Biological Weapons of Mass Destruction-Symptoms and Treatments

Course Objectives – Upon completion of this course, the nurse will be able to:

- Define bioterrorism
- List viruses, bacteria and other agents that can be used as biological weapons
- Be familiar with the symptoms of: Anthrax, Botulism, Plague, Smallpox, Tularemia, and Viral hemorrhagic fevers
- Understand how these agents could be used as biological weapons
- Discuss treatment options for these agents/diseases
- Differentiate between the three Categories of biological agents
- Explain the basics of the Disaster Paradigm

“As a nurse, it may be difficult to fathom walking past a mortally wounded person to treat someone else, or to take a terminally ill patient off a ventilator to allocate it to a patient with a better chance of survival. But during a disaster, those and other ethical dilemmas can and do arise. For example, in New Orleans following the floods after Hurricane Katrina in 2005, nurses and physicians found themselves in terrible ethical situations, unable to provide life-sustaining care for patients, and faced with dire circumstances.”

The word "bioterrorism" refers to biological agents (microbes or toxins) used as weapons to further personal or political agendas. Acts of bioterrorism range from a single exposure directed at an individual by another individual to government-sponsored biological warfare resulting in mass casualties. Bioterrorism differs from other methods of terrorism in that the materials needed to make an effective biological agent are readily available, require little specialized knowledge and are inexpensive to produce. Until the aftermath of 9/11, few instances of bioterrorism were documented in the U.S.

A bioterrorist attack could be caused by virtually any pathogenic microorganism. The agents of greatest concern are anthrax (a bacterium) and smallpox (a virus). Both can be lethal. Anthrax is not communicable while smallpox is readily transmitted from person to person.

Who's at Risk?

In the U.S., the risk of contracting anthrax is extremely low. The intentional release of anthrax following the events of 9/11 resulted in twenty-two recognized cases of cutaneous and inhalational anthrax. Any risk for inhalational anthrax due to cross-contaminated mail is very low, even for postal workers. The possibility does exist, however, that if anthrax was dispersed in a public place, a large number of people could be affected. Smallpox has not occurred in the U.S. since 1949. If the virus was intentionally released, the number of people affected could run to the tens of thousands.

Can It Be Prevented?

Bioterrorism differs from other methods of terrorism in that the effects are not always immediately apparent. An attack may be difficult to distinguish from a naturally occurring infectious disease outbreak. The first evidence of an attack will be in hospital emergency rooms where the proper diagnosis will be essential in treating and preventing the spread of the disease.

Bioterrorism

- Is defined as an attack that uses the deliberate release of viruses, bacteria or other germs (agents) to cause illness or death in people, animals or plants
- Biological agents can be spread through the air, water or in food
- Agents are separated into three categories, A, B and C.

Category A is considered the highest risk
Category A

- includes organisms or toxins that pose the **highest risk** to the public and national security because they:
  - ✓ are easily spread or transmitted from person to person
  - ✓ result in high death rates and have potential for major public health impact
  - ✓ might cause public panic and social disruption
  - ✓ require special action for public health preparedness
  - ✓ are infectious via aerosol and fairly stable in aerosol.
  - ✓ have a high morbidity and mortality rate.
  - ✓ are difficult to diagnose and/or treat.

Category A agents include:

- **Anthrax**
- **Botulism**
- **Plague**
- **Smallpox**
- **Tularemia**
- **Viral hemorrhagic fevers (Ebola, Marburg, Lassa, Machupo)**

**Anthrax (Bacillus anthracis)**

- a bacterium that forms **spores**
- infects livestock far more often than people
- there are 3 types of anthrax that cause human disease
  - ✓ **Skin (cutaneous)**
  - ✓ **Lungs (inhalation)**
  - ✓ **Digestive (gastrointestinal)**
Anthrax from animals

- humans can become infected with anthrax by handling products from infected animals or by breathing in anthrax spores from infected animal products (like wool)
- humans can also become infected by eating undercooked meat from an infected animal

Symptoms:

- Symptoms of anthrax are different depending on the type of the disease: digestive, lungs or skin
- **Gastrointestinal**: first signs and symptoms are nausea, loss of appetite, bloody diarrhea and fever, followed by stomach pain
- **Inhalation**: first signs and symptoms are cold or flu symptoms. Later signs and symptoms include severe respiratory distress, hemodynamic failure and death
  - **Inhalation anthrax is the most lethal type.**
  - Distinguishing inhalation anthrax from cold or flu
    - anthrax, colds and flu patients have similar signs and symptoms at early phase such as fever, chills, cough and muscle aches
    - **Signs and symptoms of anthrax DO NOT include a runny nose**
    - anthrax involves severe breathing problems and has abnormal X-ray or CT scans (widening mediastinum)
- **Cutaneous**
  - First symptom is a small sore that develops into a blister
  - The blister then develops into a skin ulcer with a black area in the center
  - The sore, blister and ulcer do not hurt

Anthrax as a weapon

- This happened in the US in 2001.
- Anthrax was spread through the postal system via letters laced with Anthrax spores
- There were 5 deaths and 17 people developed infections
- The fatality rate for cutaneous anthrax is about 20%; for inhalational anthrax, the rate is closer to 75%.
Cutaneous anthrax can be transmitted by direct exposure to vesicle secretions of lesions. Use contact precautions. People with cuts or open sores can get cutaneous anthrax if they come in direct contact with the bacteria or its spores.

A Cutaneous Anthrax infection in various stages of healing:

Diagnostics:
- Pulmonary Anthrax: nasal swab, blood, CSF, sputum cultures, CXR
- Cutaneous Anthrax: gram stain culture, blood, skin biopsy
- GI Anthrax: vomit, feces, blood cultures

Treatment:
- **Antibiotics**
  - **Inhalation Anthrax**
    - Ciprofloxacin 400mg q12h IV...
      - OR
      - Doxycycline 100mg q12h IV...
    - AND
    - 102 additional antimicrobials such as Vancomycin, Penicillin, Rifampin, Ampicillin, etc
  - **Cutaneous Anthrax**
    - Ciprofloxacin 500mg PO twice daily...
      - OR
    - Doxycycline 100mg PO twice daily
    - Continue PO for 60 days
  - **Gastrointestinal Anthrax**
    - Ciprofloxacin 500mg PO twice daily...
      - OR
    - Doxycycline 100mg PO twice daily
    - Continue PO for 60 days
Vaccination:

- Primarily given to military personnel
- Recommended only for those at high risk: workers in research labs and people that handle potentially infected animals
- Immunization consists of 5 IM injections given at Day 0, week 4, months 6, 12 and 18. Annual boosters are then recommended
- Treatment that combines the 60 days antibiotics plus 3 doses of vaccine used in post exposure prophylaxis are very effective in preventing anthrax disease from occurring after exposure

Important notes on Anthrax:

- Anthrax is not transmitted from person to person.
- Exposed patients are not contagious
- If bioterrorism is suspected, local hospitals should contact law enforcement officers for referring specimens to a microbiology lab that utilizes Biological Safety Level 2 practice
- Suspicious packages/letters: don't shake or empty contents. Place in plastic bag, cover contents with clothing or trash can. Leave the room. Wash hands with soap and water. Turn off ventilation system. Report to local police

Smallpox (variola major)

- a serious, contagious and sometimes fatal infectious disease
- There is no specific treatment and the only prevention is vaccination
- humans are the only known reservoir
- the disease is now eradicated after a successful worldwide vaccination program, the last case in the US was in 1949
- The last naturally occurring case in the world was in Somalia in 1977
- Routine vaccinations stopped in the US in 1972
- The majority of people infected with smallpox do recover. There is a fatality rate of approximately 30%.
Symptoms:

- First signs and symptoms include: fever, malaise, head and body aches, and sometimes vomiting.
  - The fever is usually high (101-104)
  - This is called the **prodrome** phase and may last for 2-4 days

- A *rash emerges* first as small red spots on the tongue and in the mouth
  - Those spots develop into sores that break open and spread large amounts of the virus into the mouth and throat. At this time, the person becomes most contagious
  - Rash begins on the face, hands and forearms

- Synchronous progression: macules $\rightarrow$ vesicles $\rightarrow$ pustules $\rightarrow$ scabs

*Child with Smallpox at various stages*

**Prodrome**

*prodrome* ['prōˌdrōm]

*noun*

*a* **early symptom** indicating the onset of a disease or illness.
Vaccination:

- Intradermal inoculation with bifurcated needle (Scarification)
- Pustular lesion or indurations surrounding central lesion (scab or ulcer) 6-8 days post-vaccination
- Post vaccination side effects: low grade fever, axillary lymphadenopathy
- Scar (permanent) demonstrates successful vaccination
- Vaccination only lasts 3-5 years. In people exposed to smallpox, however, the vaccine can lessen the severity of, or even prevent, illness if given within 4 days of exposure. The U.S. has a supply of vaccine for emergency use.
- Potential complications of vaccination:
  ✓ inadvertent inoculation (skin, eye)
  ✓ The healing pustule from a vaccinated person has live vaccinia virus which can cause infection in unvaccinated people until scabbed over/healed

Medical Management:

- **Supportive care**
- Strict respiratory/contact isolation/Hepa filter room (the patient is infectious until all scabs have separated)
- Notify public health authorities immediately for any suspected cases
- Healthcare workers would need to be vaccinated to provide medical care for smallpox patients in the event of an outbreak

Plague (*Yersinia pestis*)

- Transmitted from wild rodents or their fleas or from direct contact with plague-infected animals
- Southwestern states in US affected more
- Has 3 forms
  ✓ *Bubonic Plague* (infection of the lymph glands)
    - signs and symptoms include enlarged, tender lymph nodes, fever, chills and prostration (extreme exhaustion or lack of energy or power)
  ✓ *Septicemic plague* (infection of the blood)
- signs and symptoms include fever, chills, prostration, abdominal pain, shock and bleeding into skin and other organs

  ✓ **Pneumonic Plague** (infection of the lungs)

  - **CAN spread from person to person**
  
  - signs and symptoms include fever, chills, cough and difficulty breathing, rapid shock and death if not treated early

Types of Plague

![Bubonic plague, Septicemic plague, Pneumonic plague](image)

- **Transmission**
  
  - flea borne, from infected rodents to humans
  
  - direct contact with infected tissues or fluids from handling sick/dead animals
  
  - respiratory droplets from cats and humans already infected with pneumonic plague
  
  - wild rodents (squirrels, prairie dogs, and other burrowing rodents)

Treatment:

- **Antibiotic therapy**
  
  ✓ Gentamicin or Streptomycin
  
  ✓ Tetracyclines
  
  ✓ Sulfonamides
  
  ✓ Chloramphenicol (meningitis/pleuritis)
Supportive therapy

Isolation and droplet precautions for pneumonic plague until sputum cultures become negative

Antibiotic resistant strains have been documented

Prophylaxis:

- Bubonic: oral Doxycycline, Tetracycline, or Sulfamethoxazole and trimethoprim (Bactrim, Septra) for 7 days
- Pneumonic: oral Doxycycline, Tetracycline, continue for 7 days post exposure
- Vaccine no longer manufactured in US

Prevention:

- Eliminate food/shelters for rodents
- Treat pets for flea control regularly
- Avoid sick/dead animals
- Use insect repellant when outdoors in areas where there is a risk of flea exposure

Tularemia

- Tularemia is caused by the bacterium *Francisella tularensis*. This bacterium can be found in animals such as rodents, rabbits, hares, birds, sheep and domesticated animals such as cats and dogs.

- It can be spread to humans by:
  - Being bitten by a tick, mosquito or other insect that has been infected by the bacteria
  - Exposure to dead animals that were infected
  - Eating/drinking contaminated food/water
  - Breathing in the bacteria

- There are several types of Tularemia including:
  - Ulceroglandular (most common form, caused by insect or animal bite)
  - Glandular
  - Oculoglandular
  - Oropharyngeal
  - Pneumonic
  - Typhoidal.
Symptoms:

- The Symptoms depend on where the bacteria entered the body.
- The most common signs and symptoms of Ulceroglandular Tularemia include:
  - Sudden fever, chills
  - Headache
  - Skin ulcer at the bite site
  - Muscle and/or joint pain
  - Dry cough, shortness of breath
  - Progressive weakness
  - Swollen/painful lymph glands

Treatment:

- Antibiotics:
  - Contained Setting:
    - Streptomycin is the drug of choice
    - Gentamicin can be used if Streptomycin can’t be used
  - Mass Exposure Setting
    - Ciprofloxacin and doxycycline are preferred

**Tularemia used as a weapon:**

- If used as a weapon, it is reported that this disease would most likely be made into an aerosol for airborne exposure by inhalation. If exposed in this manner, people would experience life-threatening respiratory illnesses (severe pneumonia, systemic infection) if they weren’t able to receive treatment in a timely manner.

**Viral Hemorrhagic Fevers (VHF)**

- caused by several different virus families
  - Filovirus (Ebola, Marburg)
✓ Arenaviruses (Lassa, Junin, Machupo, Sabia, Guanarito)
✓ Bunyaviruses
✓ Flaviviruses

- Natural vectors: Rodents, mosquitoes, ticks
- **NO natural occurrence in the US**

Clinical Presentation:
- Initial signs and symptoms include marked fatigue, dizziness, muscle aches, loss of strength and exhaustion
- Usual patient history
  ✓ foreign travel to endemic/epidemic areas
  ✓ nosocomial exposure
  ✓ contact with rodents or animal blood
  ✓ Incubation typical 5-10 days with a range of 2-16 days
- Illness progresses to severe prostration, bleeding and shock
- Mortality depends on viral agent: Lassa=10% whereas Ebola=90%

Treatment:
- Will mostly consist of supportive care: maintaining BP and fluids, Correcting bleeding disorders (coagulopathies), Sedation and pain control
- Ribavirin (Rebetol, Copegus)- Is an antiviral drug. It is thought to interfere with the production and/or action of viral DNA and RNA which are critical to the survival and multiplication of the virus. May be effective for some types of VHF
- Patient isolation:
  ✓ single room with adjoining anteroom if available (handwashing facility with decontamination solution)
  ✓ negative air pressure
  ✓ strict barrier precautions including protective eyewear/face shield
  ✓ All body fluids disinfected
Botulism

- A rare but serious paralytic illness caused by a nerve toxin that is produced by the bacterium *Clostridium botulinum*

- There are 3 main types of Botulism
  - **Foodborne**: caused by eating foods that contain the toxin. Toxin produced anaerobically in improperly processed or canned, low-acid foods contaminated by spores
  - **Wound botulism**: caused by toxin produced from the wound infected with *Clostridium botulinum*
  - **Infant botulism**: caused by consuming the spores of the bacteria, which then grow in the intestines and release toxin

- *Clostridium botulinum* is the name of a group of bacteria commonly found in soil

- There are 7 types of Botulism (a-f); only types A, B, E and F cause illness in humans

**Inhalation Botulism:**

- *NO natural occurrence, developed as a biological weapon*

Symptoms:

- Signs and symptoms: double vision, blurred vision, drooping eyelids, slurred speech, difficulty swallowing, dry mouth and muscle weakness.
  - These are all symptoms of the muscle paralysis caused by the bacterial toxin. The most common signs are neurological.
  - If untreated, these symptoms may progress to cause paralysis of the arms, legs, trunk, and respiratory muscles. It can progress to bilateral flaccid paralysis and respiratory failure due to paralysis of the diaphragm.

- In food borne botulism, signs and symptoms generally begin 18-36 hours after eating contaminated food, but they can occur as early as 6 hours or as late as 10 days.
Treatment:

- Ventilator assistance and supportive care
- *Botulism antitoxin bivalent* - for food borne and wound botulism (when diagnosed early)
  - available only from CDC
  - *most effective if given early*
  - blocks the action of toxin circulating in the blood. This can prevent patients from worsening but recovery still takes many weeks.
  - *Not routinely given for treatment of infant botulism*
- Removal of contaminated food in gut through induced vomiting or enemas
- Surgical treatment for infected wounds (to remove source of toxin)

Prevention:

- Most foodborne botulism cases are caused by *home-canned foods with low-acid content* (asparagus, beets, corn, green beans)
  - home canning should be done following strict hygienic procedures
  - botulism spores are killed by high temps
  - it is advisable to boil home canned foods for 10 minutes before eating
- Herbs in oils should be refrigerated
- Potatoes baked in foil should be served hot or be refrigerated
- *No honey for children younger than 12 months old*

**Category B**

- These agents are the second highest priority because:
  - they are moderately easy to spread
  - they result in moderate illness rates and low death rates
  - they require specific enhancements of CDC’s lab capacity and enhanced disease monitoring
Category C

- Third highest priority agents include emerging pathogens that could be engineered for mass spread in the future because:
  - they are easily available, produced and spread.
  - they have potential for high morbidity and mortality rates and major health impact

- Emerging infectious diseases such as Nipah virus and Hantavirus

The Disaster Paradigm:

- A disaster is an unexpected event whose effect leads to significant destruction and/or adverse consequences

Important elements in Disaster Response:
Detection

- awareness of an unusual situation

- **important that nurse does not become a victim. Ensure personal safety** – Use of Personal Protection Equipment (PPE) is a must!

Incident command

- refers to the need for the emergency system to be activated when a threat/hazard suspected

Scene security and safety

- done by police, fire dept, FEMA, Hazmat, EMS, and hospital security and others

- PPE (Level A, B, C and D)

Assessment

- First Responders and trained individuals (healthcare workers) will assess the scene

Support

- includes human resources, agencies, facilities, supplies and vehicles

- Chaos is common in every disaster

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### Triage, Treat and Evacuate:

- **The goal is to identify the greatest number who will survive!**

- Healthcare responders must be able to quickly distinguish between actual victims with exposure to the weapon (biological, chemical, nuclear) and the “walking worried well”

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**The Bottom Line**

A news story about bioterrorism carries inherent drama but also certain responsibilities. A story can raise concerns and heighten the public’s awareness of the topic or it could cause alarm and panic. And because biological materials are inexpensive and readily available, some thought should be given to whether or not the report will give ideas to potential terrorists.

If a person thinks they have been exposed to a biological incident or they suspect a biological threat is planned, they should contact their local health department and/or their local police department. Either of these agencies will promptly notify the FBI, which is responsible for coordinating interagency investigation of bioterrorism.
Bioterrorism Response Resources

- For more information on Bioterrorism Preparedness, please visit the Centers for Disease Control and Prevention website: http://www.bt.cdc.gov/bioterrorism/prep.asp
REFERENCES


https://www.cdc.gov/healthcommunication/toolstemplates/entertainmented/tips/bioterrorism.html