

**Bioterrorist threats: sources,
recognition and safety issues**

Arthur Jones, EdD, RRT

Learning Objective

- ^ Describe the etiology, manifestations, management and safety precautions related to the most 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- US develops weapons

History

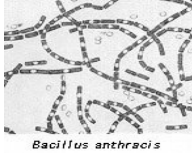
- ^ 1969- US ends weapons program
- ^ 1970- anthrax vaccine FDA approved
- ^ 1972- International convention outlaws biological weapons
- ^ 1995- Iraq admits to producing 8500 L of anthrax weapon
- ^ 2001- letter containing anthrax is mailed to NBC

Etiology

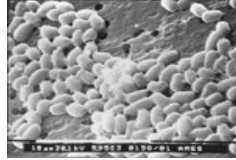
- ^ Causative organism- bacillus anthracis
- f gram-positive, spore-forming rod
- f spore-forming ==> very tough organism
- f occurs globally, esp. in developing countries
- f primarily infects herbivores
- f produces lethal toxin

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



Cutaneous Anthrax

^ Manifestations

- ◆ Proximal lymphedema develops
- ◆ Infection disseminates
 - f* septicemia
 - f* 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
 - ◆ chest xray- mediastinal widening
 - ◆ hypoxemia

Anthrax

- △ Diagnosis
 - ◆ index of suspicion- exposure risk
 - f occupation
 - f location
 - ◆ pathognomonic
 - f previously healthy adult
 - f overwhelming flu-like signs
 - f 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:
 - f* ciproflaxin
 - f* doxycycline
 - f* penicillin
 - f* amoxicillin
 - f* chloramphenicol
 - f* 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
 - f* three injections, two weeks apart
 - f* three injections at 6, 12, 18 mo.

Anthrax

^ Prevention- vaccination

- ◆ adverse reactions
 - f* soreness, edema at injection site
 - f* fever, nausea headaches (5-35%)
 - f* 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:
 - f cowpox
 - f monkeypox
 - f 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 varians are required to produce disease
- ^ Viruses migrate and 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 and plantar location
 - ◆ confirmed by laboratory analysis

Diagnosis

- ^ Management
 - ◆ strict isolation
 - ◆ supportive care
 - ◆ antibiotics for secondary bacterial infection
 - ◆ antiviral agents
 - f* currently, none are approved
 - f* agents for HIV have potential

Prevention

- ^ Post-exposure control
 - ◆ all face-to-face contacts with victim
 - f* vaccinated
 - f* 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 and 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
 - f colorless
 - f odorless, tasteless
 - f 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

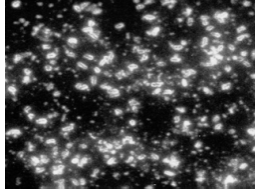
- ^ Naturally occurring plague- ancient
- ^ 425 BC- first recorded epidemic in Athens
- ^ 540 AD- first recorded pandemic
- ^ 1340 AD- pandemic from China to Europe, killing 1/3 of Europeans
- ^ 1400s AD- used as biological weapon by Tatars
- ^ 1665 AD- great plague of London

History

- ^ 1894- causative organism identified by Yersin, 'yersinia pestis'
- ^ present day
 - ◆ natural epidemics recur
 - ◆ organism present in rodents, worldwide, including Western US
- ^ 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

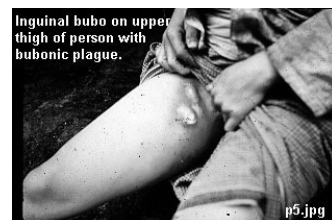
Transmission Modes

- ^ 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- Pneumonic

- ^ 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 and Review

- ^ Anthrax
 - ◆ antracis bacillus
 - ◆ cutaneous, gastrointestinal, pulmonary
 - ◆ pulmonary manifestations:
 - ◆ management
 - ◆ prevention- immunization, chemoprophylaxis
 - ◆ universal precautions

Summary and Review

- ^ Smallpox
 - ◆ variola major
 - ◆ communication- droplet nuclei
 - ◆ primary manifestation- centrifugally distributed rash
 - ◆ management
 - f* supportive
 - f* isolation
 - f* home care

Summary and Review

- ^ Smallpox
 - ◆ prevention- vaccination
 - ◆ precautions
 - f* strict isolation
 - f* biohazardous waste

Summary and Review

- ^ Botulism
 - ◆ clostridium botulinum - produces neurotoxin
 - ◆ sources
 - ◆ manifestation- descending paralysis
 - ◆ management
 - f* may require intubation, ventilation
 - f* antitoxin
 - ◆ prevention- immunization (botulinum toxoid)
 - ◆ universal precautions

Summary and Review

^ Plague

- ◆ yersinia pestis- gram negative rod
- ◆ insect vector (flea)
- ◆ infected rodents, people
- ◆ types
- ◆ manifestations - buboes, pneumonia
- ◆ management- antibiotics, etc
- ◆ prevention
- ◆ precautions

References

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