Chapter 31

Biological Warfare Agents

Introduction

Biological warfare (BW) agents infect the body via the same portals of entry as infectious organisms that occur naturally. These include inhalation into the respiratory tract, ingestion into the GI tract, and absorption through mucous membranes, eyes, skin, or wounds. Most BW agents will enter the body through inhalation. Usually, the disease produced by a BW agent will mimic the naturally occurring disease, but the clinical presentation can be different if delivery of an agent occurs through a portal that differs from the natural portal.

Detection

- Compressed epidemiology with record numbers of sick and dying in a short time.
- High attack rates (60%–90%).
- High incidence of pulmonary involvement when usual form of infection is not (eg, anthrax).
- Incidence of a particular disease in an unlikely location.
- Increased deaths of animals of all species.
- Near simultaneous outbreaks of several different epidemics at the same site.
- Biological Identification Detection System or standoff BW detectors alarming.
- Direct evidence of an attack such as contaminated or unexploded munitions.

Diagnosis

The first indication of an attack may be when large numbers of patients present with the same constellation of signs and symptoms, especially for a disease that is not endemic to the area of operations.

Rapid diagnostic tests may be available in forward areas to assist clinicians in early diagnosis:

- Isolation of the etiologic agent can occur within 1–2 days for some agents.
- Enzyme-linked immunosorbent assays (ELISA).
- Genome detection by polymerase chain reaction (PCR).
- Antibody detection.

Prevention and Protection

- Immunizations: Anthrax, and in specific scenarios, smallpox and plague.
  - Pre- or postexposure chemoprophylaxis—anthrax, plague, Q fever, and tularemia. Chemoprophylaxis for anthrax is presently FDA-approved for postexposure only.
    - Investigational new drugs exist for the treatment of Argentine hemorrhagic fever, botulinum toxin, Q fever, Rift Valley fever, Venezuelan Equine Encephalitis (VEE), and tularemia.
- Protective clothing and mask.

Decontamination —Personnel, Equipment, and Clothing

- **Mechanical** decontamination removes, but not necessarily neutralizes, the BW agent.
  - Brushing to ensure loosening of the BW agent from the surface.
  - Filtration and chlorination of drinking water to remove organisms.
- **Chemical** decontamination renders BW agents harmless through the use of disinfectants.
  - Soap and water followed with copious rinsing with water is often sufficient.
  - For patients requiring urgent decontamination, biologic agents are neutralized within 5 minutes when contaminated areas are washed with a 0.5 % hypochlorite solution (1 part household bleach mixed with 9 parts water).
  - **Do not use hypochlorite in the eyes, abdominal cavity, or on nerve tissue**.
  - A 5% hypochlorite solution (ie, household bleach) may be used to decontaminate clothing or equipment.

- **Physical** decontamination such as heat and solar ultraviolet (UV) radiation.
  - o Dry heat for 2 hours at 160°C.
  - o Autoclaving at 120°C under 1 atm of overpressure for 20 minutes.
  - o UV radiation difficult to standardize.
- Dry biological agents can be a hazard through secondary aerosolization; but adequate liquid decontamination will prevent this hazard. There is no vapor hazard, and special protective masks are generally not required for surgical personnel.

Infection Control

Infection control procedures should be reinforced for situations involving BW agents. Standard precautions are appropriate for BW agents once they have been identified. For an undifferentiated febrile illness following a BW agent attack:

- Place patients together in an isolated setting such as a designated tent or other structure.
- Surgical masks may be placed on patients when isolation is not possible.
- Employ respiratory droplet precautions along with standard precautions until diseases transmissible by droplet (such as plague and smallpox) have been excluded.

Medical Evacuation

- If plague, smallpox, and the hemorrhagic fevers can be **excluded**, patients may be evacuated using standard precautions and the disease-specific precautions.

> **Plague and smallpox are internationally quarantinable diseases (IQDs). Do not evacuate patient across international borders unless authorized by the theater surgeon.**

- Isolation precautions should be added to standard precautions.
- Immediately upon diagnosing patients with smallpox, the line and medical chain of command must be notified.
- Observe strict quarantine.

- Standard and respiratory droplet isolation precautions.
  - **Standard precautions**.
    - Hand washing after patient contact.
    - Use of gloves when touching blood, body fluids, secretions, excretions, and contaminated items.
    - Use of mask, eye protection, and gown during procedures likely to generate sprays of blood, body fluids, secretions, or excretions.
    - Handle contaminated patient-care equipment and linen in a manner that precludes transfer of micro-organisms to individuals or equipment.
    - Practice care when handling sharps and use pocket mask or other ventilation device when ventilating the patient.
    - Place patient in private room when possible. Limit the movement or transfer of patient.
  - **Droplet precautions**.
    - Standard precautions plus:
      - Place patient in private room or with someone with the same infection. If not feasible, maintain at least 1 m distance between patients.
      - Use of a mask when working within 1 m of patient.
      - Mask the patient if he/she needs to be moved.
- All contacts should be vaccinated within 7 days of exposure and quarantined together for at least 17 days following the most recent exposure.

Hemorrhagic fevers—Hanta, Ebola, Lassa, Rift Valley, HFRS

- Except for yellow fever, quarantine is not mandatory; however, person-to-person transmission is possible, therefore, universal precautions are recommended.
- Medical evacuation may result in increased morbidity and mortality, thus treatment at local MTFs is preferred.
- When necessary, patients may be evacuated using universal and respiratory droplet isolation precautions.

Biological Agents

There are two biological toxins that are potential BW agents: botulinum and ricin (see Table 31-1).

Table 31-1

Biological Toxin	Signs/Symptoms	Medical Management
Botulinum	Cranial nerve palsies Paralysis Respiratory failure	Antitoxin/supportive care
Ricin	Fever, cough, SOB Arthralgias, pulmonary edema	Nonspecific/Supportive care

Bacterial Agents

The bacteria or rickettsia most often considered to be potential BW threat agents include *Bacillus anthracis* (anthrax), *Brucella* sp. (brucellosis), *Vibrio cholerae* (cholera) *Burkholderia mallei* (glanders), *Yersinia pestis* (plague), *Francisella tularensis* (tularemia), and *Coxiella burnetii* (Q Fever) (see Table 31-2).

Table 31-2

Bacterial	Signs/Symptoms	Medical Management
Anthrax	Fever, malaise, cough, SOB, cyanosis	Ciprofloxacin
Plague	High fever, chills, headache, cough, SOB, cyanosis	Streptomycin
Brucellosis	Fever, headache, myalgias, sweats, chills	Doxycycline
Cholera	Massive watery diarrhea	Fluid therapy and antibiotics (tetracycline, doxycycline or ciprofloxacin)
Tularemia	Local ulcer, lymphadenopathy, fever, chills, headache, and malaise	Streptomycin
Q-fever	Fever, cough, and pleuritic chest pain	Tetracycline

Viral Agents

A number of viruses are BW agents, including smallpox, the viral hemorrhagic fevers (VHF), and the alpha virus that causes VEE (see Table 31-3).

Table 31-3

Viral	Signs/Symptoms	Medical Management
VEE	Fever and encephalitis	Nonspecific/supportive care
Smallpox	Malaise, fever, rigors, vomiting, headache followed by pustular vesicles	Antiviral under investigation
VHF	Flushing of the face, petechiae, bleeding, fever, myalgias, vomiting, and diarrhea	Nonspecific/supportive care