BIOTERRORISM
PROFESSOR THORNTON

Potential Bioterrorism Agents
- Bacterial Agents
  - *Anthrax
  - Brucellosis
  - Cholera
  - *Plague, Pneumonic
  - *Tularemia
  - Q Fever

Source: U.S. A.M.R.I.I.D.

Biological Agents of Highest Concern
- Variola major (Smallpox)
- Bacillus anthracis (Anthrax)
- Yersinia pestis (Plague)
- Francisella tularensis (Tularemia)
- Botulinum toxin (Botulism)
- Filoviruses and Arenaviruses (Viral hemorrhagic fevers)

ALL suspected or confirmed cases should be reported to health authorities immediately

Advantages of Biologics as Weapons
- Easy to obtain
- Inexpensive to produce
- Potential for dissemination over large geographic area
- Creates panic
- Can overwhelm medical services
- Perpetrators escape easily

BIOLOGIC AGENTS
Category A agents
- Easily disseminated and some transmitted from person to person
- Potential for mass casualties
- Require a sophisticated public health structure for management
- Examples- Anthrax, Botulism, Plague, Small Pox, Tularemia and viral hemorrhagic fever

BIOLOGIC AGENTS
Category B Agents
- Delivered through water and food sources
- Produce moderate morbidity and low mortality
- Require management assistance from the public health sector
- Examples Q fever, Brucellosis, Glanders, ricin toxin, epsilon toxin, and Staphylococcus enterotoxin

BIOLOGIC AGENTS
Category C Agents
● Haven't been weaponized (but could be)
● Have potential for high morbidity and mortality,
● Readily available and fairly easy to produce and disseminate
● Examples: Nipah virus, Hantavirus, tick borne encephalitis, yellow fever, and multidrug resistant TB

Small Pox Blankets

BIOLOGIC AGENTS
● History
● Occupational
● environmental
● travel risks-

Routes of Infection
● Skin
  ● Cuts
  ● Abrasions
  ● Mucosal membranes

Routes of Infection
● Gastrointestinal
  ● Food
    ● Potentially significant route of delivery
    ● Secondary to either purposeful or accidental exposure to aerosol
  ● Water
    ● Capacity to affect large numbers of people
    ● Dilution factor
    ● Water treatment may be effective in removal of agents

Routes of Infection
● Respiratory
  ● Inhalation of spores, droplets & aerosols
  ● Aerosols most effective delivery method
  ● droplet most effective

Medical Response
● Pre-exposure
  ● active immunization
  ● prophylaxis
  ● identification of threat

Medical Response
● Incubation period
  ● diagnosis
  ● active and passive immunization
• antimicrobial or supportive therapy

16 Medical Response
• Overt disease
  • diagnosis
  • treatment
  • may not be available
  • may overwhelm system
  • may be less effective
  • direct patient care will predominate

17 Bioterrorism:
What Can Be Done?
• Awareness
• Laboratory Preparedness
• Plan in place
• Individual & collective protection
• Detection & characterization

18 SMALL POX-
• declared dead in 1980-
• only CDC and Russia has samples
• is now a major concern for weapons of mass destruction.
• Has aerosol transmissibility,
• ease of large-scale weapon production
• vast number of people with out antibodies from either vaccination or previous exposure.

19 PATHOGENESIS
• large complex virus that has two predominant strains
• Variola major- 30% greater mortality
• Variola minor- fatality rate of 1%
• Hemorrhagic and malignant small pox are rare and deadly strains

20 TRANSMISSION
• Incubation Period- 7-17 days- Not Contagious- no symptoms
• Initial symptoms (Prodrome)- 2-4 days-Flu like symptoms- high fever 101⁰ to 104⁰ sometimes Contagious
• Early rash- 4 days- MOST CONTAGIOUS
• Pustular rash- 5 days- Contagious
• Pustules and scabs- 5 days- Contagious
• Resolving scabs- 6 days- Contagious
• Scabs resolved- Not Contagious

21 TRANSMISSION
• Infectious after the onset of debilitating flu like symptoms and the onset of the characteristic rash.
• Once the rash has appeared airborne dissemination via the respiratory tract is responsible for transmission. Airborne transmission is possible but not as readily as
measles or chicken pox.
• remains infectious until the last scabs fall off.

22 CLINICAL PRESENTATION
• Incubation 12-14 days
• Flu like symptoms,
• Malaise
• high fever
• rigors- sudden chills
• vomiting
• headache
• backache
• some develop delirium

23 CLINICAL PRESENTATION
• After two to three days the fever breaks and the patient begins to feel somewhat better
• Maculopapular rash appears – mouth and pharynx
• Face and forearms
• Progressing quickly to the trunk and lower extremities
• 8-14 days after the onset of the rash pustules form scabs that leave permanent depressed depigmented scars as they separate.

24 DIAGNOSIS
• Character and spread of lesions-
• all lesions are identical and
• advance concurrently through stages of development

25 Small Pox

26 MANAGEMENT
• Supportive
• Isolation at home preferred or isolation facilities,
• Quarantine of regions in event of bioterrorism attach.-
• Negative pressure rooms- 6-12 exchanges per hr
• Airborne precautions (N95 respirator- TB mask)-
• Pt to wear a mask if transported
• Contact Isolation- gowns gloves and single use items

27 NURSING CARE
• Adequate hydration-
• mouth sores a challenge-

• antibiotics for infected lesions
• psychosocial support-

28 DECONTAMINATION
• Most variola virus dies within 24 hours on surfaces
• Hot water wash and dilute bleach or formaldehyde
• Persons who die from small pox should be cremated

29 PROPHYLAXIS
• Small Pox vaccine scarification
• Pts are to return on 7th day for evaluation
• Primary response
• papule forms by day 2-3
• into a vesicle by day 3-5
• starts to drain by day 5-7
• scab forms by day 10-12.

30 PROPHYLAXIS
• Keep site clean and dry do not scratch or touch drainage may transfer to another site (secondary inoculation- eyes can lead to blindness, open areas –lesions anywhere on the body) Rx vaccinia immune globulin (VIG)therapy

31 VACCINATION REACTION

32 VACCINATION REACTION

33 PROPHYLAXIS
• Post vaccination symptoms
• Moderate pruritus at the site
• Localized pain from lymphadenopathy
• Low grade fever
• Localized muscle aches and joint pains

34 Small Pox Vaccine
• Updates:
  • March 28, 2003, Oct 05 no change
  • According to the Centers for Disease Control and Prevention (CDC) (http://www.bt.cdc.gov/agent/smallpox/vaccination/heartproblems.asp), careful monitoring of smallpox vaccinations that have been given recently has suggested that there may be an association between the vaccine and cardiac disease. Incidents of myocarditis, pericarditis, and/or a myopericarditis, angina and myocardial infarction have been reported following smallpox vaccination.

35 Small Pox Vaccine
• Currently, the CDC is recommending, as a precautionary step, people who have been diagnosed as having heart disease with or without symptoms should not get the smallpox vaccine at this time. These include heart conditions such as:
  • previous myocardial infarction
  • angina
  • congestive heart failure
  • cardiomyopathy

36 ANTHRAX
PATHOPHYSIOLOGY
• Gram positive spore-forming no motile rod
• Anthrax spores an encapsulated
• Host
• Unusual in humans

• Acquired through the
• skin
- lungs
- GI tract

37  **CUTANEOUS**
- Spores come into contact with broken skin
- Commonly on the head, neck or extremities
- Incubation- 2-5 days
- Initial lesion is popular and becomes vesicular in 24-36 hours
- Lesion forms a black, depressed eschar within 2-6 days
- Edema and smaller secondary vesicles may surround some lesions
- Pain uncommon
- Left untreated death from septicemia and meningitis in 5-20%

38  **Anthrax: Cutaneous**

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44  **INHALATION**
- Anthrax not normally airborne
- Inhalation by aerosolization
- Not contagious from one person to another
- Standard precautions
- Incubation up to 60 days but could be longer

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47  **INHALATION**

Prodromal
- Flu like symptoms and mild and non specific- malaise, dry cough and mild fever
- Symptoms improve for 1-2 days followed by acute, severe dyspnea, stridor and cyanosis
- Chest X-Ray- widening mediastinum from lymphadenopathy – poor prognosis
- Septic shock and ½ develop meningitis
- Die with in 24-36 hours from hemorrhagic thoracic lymphadenitis and hemorrhagic mediastinitis

48  **DIAGNOSIS**
- Aerobic culture but takes too long should be treated if known or suspected contact
- Bacteriophage PlyG lysin

49  **GI**
- Naturally occurring disease is rare and fatal
• Not a good bioterrorism weapon
• diarrhea, fever and bacteremia

50 GENERAL DIAGNOSIS OF ANTHRAX
• Mayo clinic 1 hr DNA test
• Standard Precautions
• Blood work and chest X-Ray
• Skin lesions scraping sent for Gram stain and culture
• Stools for GI anthrax

51 TREATMENT
Antibiotics-
• Cipro 400 mg IV q 12 continue therapy for 60 days (Check CDC guidelines for changes) for inhalation anthrax
• Prophylactic- cipro 500 mg q 12 x 60 days- doxycycline for cipro intolerance
• Amoxicillin is recommended to treat people who have been exposed to anthrax, when other antibiotics are not as safe to use such as with children and pregnant women, CDC March 25, 2005

52 Anthrax Vaccine
• Anthrax vaccine not approved for public use (yet) Offered to patients exposed and workers exposed- 3 vaccine injections at 2 week intervals (NSG 2002 Feb p39;
• BioThrax™ is not licensed for post-exposure prophylaxis for prevention of inhalational anthrax, or for use in a 3-dose regimen
• Adverse reactions to vaccine- fatigue, headache, joint and muscle pains and local reactions that could be mild or severe

53 Disinfection and Disposal (1)
Effective sporicidal solutions
• Commercially-available bleach, 0.5% hypochlorite (1 part household bleach to 9 parts water)
• Rinse off concentrated bleach to avoid caustic effects
• Approved sporicidal agents
• Cremation

54 PLAGUE
• Pneumonic plague-
• Transmission – as in aerosol cloud – inhalation- person to person through respiratory droplet infection.
• Incubation- 1-6 days
• Dx no tests available

55 PLAGUE
• Sudden attack of illness presenting with severe pneumonia and sepsis.
• Protective Measures
• Aerosol spray remains for only a couple of hours
• Respiratory isolation during the first 48 hrs
• Gown, gloves, eye protection, and mask
• Patients to wear a mask if transported
• Persons with face to face contact
PLAGUE
- Management
- Streptomycin or gentamycin IM or IV for mass administration doxycycline or cipro

BOTULISM
- Muscle paralyzing disease- toxin- Clostridium Botulinum
- Three kinds occur naturally food borne, susceptible infants harbor C.botulinum in their intestines and wound infections
- Fourth man made- inhalation- aerosol- not transmitted from person to person
- Recovery weeks to months

BOTULISM
- Looks like 'Gillian Barre syndrome or Myasthenia Gravis
- *Afebrile

BOTULISM
- Protection
- No isolation
- Wash contaminated clothing and items warm water and detergent
- Interventions
- Early recognition- antitoxin-
- Supportive- ventilator if needed- monitor for respiratory failure
- Antibiotic not indicated
- Long term Nursing Care

Tularemia
- Infectious disease caused by bacterium, Francisella tularensis
- found in animals (especially rodents, rabbits, and hares).

Spread of Tularemia
- the bite of an infected insect or other arthropod (usually a tick or deerfly),
- handling infected animal carcasses,
- eating or drinking contaminated food or water, or
- breathing in F. tularensis.

Tularemia
- Francisella tularensis is highly infectious:
- As a bioweapon, the bacteria would likely be made airborne for exposure by inhalation.
- severe respiratory illness, -life-threatening pneumonia and systemic infection,
- Readily available in nature
- manufacturing an effective aerosol weapon would require considerable sophistication.

Symptoms of Tularemia
- Inhalation could include
- sudden fever, chills, headaches, muscle aches, joint pain, dry cough, progressive weakness, and pneumonia.
- Persons with pneumonia can develop chest pain and bloody sputum and can have
trouble breathing or can sometimes stop breathing.

64 Other Symptoms of Tularemia
- ulcers on the skin or mouth, swollen and painful lymph glands, swollen and painful eyes, and a sore throat.
- Symptoms usually appear 3 to 5 days after exposure to the bacteria, but can take as long as 14 days.

65 Management
- No isolation necessary.
- Tularemia is not known to be spread from person to person, treated as soon as possible.
- The disease can be fatal if it is not treated with the appropriate antibiotics.

66 Management
- Antibiotic from the tetracyclines (such as doxycycline)
- Or fluoroquinolone (such as ciprofloxacin) given orally
- Streptomycin or gentamicin, which are given intramuscularly or intravenously

67 Tularemia
- A vaccine for tularemia is under review by the Food and Drug Administration and is not currently available in the United States.

69 Excellent Summary table in the Skills Book – Smith and Duel Sixth edition, pps. 424-425

70 Chemical Weapons
- Characteristics of Chemicals
  - Volatility- tendency of a chemical to become a vapor. Most chemicals are heavier than air except (hydrogen cyanide)- stand up because the chemical will sink.
  - Persistence- means that the chemical is less likely to vaporize and disperse. Weaponized chemicals are more likely to persist. And cause secondary exposure

71 Characteristics of Chemical Weapons
- Toxicity- potential to cause injury- dose, concentration and time of exposure add up to toxicity
- Latency-time from absorption to symptoms- sulfur mustards and pulmonary agents have the longest latency, nerve gas and cyanide produce symptoms right away

72 Chemical Weapons
- Limit Exposure- evacuation and removal of clothing and decontamination as close to the site as possible. Must contain the runoff

73 Vesicants
- Cause blistering- burning eyes, bronchitis, pneumonia, hematopoietic suppression and death
- Sulfur mustard- long latent period and penetrates the skin if not rapidly removed- irreversible skin damage but seldom
fatal- looks like burns superficial to partial thickness burns
- Nitrogen mustard
  - Eye pain, photophobia, lacrimation and decreased vision
  - Respiratory- obstruction of airways
  - GI-N&V and Upper GI bleeding
  - Decontaminate with soap and water blot dry do not rub

74 Nerve Agents
- Sarin and organophosphates (malathion)- cheap and effective in small quantities and easily dispersed.
- Inhaled or absorbed through skin.
- Inhibition of cholinesterase
- Signs and symptoms related to cholinergic crisis as in Myasthenia Gravis
- lethal dose leads to loss of consciousness, seizures, copious secretions, flaccid muscles and apnea
- Maintain airway and suction- plastic airway equipment will absorb sarin gas and continue exposure to the agent

75 Decontamination and Treatment for Nerve Agents
- Decontamination
  - Large amounts of soap and water or saline solution for 8-20 minutes. Blotted off not wiped
  - 0.5% Bleach solution may also be used.
- Treatment for Nerve Agents
  - Atropine or Pralidoximime – military personnel are given a Mark I auto injector which contains 2 mg of atropine and 600 mg of Pralidoximime in the event of nerve gas exposure

76 Nuclear Radiation Exposure
- Multiple possible exposure-
- Long term effects –thyroid cancer, and leukemia
- Exposure
  - Affected by time,
  - distance
  - shielding.
  - The greater the time etc - the greater the exposure

77 Three types of radiation induced injury
- external irradiation- all or part of the body is exposed to radiation that penetrates or passes completely through the body- Pt is not radioactive and does not require special isolation or decontamination- not necessarily a medical emergency
- contamination- exposed to radioactive materials either externally or internally- requires immediate medical management to prevent incorporation
- Incorporation- actual uptake of radioactive material into cells and tissues.-kidney, liver, bone and thyroid- consequences of contamination and incorporation notes days to yrs later.

78 Priorities in treatment of radiation exposure
- Treat life threatening injuries and illness first
- limit exposure
- contamination control
- decontamination

79 Radiation Decontamination
- Limit movement of persons
- Decontaminate outside the hospital- showers until all contaminates have been removed
- Double bag waste- plastic lined containers
- Staff to wear protective clothing- water resistant gowns, double glove, masks, caps, goggles and booties

80 Acute Radiation Syndrome (ARS)
- Prodromal phase (Presenting symptoms)-
  - 48-72 hrs after exposure
  - Signs and symptoms:
- N&V, loss of appetite, diarrhea, fatigue
- High dose- fever, respiratory distress and increased excitability

81 Acute Radiation Syndrome (ARS)
- Latent Phase (a symptom free period)
- After prodromal can last up to 3 weeks
- High dose latent phase is shorter
- Decreasing lymphocytes, leukocytes, thrombocytes and RBC’s

82 Acute Radiation Syndrome (ARS)
- Illness Phase
- After latent period
- Infection, fluid and electrolyte imbalance, bleeding, diarrhea, shock and altered level of consciousness
- Recovery
- After illness phase
- Weeks to months for full recovery
- Death
- Increased ICP as a sign of impending death

83 Radiation Survival
- Three categories of predicted survival
- Probable-no initial or minimal symptoms
- Possible- N&V that persists for 24-48 hrs- will have latent period- supportive treatment- Blood products, prevent infection, nutrition
- Improbable- large dose of radiation, N&V, shock
  - black category for mass casualty situations