

Anthrax

History

- Book of Exodus: 5th & 6th plagues of Egypt (boils)
- 1600s: "Black Bane" kills cattle in Europe
- 1880: Immunization of cattle
- 1915: First used as a bioweapon - against cattle
- 1950s-60s: U.S. develops bioweapons

History

- 1969: U.S. ends bioweapons program
- 1970: Anthrax vaccine is FDA approved
- 1972: International convention outlaws biological weapons
- 1995: Iraq admits to producing 8,500 L of anthrax weapon
- 2001: Letter containing anthrax is mailed to NBC

Etiology

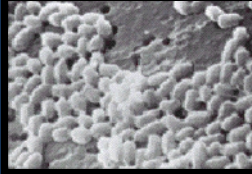
- Causative organism: bacillus anthracis
 - ❖ Gram-positive, spore-forming rod
 - ❖ Spore-forming → very tough organism
 - ❖ Occurs globally, esp. in developing countries
 - ❖ Primarily infects herbivores
 - ❖ Produces lethal toxin

Etiology

- > Bacillus anthracis



Vegetative organism



Spores on SEM

Routes for Transmission

- > Cutaneous: most common
- > Gastrointestinal: ingestion of poorly cooked meat from infected animals
- > Inhalation of dust that contains spores - woolsorter's disease

Cutaneous Anthrax

- > Etiology & pathogenesis
 - ❖ Introduced via skin or mucus membrane through cut or abrasion
 - ❖ Spores germinate & multiply
- > Manifestations: skin lesion
 - ❖ Develops 12 - 36 H after infection
 - ❖ Resembles bug or spider bite
 - ❖ Black eschar develops

Cutaneous Anthrax



See links below to view more cutaneous anthrax

Cutaneous Anthrax

- > Manifestations
 - ❖ Proximal lymphedema develops
 - ❖ Infection disseminates
 - Septicemia
 - Meningitis
 - ❖ Frequently fatal, if untreated

Gastrointestinal Anthrax

- > Manifestations: inflammation of GI tract
 - ❖ Nausea
 - ❖ Hematemesis
 - ❖ Fever
 - ❖ Acute abdomen - abdominal pain
 - ❖ Severe diarrhea
 - ❖ Sepsis
- > High mortality rate

Inhalational (Pulmonary) Anthrax

- > Etiology: inhalation of spores
 - ❖ Special processing for deposition
 - ❖ 1 - 5 micron
 - ❖ Too large: upper airway deposition
 - ❖ Too small: exhaled

Inhalational (Pulmonary) Anthrax

- > Incubation period: generally 3-5 D, depends on germination rate
- > Manifestations - early
 - ❖ Fever, chills
 - ❖ Dyspnea
 - ❖ Cough
 - ❖ Headache
 - ❖ Nausea & vomiting
 - ❖ Chest pain

Inhalational (Pulmonary) Anthrax

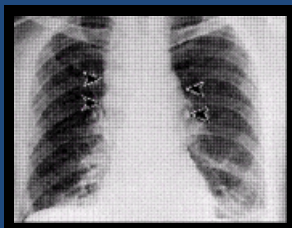
- > Manifestations: fulmination
 - ❖ Fever
 - ❖ Dyspnea
 - ❖ Stridor: mediastinal enlargement
 - ❖ Diaphoresis

Inhalational (Pulmonary) Anthrax

- > Manifestations: fulmination
 - ❖ Fever
 - ❖ Dyspnea
 - ❖ Stridor: mediastinal enlargement
 - ❖ Diaphoresis
 - ❖ Shock
 - ❖ Hemorrhagic meningitis: delirium
 - ❖ Hypoxemia

Inhalational (Pulmonary) Anthrax

- > Chest x-ray: mediastinal widening



Anthrax

- > Diagnosis
 - ❖ Index of suspicion: exposure risk
 - Occupation
 - Location
 - ❖ Pathognomonic
 - Previously healthy adult
 - Overwhelming flu-like signs
 - Widened mediastinum

Anthrax

- > Diagnosis
 - ❖ Sputum exams are **NOT** useful
 - ❖ Standard blood culture: growth in 6 - 24 H
- > Pathology: hemorrhagic, necrotizing pneumonic lesion

Anthrax

- > Management
 - ❖ Antibiotics: susceptible to
 - Ciproflaxin
 - Doxycycline
 - Penicillin
 - Amoxicillin
 - Chloramphenicol
 - Rifampin
 - ❖ **NOT** susceptible to cephalosporins

Anthrax

- > Management
 - ❖ Supplemental oxygen
 - ❖ Mechanical ventilation
 - ❖ Vasopressors for shock
 - ❖ Other supportive measures

Anthrax

- > Prevention
 - ❖ Direct, person-to-person spread is unlikely
 - ❖ Universal precautions for patient care: no special barriers
 - ❖ Antibiotics for suspected exposure (60 D)

Anthrax

- > Prevention: vaccination
 - ❖ Human live attenuated vaccine
 - Three injections, two weeks apart
 - Three injections at 6, 12, 18 mo.

Anthrax

- > Prevention: vaccination
 - ❖ Adverse reactions
 - Soreness, edema at injection site
 - Fever, nausea, headaches (5 - 35%)
 - Serious events 1:50,000 doses

Anthrax

- > Decontamination
 - ❖ Bleach
 - ❖ Sandia foam: new, safe
 - ❖ Formaldehyde
 - ❖ Nanoemulsion

Anthrax

- > Why anthrax?
 - > It is tough
 - ❖ Sunshine kills spores
 - ❖ Heat does not kill
 - ❖ Explosion does not kill → can be dispersed by explosive shells

Smallpox

History

- 10,000 BC: Believed to have appeared in Africa
- 1350 BC: First recorded epidemic in Egypt
- 180 AD: Major epidemic coincides with fall of Roman empire
- 1500-1800 AD: Introduction of smallpox to New World decimates native population

History

- 1763: Biological warfare by placing smallpox scabs in blankets given to Native Americans
- 1600: Chinese introduced variolation, an early vaccination
- 1796: Jenner uses cowpox extract to vaccinate against smallpox

History

- 1967: World Health Organization campaign to eradicate smallpox
- 1972: Routine vaccination ceased
- 1980: WHO recommends cessation of vaccination
- 1980: Soviet government initiates program to produce large quantities of smallpox

WHO Poster: 1980



Etiology

- Causative organism: variola virus
 - ❖ DNA virus
 - ❖ Very infectious
 - ❖ Related to
 - Cowpox
 - Monkeypox
 - Vaccinia virus
 - ❖ Variola major: more virulent form
 - ❖ Variola minor: less virulent

Pathogenesis

- Transmission mode: person-to-person via droplet nuclei
- Virus implants on oropharyngeal or respiratory mucosa
- Only few virions are required to produce disease
- Viruses migrate & multiply in regional lymph nodes, spleen, & bone marrow
- Incubation: about 12 D

Manifestations: Variola Major

- Fever
- Malaise
- Headache, backache
- Maculopapular rash
 - ❖ Oropharyngeal mucosa
 - ❖ Face
 - ❖ Forearms
 - ❖ Trunk
 - ❖ Legs

Manifestations: Variola Major

- Smallpox rash



Manifestations: Variola Major

- Smallpox rash



Manifestations: Variola Major

- Rash becomes pustular
- Large amount of virus in saliva: most infectious phase
- Scabs develop
- Toxemia
- Encephalitis
- Mortality (30%): 5th or 6th day after onset of rash

Variola: Alternate Forms

- Malignant
 - ❖ Abrupt onset
 - ❖ Frequently fatal
- Hemorrhagic
 - ❖ Rash hemorrhages
 - ❖ Frequently fatal

Variola: Alternate Forms

- Variola minor
 - ❖ Fewer constitutional symptoms
 - ❖ Sparser rash
- Partially immune victims: similar to variola minor

Diagnosis

- One suspected case → international health emergency
- Characteristic rash
 - ❖ Centrifugal distribution
 - ❖ Same stage of development at each location
 - ❖ Palmar & plantar location
 - ❖ Confirmed by laboratory analysis

Diagnosis

- Management
 - ❖ Strict isolation
 - ❖ Supportive care
 - ❖ Antibiotics for secondary bacterial infection
 - ❖ Antiviral agents
 - Currently, none are approved
 - Agents for HIV have potential

Prevention

- Post-exposure control
 - ❖ All face-to-face contacts with victim
 - Vaccinated
 - Surveillance for fever, rash
 - ❖ Home care recommended for victims
 - ❖ Vaccination of healthcare workers, police, transit workers, etc.

Hospital Infection Control

- Smallpox spreads easily by droplets
- Rooms: negative pressure with HEPA
- Vaccination of employees, patients
- Laundry & waste- biohazards

Botulism

History

- First identified as poison from sausage (botulus = sausage)
- 1735: First case described
- 1897: Botulism toxin identified
- 1930s: Japanese used as weapon
- 1991: Iraq admits to producing 19,000 L of botulism toxin

Etiology

- Causative organism: clostridium botulinum bacterium
 - ❖ Widespread, soilborne
 - ❖ Obligate anaerobe
 - ❖ Spore-forming
 - ❖ Produces botulinum neurotoxin
 - Colorless
 - Odorless, tasteless
 - Inactivated by heat

Forms

- Food-borne: ingestion of toxin in foods that have not been canned or preserved properly

Forms

- Wound botulism, systemic spread of toxin produced by organisms inhabiting wounds, associated with
 - ❖ Trauma
 - ❖ Surgery
 - ❖ Subcutaneous heroin injection
 - ❖ Sinusitis from intranasal cocaine abuse

Forms

- Infant botulism
 - ❖ Intestinal colonization of organisms in infants younger than 1 year
 - ❖ Associated with ingestion of honey by infants

Modes of Toxin Transmission

- Food: almost all types
- Aerosol: bioterrorism
- Water supply: unlikely because water treatment deactivates toxin

Manifestations

- Incubation: 2 H to 8 D after exposure, ingestion
- Diplopia
- Blurred vision
- Dysphonia
- Dysphagia
- Dysarthria
- Loss of gag reflex

Manifestations

- Paralysis
 - ❖ Loss of head control
 - ❖ Generalized weakness
 - ❖ Diaphragm & accessory ventilatory muscles
 - ❖ Recovery in weeks to months

Manifestations

- Pathognomonic
 - ❖ Symmetric, descending paralysis
 - ❖ Afebrile patient
 - ❖ Normal sensorium

Diagnosis

- Differential diagnosis - rule out
 - ❖ Guillain-Barre syndrome
 - ❖ Myasthenia gravis
 - ❖ Poliomyelitis
- Laboratory tests: available only at CDC
 - ❖ Blood
 - ❖ Gastric aspirates
 - ❖ Stool

Management

- > Botulism is **NOT** an infection
- > Evaluate airway & breathing
 - ❖ Loss of gag reflex → intubation
 - ❖ Loss of ventilatory muscles → ventilation

Management

- > Botulism antitoxin: **STAT**
 - ❖ Minimizes severity
 - ❖ Does not reverse existing paralysis

Prevention

- > Botulism toxoid: immunization
- > Botulism antitoxin
 - ❖ Post-exposure prevention
 - ❖ Scarce

Prevention

- > Decontamination: usual procedures
- > Infection control
 - ❖ No isolation necessary
 - ❖ Universal precautions

Plague

History

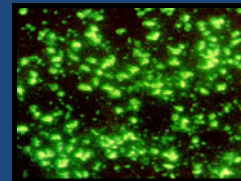
- > Naturally occurring plague: ancient
- > 425 BC: first recorded epidemic in Athens
- > 540 AD: first recorded pandemic
- > 1340 AD: pandemic from China to Europe, killing 1/3 of Europeans
- > 1400s AD: used as biological weapon by Tatars
- > 1665 AD: great plague of London

History

- > 1894: causative organism identified by Yersin, 'yersinia pestis'
- > Present day
 - ❖ Natural epidemics recur
 - ❖ Organism present in rodents, worldwide, including Western U.S.
- > WWII: used by Japan as biological weapon
- > Soviet Union developed large quantities of weapon-grade plague

Etiology

- > Causative organism
 - ❖ Yersinia pestis
 - ❖ Gram-negative bacillus



Etiology

- > Causative organism: yersinia pestis
- > Insect vector: x. cheopis flea
- > Animal reservoir: rodents
 - ❖ Rats
 - ❖ Mice
 - ❖ Prairie dogs
 - ❖ Ground squirrels

Forms

- > Bubonic: buboes are infected lymph glands
- > Pneumonic: pulmonary infection
- > Septicemic: disseminated to blood

Transmission Modes

- > Bites of infected fleas: bubonic form
- > Aerosol
 - ❖ Pneumonic
 - ❖ Biological weapon

Manifestations: Bubonic

- > Incubation: bubonic 2-10 D
- > Malaise
- > High fever
- > Lymph glands
 - ❖ Swollen & tender
 - ❖ May progress to buboes
- > Leukocytosis
- > Mortality 50%, if untreated

Manifestations: Bubonic



Manifestations: Bubonic

- > Incubation 2-3 D
- > Malaise
- > High fever, chills
- > Headache
- > Hemoptysis
- > Leukocytemia

Manifestations: Pneumonic

- > Rapidly progressive bronchopneumonia
- > Dyspnea
- > Stridor
- > Hypoxemia
- > Mortality: 100% if untreated

Diagnosis

- > Index of suspicion: sudden outbreak of severe pneumonia & sepsis
- > Gram stain: sputum or blood, gram negative bipolar rod

Management

- > Antibiotics: initiate **STAT**
 - ❖ Streptomycin: drug of choice
 - ❖ Gentamycin
 - ❖ Doxycycline
 - ❖ Tetracycline
 - ❖ Chloramphenicol
 - ❖ Trimethoprim-sulfamethoxazole
 - ❖ **NOT** cephalosporins

Management

- > Supportive measures
 - ❖ Oxygen
 - ❖ Mechanical ventilation

Prevention

- Post-exposure antibiotics: seven days post-exposure
 - ❖ Tetracycline
 - ❖ Doxycycline
 - ❖ TMP-SMT
 - ❖ Chloramphenicol

Prevention

- Isolation
 - ❖ Respiratory isolation of patient for first 48 hours
 - ❖ Close contacts who refuse chemoprophylaxis
- Vaccine: limited availability
- Decontamination: usual measures

Additional Bioterrorist Threats

- Tularemia: extremely infectious bacterium
- Ebola: rapidly fatal virus
- Aflatoxin: carcinogen
- Clostridium perfringens: gangrene
- Ricin: slow poison

Summary & Review

- Anthrax
 - ❖ Antracis bacillus
 - ❖ Cutaneous, gastrointestinal, pulmonary
 - ❖ Pulmonary manifestations
 - ❖ Management
 - ❖ Prevention: immunization, chemoprophylaxis
 - ❖ Universal precautions

Summary & Review

- Smallpox
 - ❖ Variola major
 - ❖ Communication: droplet nuclei
 - ❖ Primary manifestation: centrifugally distributed rash
 - ❖ Management
 - Supportive
 - Isolation
 - Home care

Summary & Review

- Smallpox
 - ❖ Prevention: vaccination
 - ❖ Precautions
 - Strict isolation
 - Biohazardous waste

Summary & Review

- > Botulism
 - ❖ Clostridium botulinum: produces neurotoxin
 - ❖ Sources
 - ❖ Manifestation: descending paralysis
 - ❖ Management
 - May require intubation, ventilation
 - Antitoxin
 - ❖ Prevention: immunization (botulinum toxoid)
 - ❖ Universal precautions

Summary & Review

- > Plague
 - ❖ Yersinia pestis: gram negative rod
 - ❖ Insect vector (flea)
 - ❖ Infected rodents
 - ❖ Types: bubonic, pneumonic, septicemic
 - ❖ Manifestations: buboes, pneumonia
 - ❖ Management: antibiotics, etc.
 - ❖ Prevention: immunization, chemoprophylaxis
 - ❖ Precautions: isolation first 48 hours

References

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