CHAPTER 19

ENVIRONMENTAL HEALTH

Section I. INTRODUCTION

19-1. General

History has shown that more time was lost due to environmental illnesses and injuries than to combat injuries. The death rate from illness and injuries have also surpassed those due to combat injuries. As recently as the Vietnam conflict, the communicable illness and injury rate exceeded the combat injuries by a margin of 4 to 1.

19-2. Employment of Protective Measures

The number of environmental illnesses and injuries can be reduced significantly by applying simple commonsense protective measures. As the unit medical specialist, you can assist the commander in identifying problem areas and developing protective measures. The use of insect repellents can reduce the number of mosquito bites, which in turn can reduce the number of malaria cases. Treating water with iodine or other purification materials can reduce the probability of personnel getting typhoid fever from drinking contaminated water. Keeping food cold, 45°F, in storage or hot, 140°F, on the serving line can reduce the chances of food poisoning.

Section II. COMMUNICABLE DISEASES

19-3. General

Communicable disease is an illness due to a specific infectious agent or its toxic products which arises through transmission of that agent or its products from an infected person or animal or a reservoir to a susceptible host, either directly or indirectly, through an intermediate plant or animal host, a vector, or the environment.

19-4. Types of Organisms Which Cause Communicable Diseases

The following is a classification of disease organisms and examples of the diseases they can cause:

- Bacteria: plaque, staphylococcal wound infections, typhoid fever, gonorrhea.
- Viruses: influenza, hepatitis, measles, rabies, yellow fever.
- Rickettsia: typhus, rocky mountain spotted fever.
- Fungi, yeasts: athletes foot, yeast infections.
- Protozoa: malaria, amebiasis.
- Helminths (worms): hookworms, filariasis.

19-5. Infection

An infection is a condition caused by the entry and development or multiplication of pathogens. Pathogens are disease-producing microorganisms. Pathogenic agents of one kind or another are present in all areas where life exists naturally. They inhabit the air, soil, and water. They are also in waste products, respiratory tract, alimentary tract, and skin of humans and animals. Some of these organisms can survive for only a few minutes outside the human body, while others can survive for years.

19-6. Communicability and Transmission

a. The communicability of the causative organisms is affected by the following:

- *Reservoir*—Any person, animal, plant, soil, or substance in which an infectious agent lives and multiplies, on which it depends for survival, from which it can be transmitted to a susceptible host.

- *Transmission*—Any mechanism by which an infectious agent is spread through the environment, or directly to another person. It includes the exit from an infected host and the entry to a susceptible host.

- *Host*—A person or other living animal that gives subsistence to an infectious agent under natural conditions. A host may have variable symptoms or an inapparent (asymptomatic) infection. Figure 19-1 illustrates the chain of infection.

b. Principles of communicable disease prevention and control are illustrated in Figure 19-2.

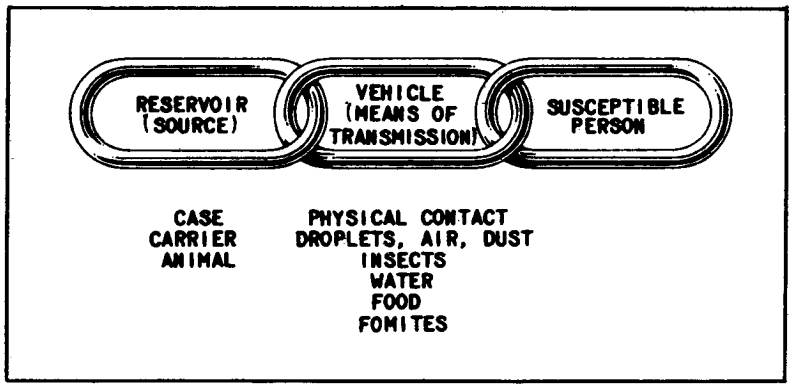

Figure 19-1. Chain of infection.

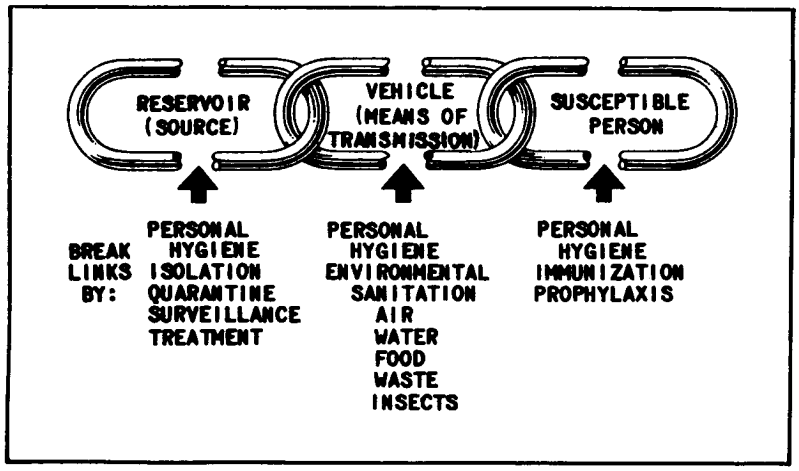

Figure 19-2. Principles of control.

19-7. Reservoirs of Disease

Major reservoirs of disease and control measures include:

	Reservoirs	*Control*
a.	Humans	Medication to prevent malaria. Treatment of venereal disease contact.
b.	Animals (mammals)	Immunization of pets. Quarantine of animals.
c.	Arthropods (ticks, insects)	Insecticides. Control of breeding areas. Immunizations.

19-8. Modes of Transmission

The major routes or modes of transmission control measures are:

	Mode of Transmission	*Control*
a.	Airborne droplets/nuclei (tuberculosis, influenza, other respiratory infections)	Cover nose and mouth while coughing. Avoid crowds during flu season.
b.	Fecal-oral (dysenteries, Hepatitis A)	Wash hands after using latrine. Stay home from work when ill with disease.

c.	Skin, mucous membrane (impetigo, carbuncles common cold, venereal diseases, hookworm)	Handwashing. Isolation. Treatment of patient. Wearing of shoes. Proper disposal of wound dressings.
d.	Food and water (dysentery, hepatitis, staph enteritis)	Handwashing by food handlers. Proper cooking of food. Chlorination of water.
e.	Fomites—articles contaminated with infections, micro-organisms (bed linens, eating utensils, handkerchiefs)	Proper washing of linens. Sanitize eating utensils.
f.	Arthropods (mosquitoes, ticks)	Insecticide sprays, repellents. Immunizations.

19-9. Communicable Diseases of Military Importance and Their Control

a. Respiratory diseases (common cold, influenza, pneumonia).

(1) Modes of transmission—coughing, sneezing, and oral contact.

(2) Control measures—individual immunizations, personal hygiene, and adequate ventilation.

b. Intestinal diseases (diarrhea, dysentery, and typhoid).

(1) Modes of transmission—contaminated food and water, flies, and infected individuals.

(2) Control measures—eat only approved food and drink only treated water, dispose of waste matter properly, maintain good personal hygiene (wash your hands before eating), practice insect and rodent control, and keep immunizations current.

c. Insect-borne diseases (malaria, typhus, and encephalitis).

(1) Modes of transmission—insect bites and mechanical transmission (disease-causing organisms deposited by insects on food, drink, or open sores).

(2) Control measures—keep immunizations current; take prescribed prophylaxis (malaria pills); bathe daily and change your clothing daily (if not daily, as often as the circumstances will permit); blouse your pants legs, button your shirt sleeves and collar; use insect repellents; and spray pesticides to eliminate or control insects.

NOTE

See FM 21-10 for insect control methods.

CAUTION

When using pesticides in control programs, follow the container's label instruction.

d. Venereal diseases (syphilis, gonorrhea, Herpes Simplex II).

(1) Mode of transmission is contact with infected persons.

(2) Control measures—

- Attend sex education classes and obey "off limits" restrictions.
- Maintain personal hygiene (wash genitals thoroughly; use condoms).
- Identify and report all infected sexual partners.
- Report visible signs of infection.
  - o MALE—Sore(s) on genitals or discharge from penis.
  - o FEMALE—Vaginal discharge, lesions of the skin and mucous membranes, or moist papules in folds of skin in the genitalia.
- Secure prompt medical treatment.

NOTE

Contracting venereal disease (VD) is not a cause for disciplinary action, but failure to report for proper medical treatment or violating "off limits" restrictions could result in such action.

Section III. HEAT INJURIES

19-10. General

a. Heat Injuries. Heat injuries are frequently preventable conditions. Prevention depends on the availability and consumption of adequate amounts of water, acclimatization, and protection from undue heat exposure. A soldier's ability to function in a hot climate will depend largely on factors such as general health, age, acclimatization, obesity (being overweight), and use of drugs or alcohol.

(1) A general preventive measure is to drink sufficient amounts of liquids and replace body salt lost through perspiration. Instruction to individuals on how to live and work (or fight) in hot climates will also contribute to the prevention of heat injuries. Heat injuries can be fatal if not treated promptly and correctly. The availability of sufficient water during

training or combat operations in hot weather is very important. Perspiration can cause the loss of more than a quart (480 cc's) of body fluids (water) in an hour. Since the body depends on water to help cool itself, lost fluids must be replaced immediately. The best way for soldiers to function in extreme hot climates is to drink water frequently. Individuals should not rely on thirst alone as an indicator for water replacement needs.

(2) Individuals who have suffered one heat injury are prone to suffer another one. A patient suffering from a heat injury should have recovered enough not to risk a recurrence before returning to duty. Other conditions which may increase heat stress and cause heat injury include infections, pyrexia (fever), a recent illness or injury, obesity, dehydration, exertion, heavy meals, and alcohol or drugs.

b. Diet. A balanced diet usually provides enough salt even in hot weather. However, when soldiers are on reducing or other special diets, salt may need to come from other sources. A special diet must be prescribed by a physician or dietitian to insure that it provides all essential requirements.

c. Clothing and Equipment. The types of clothing and equipment a soldier wears and the way he wears them also affect the body and acclimatization. Clothing protects the body from radiant heat but excessive or tight-fitting clothing, web equipment, and packs reduce the ventilation needed to cool the body. During periods of inactivity when such items are not needed, they should be removed, mission permitting.

19-11. Category of Heat Injuries

The categories of heat injuries are—

- Heat cramps.
- Heat exhaustion.
- Heat stroke.

19-12. Heat Cramps

Heat cramps are caused by an excessive loss of salt in the body. Salt imbalance causes changes in nerve impulses to muscles which, in turn, cause spasms and the inability of muscles to relax. After prolonged exertion in hot weather, the signs and symptoms of heat cramps will appear in the arms, legs, and/or stomach.

a. The signs and symptoms of heat cramps.

- The patient is experiencing muscle cramps of his extremities and/or abdomen after prolonged exertion in hot weather. He grasps or massages the affected arm or leg, or bends over at the waist (indicating cramps of the abdomen).
- The patient is pale and has wet skin.
- He is experiencing dizziness and extreme thirst.

b. Treatment for heat cramps.

(1) Have individual drink 250 cc's (1/4 canteen) of water.

(2) Administer one canteen of water with ¼ teaspoon of table (C-ration packet) salt added. Have the patient drink the canteen of salt solution over a 30-minute period.

CAUTION

Do not give the patient salt water if he is nauseated. Have him drink a canteen of unsalted water.

(3) If conditions permit, move the patient to a shaded area.

(4) Have him sit or lie in a comfortable position.

(5) Loosen all tight-fitting clothing.

(6) Allow him to rest until cramps have subsided.

c. Record the treatment given if he is being evacuated.

d. Evacuate the patient to an MTF if cramping symptoms persist.

19-13. Heat Exhaustion

Heat exhaustion is caused by dehydration and loss of body salt. It is basically a hypovolemic problem (an abnormal decrease in the volume of circulating fluid (plasma) in the body).

a. Signs and symptoms of heat exhaustion.

- The patient feels dizzy, weak, and/or faint.
- His skin feels cool and moist to the touch.
- He may feel nauseous (sick to his stomach) or may have a headache.

b. Treatment for heat exhaustion.

(1) Have the patient drink one canteen of water to relieve the symptoms.

(2) If he complains of cramps, give him one canteen of water with ¼ teaspoon of table salt added. Have him drink the canteen of salt solution over a 30-minute period.

CAUTION

Do not administer salt if the patient is nauseated. Have him drink a canteen of unsalted water.

NOTE

If the patient is unable to drink water due to nausea and/or if symptoms have not improved within 20 minutes after liquids have been given orally, then he must be evacuated to an MTF.

(3) If conditions permit, move the patient to a shaded area. Have him lie in a comfortable, supine (flat on his back) position.

(4) Loosen all tight-fitting clothing.

(5) Elevate his feet above the level of his heart. If a litter is available, have the patient lie on the litter in a supine position and elevate the foot of the litter.

c. Record the treatment given if the patient is being evacuated.

d. Evacuate the patient to the nearest MTF if symptoms persist.

19-14. Heat Stroke

Heat stroke (hyperthermia) is a MEDICAL EMERGENCY caused by failure of the heat-regulating mechanism of the body. Persons who are not acclimatized to heat, the elderly, and those with cardiovascular (heart and blood vessel) problems are particularly vulnerable. Also, obesity, dehydration, excessive use of alcohol or drugs, poor health, and the lack of sleep contribute to the possibility of hyperthermia.

a. Signs and symptoms of heat stroke.

- The patient may have a headache and visual disturbance (impaired vision).

- He may have a high fever (elevated temperature) and will not be sweating (skin may appear dry). His skin will appear abnormally hot to the touch.

NOTE

Oral temperature may range up to 105°F (40°C) or higher and the rectal temperature may range up to 107°F (42°C) or higher.

- His pulse may be rapid or irregular.

- The patient may have muscle cramps and convulsions.

- The patient may feel dizzy or nauseated.

- The patient may be unconscious.

b. Treatment (emergency management) for heat stroke. Reduce the body temperature to 102°F (39°C) as quickly as possible, using one or more of the methods indicated below.

CAUTION

If individual is unconscious, insure that he has adequate respiration (open the airway) and adequate circulation. Also, insure that the patient has not gone into shock. If necessary, initiate treatment for shock.

- *First Method.* If a thermometer is available, immerse patient in cool water (including torso, trunk, and extremities). While patient is immersed, massage his arms and legs (extremities). Massaging allows skin capillaries to dilate and transmit a cooling effect.

CAUTION

It is vital to determine when the patient's temperature cools to 102°F (39°C). When this happens, he must then be taken out of the water immediately. Once the patient's temperature falls to 102°F, it will drop even more rapidly if he is left immersed and worsen his condition.

- *Second Method.* If no thermometer is available, immerse only the patient's trunk in the cool water. Be careful not to overcool him, as this would cause the patient's temperature to go to the other extreme (below 98.6°F (37°C). Massage the patient while immersed in cool water to help skin (capillaries) transmit cooling effect.

- *Third Method.* If facilities are not available for immersing the patient, pour cool water over the patient or sponge him liberally, then fan him to permit the cooling effect of evaporation.

c. Record the treatment given.

d. Evacuate the patient to an MTF as soon as possible for definitive treatment. If available, place ice bags at the sides of the patient's neck and under his armpits while transporting to the MTF.

Section IV. COLD INJURIES

19-15. General

a. Cold weather operations pose a particular threat to the combat soldier since it is possible for him to sustain a serious injury unrelated to combat or training.

b. Cold injuries to the body can occur when an individual is exposed for prolonged periods to temperatures at or below 50°F, or to extreme cold for shorter periods.

c. Such exposure can cause surface tissue damage or it can cause generalized body chilling which can result in death.

d. Specific preventive measures are directed toward conserving total body heat and avoiding prolonged exposure to cold and moisture. Regular water intake is especially necessary in cold weather to avoid dehydration.

e. The medical specialist must be able to recognize the signs and symptoms of all forms of cold injury. While some injuries are superficial and not serious enough to require evacuation, others can cause permanent injury or death. The windchill chart (Table 19-1) will help you to judge the severity of the environment. Some weather conditions require reducing the exposure time of individuals engaged in patrols, guard duty, or motor movement in unheated vehicles despite the adequacy of clothing and equipment. These possible conditions can frequently be anticipated by the use of meteorological data and existing weather conditions to predict the hazard for the following 12-hour period.

Table 19-1. Windchill Chart

	LOCAL TEMPERATURE (°F)										
Wind speed (MPH)	32	23	14	5	-4	-13	-22	-21	-40	-49	-58
	EQUIVALENT TEMPERATURE (°F)										
CALM	32	23	14	5	-4	-13	-22	-31	-40	-49	-58
5	29	20	10	1	-9	-18	-28	-37	-47	-56	-65
10	18	7	-4	-15	-26	-37	-48	-59	-70	-81	-91
15	13	-1	-13	-25	-7	-49	-61	-73	-85	-97	-109
20	7	-6	-19	-32	-44	-57	-70	-83	-96	-109	-121
25	3	-10	-24	-37	-50	-64	-77	-90	-104	-117	-117
30	1	-13	-27	-41	-54	-68	-82	-97	-109	-123	-137
35	-1	-15	-29	-43	-57	-71	-85	-99	-113	-127	-142
40	-3	-17	-31	-45	-59	-74	-87	-102	-116	-131	-145
45	-3	-18	-32	-46	-61	-75	-89	-104	-118	-132	-147
50	-4	-18	-33	-47	-62	-76	-91	-105	-120	-134	-148
LITTLE DANGER FOR PROPERLY CLOTHED PERSONS			CONSIDERABLE DANGER			VERY GREAT DANGER					
DANGER FROM FREEZING OF EXPOSED FLESH											

19-16. Chilblain

Chilblain results from repeated prolonged exposure of bare skin to temperatures from 60°F (16°C), down to 32°F (0°C), for acclimated, dry unwashed skin. It is usually not serious enough to require evacuation.

a. Signs and Symptoms of Chilblain.

- Skin becomes acutely red, swollen, hot, tender, and/or itching.
- Bleeding lesions may surface from continued exposure.

CAUTION

Continued exposure may lead to ulcerative (surface) or hemorrhagic (bleeding) lesions. Lesions are sores that occur where layers of skin have broken down.

b. Treatment for Chilblain.

(1) Within minutes rewarm the affected part of the body.

- **FACE.** Cover the affected area of face with warm hands until feeling/sensation returns.

- **HANDS.** Have the patient place his bare hands next to the skin in the opposite armpit.

- **FEET.** In the most sheltered area available, place the bare feet under the clothing and against the abdomen of another soldier.

(2) Protect lesions with a field dressing. Do not apply ointments because the moisture will cause further skin breakdown in a cold environment.

c. Record the Treatment Given.

d. Evacuate the Patient. Evacuate all persons with cold injuries to an MTF.

19-17. Frostbite

Frostbite results when tissues exposed to temperatures below 32°F (0°C) freeze. The degree of injury depends upon the windchill factor, duration of exposure, and adequacy of protection. Individuals with a history of cold injury are prone to repeated episodes. A sudden blanching of the skin occurs in the nose, ears, cheeks, face, fingers, or toes, followed by a momentary tingling sensation. When the face, hands, or feet stop hurting, look for frostbite. Frostbite is divided into two categories:

- Superficial.
- Deep.

a. Signs and Symptoms of Superficial Frostbite. The most commonly affected areas are the hands, feet, ears, and exposed areas of the face.

- Redness, followed by powdery flaking of the skin. Affected areas of dark-skinned persons may appear dull and grayish.
- Blister formations 24 to 36 hours after exposure, followed by flaking of superficial skin in large sheets.

b. Signs and Symptoms of Deep Frostbite.

- Lack of pain or loss of feeling in the affected area.
- When the frostbitten area thaws, it is painless, pale yellow, and waxy-looking.

- Frozen tissue may feel solid or "wooden" to the touch, but not brittle.

- When exposed to inside temperatures, the skin surface collects drops of moisture. Unless rewarming is rapid, blisters appear in 12 to 36 hours.

- Discoloration (red-violet) appears suddenly 1 to 5 days after the injury.

- Gangrene usually results when the patient does not receive proper treatment.

c. Treatment for Frostbite.

(1) Determine whether the frostbite is superficial or deep and treat accordingly.

- If the exposure time was short, the frostbite will probably be superficial.

- If the exposure time was for a longer duration, the frostbite will probably be deep.

NOTE

Do not rub the frostbitten area with snow or apply cold water soaks, or rewarm the affected area by massaging or exposing it to open fire.

(2) Move the casualty to a warm and sheltered area.

(3) Rewarm the face, nose, or ears by placing your hands on the frozen area.

(4) Rewarm frostbitten hands by placing them under clothing and against the body. Close the clothing to prevent further loss of body heat.

(5) Rewarm the feet by removing the boots and socks. Place the bare feet under the clothing and against the abdomen of a buddy. Once the feet are warmed, put on dry socks and boots, if available. If the patient must wear the wet socks and boots, he should exercise his feet by wiggling his toes.

NOTE

1. If another soldier is unavailable, you may have to use your own body heat.
2. Identify multiple casualties by severity of cold injury and determine whether the frostbite patient is in need of immediate care or can walk to the MTF.

(6) Loosen constricting clothing and remove jewelry. Loose layers of clothing are effective insulators. Air is trapped between layers of clothing and is warmed by the body.

(7) Increase insulation and exercise.

NOTE

Do not allow patient to use alcohol or tobacco. Alcohol increases loss of body heat; tobacco causes constriction of blood vessels in the extremities.

(8) Reassure the patient.

(9) Protect frozen tissue from further cold or trauma.

(10) Deep frostbite—occurs most seriously in the feet and less common in the hands and ears.

(a) Move the patient to a sheltered area.

(b) Immediately make arrangements to get the patient to an MTF.

CAUTION

Avoid thawing if it is possible that the injury may refreeze before reaching the MTF.

(c) If possible, do not let the patient walk if his feet are frozen.

(d) Avoid treating or thawing the affected area.

d. Record the Treatment Given.

e. Evacuate the Patient.

19-18. Hypothermia

Hypothermia is whole body cooling, with core body temperature (temperature measured centrally from within the rectum) below 95°F (35°C). Hypothermia is a MEDICAL EMERGENCY. Predisposing factors of hypothermia are fatigue, poor physical conditioning, dehydration, faulty blood circulation, alcohol or other drug intoxication, trauma, and immersion. Hypothermia may be accompanied by varying degrees of frostbite.

a. Signs and Symptoms of Hypothermia.

- Shallow or absence of respiration.
- Faint or unpalpable peripheral (apical) pulse.
- Patient is at first cold, then stops shivering.

- Loss of sensation or feeling.
- Sluggish or absence of pupillary reflexes.
- Mental disorientation, withdrawn appearance, depressed mood, uncoordinated movements, and/or slurred speech. Listlessness, indifference, and/or glassy stare are also good clues.

b. Treatment for Hypothermia.

(1) Determine the patient's level of consciousness.

CAUTION

Dangers exist from cardiac arrhythmia and shock. Cardiac arrhythmia may occur when the heart reaches a low temperature.

(2) Move the patient to a sheltered area to prevent further heat loss.

(3) Replace the patient's wet clothing with dry clothing, blankets, or sleeping bags. Provide heat by using a hot water bottle, electric blanket, campfire, or your own body heat. The most effective method, if available, is to immerse the patient's torso (not the limbs) in a tub of warm water (105°F (42°C) to 110°F (44°C)).

CAUTION

The patient is unable to generate his own body heat. Therefore, merely placing him in a blanket or sleeping bag is not sufficient.

(4) Provide the patient with something warm/hot and nutritious to drink. Calories may be added by using sugar or glucose tablets in hot, sweet drinks.

NOTE

Hypothermia patients have revived after as long as 30 minutes of immersion in cold water.

c. Record the Treatment Given.

d. Evacuate the Patient to the Nearest MTF.

19-19. Immersion and Trench Foot

a. Immersion foot is an injury sustained as a result of prolonged exposure (usually in excess of 12 hours) in water at temperatures usually below 50°F (10°C). It is not limited to the feet, but may involve other areas following immersion. Exposure for several days in water at 70°F (21°C) at tropical latitudes has produced severe injury.

b. Trench foot is an injury sustained as the result of exposure to cold and wet conditions, short of freezing. The average duration of exposure resulting in trench foot is 3 days.

c. The signs and symptoms of immersion foot or trench foot can be divided into three phases:

- The anesthetic phase, with loss of pain sensation and a weak pulse in the injury area.
- The reactive hyperemic phase, in which the limbs feel hot and as if burning with shooting pains.
- The vasospastic phase, in which the blood vessels contract, causing a decreased pulse and skin discoloration.
- Blisters, swelling, redness, skin surface heat, hemorrhage, and gangrene may develop in any phase.

d. Treatment for immersion foot/trench foot.

(1) Gradually rewarm the affected area by exposure to warm air. NEVER MASSAGE THE SKIN.

NOTE

Avoid extreme heat and ice application. In a field environment, warm air from a heated source may not be available. Rewarm as for a frostbite casualty.

(2) Dry the affected area immediately.

(3) Protect the affected area from trauma and secondary infections. Dry, loose clothing or several layers of warm coverings are preferable to heat.

(4) Elevate the affected parts. (This aids in reducing the amount of edema fluid.)

e. Record the treatment given.

f. Evacuate the patient to an MTF as soon as possible.

19-20. Snow Blindness

a. Snow blindness occurs when the ultraviolet rays of the sun are reflected from a snow covered surface. This condition can occur even in cloudy weather. In fact, it is more likely to occur in hazy, cloudy weather than when the sun is shining.

b. Signs and symptoms of snow blindness.

- The patient experiences a scratchy feeling in his eyelids. It may feel as if he has sand in his eyes.
- Observe his eyes for redness and watering.
- Ask him if he has a headache.

c. Treatment for snow blindness.

(1) Blindfold the patient using a dark cloth. If the patient has not developed a severe case of snow blindness, an emergency pair of sunglasses (Figure 19-3) may be made from a thin piece of wood or cardboard the width of the face. Cut slits for the eyes and attach strings to hold the improvised glasses in place.

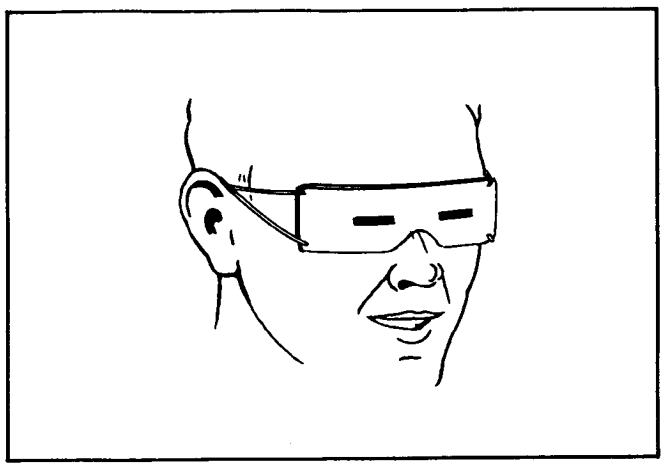

Figure 19-3. Improvised sunglasses.

(2) Reassure the patient.

d. Record the treatment given if evacuation is necessary.

e. Evacuate the patient to an MTF, if necessary.

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f. Evacuate the patient to an MTF as soon as possible.

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Section V. BITES AND STINGS

19-21. General

In the Continental United States, insect bites and stings from venomous arthropods may result in severe reactions and can cause death. Arthropods most frequently reported as responsible for bites and stings are wasps, bees, ants, spiders, and scorpions. In certain geographical locations in CONUS, some arthropods have only seasonal importance while others are present throughout the year. Because of the potential for arthropod poisoning to humans, their identification, distribution, behavior, and control are important factors in the prevention of insect bites and stings.

19-22. Black Widow Spiders

a. The black widow spider (Figure 19-4) is easily identified by its jetblack color and the reddish hourglass-shaped figure found on the underside of its abdomen. This spider is found in grass, shrubs, rock piles, latrines, and similar locations. The black widow spider prefers to remain hidden and is generally nonagressive; however, if molested, it will bite.

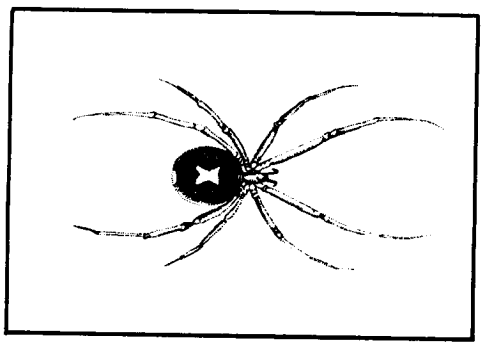

Figure 19-4. Black widow spider.

b. Signs and symptoms of a black widow spider bite.

- A dull, numbing pain at the bite site.
- Two red puncture marks with only a slight, local topical reaction.
- Severe muscular pain and spasms. The pain peaks in 1 to 3 hours and persists for 12 to 48 hours.
- Profuse sweating.
- Nausea.
- Rigid and boardlike abdomen with pain.
- Tightness in the chest with pain during inhalation.
- Possible convulsions, paralysis, or signs of shock.

c. Treatment for a black widow spider bite.

(1) Expose bite area by—

(a) Removing clothing and/or shoes to the extent necessary to expose the bite area.

(b) Removing jewelry as soon as possible to prevent restricting circulation as swelling (edema) occurs. If the jewelry cannot be removed because of swelling, place ice locally to reduce or prevent further swelling.

(c) Jewelry should be given to the patient, placed in his pocket, or otherwise protected/secured.

(2) Ask the patient if he can identify what bit him.

(3) Do not apply a tourniquet or attempt to remove the venom by incision or suction.

(4) Keep patient quiet and warm.

(5) Cleanse the bite area.

(6) Apply ice to the bite area, if available. Ice relieves pain and swelling and slows down circulation, restricting the spread of the venom.

(7) Monitor vital signs.

(8) Treat for anaphylactic shock, if necessary.

d. Record the treatment given.

e. Evacuate the patient to the nearest MTF.

19-23. Brown Recluse Spiders

a. The recluse spider (Figure 19-5) is about 3/8 inches long and is differentiated from other brown spiders by a dark brown violin shaped area on its back. This spider is found primarily in grass and weed shelters, around rocky bluffs, and in rock piles. It sometimes seeks refuge in blankets, bedrolls, shoes, clothing, or wadded-up paper. The brown recluse spider prefers to remain hidden and is generally nonaggressive; however, when molested, it will bite.

b. Signs and symptoms of a brown recluse spider bite.

- Mild to severe pain at the bite site. This usually occurs 1 to 8 hours after the bite, as there is little (if any) immediate pain.
- Redness at the bite site.
- Star-shaped, firm area of deep purple color at the bite site (usually 3 to 4 days following the bite).

- A central area of depression and ulceration (usually 7 to 14 days following the bite).
- Chills, nausea, and vomiting.
- Scar formation which follows approximately 21 days after the bite.

c. Treatment for a brown recluse spider bite.

(1) Calm the patient with reassuring words.

(2) Clean the bite site.

(3) Monitor the patient's vital signs.

d. Record the treatment given.

e. Evacuate the patient to the nearest MTF.

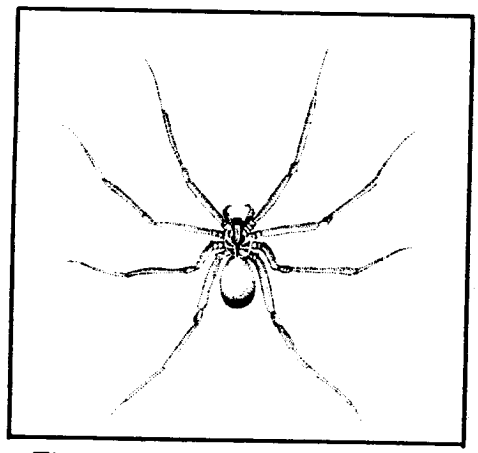

Figure 19-5. Brown recluse spider.

19-24. Scorpions

a. Scorpions are easily recognized by their crablike appearance with a long, segmented tail which ends in a sharp spine or stinger (Figure 19-6). Scorpions are most commonly found in warm climates. They prefer damp locations and are particularly active during the night. Most scorpions found in the US are capable of only causing painful stings.

b. Signs and symptoms of scorpion stings.

- Severe pain at the sting site.
- Burning sensation at the sting site.
- Local swelling and discoloration at the sting site.

NOTE

The above symptoms are characteristic of the harmless species of scorpions.

- Other signs and symptoms of the deadly species are—
  - o "Pins and needles" sensation at the sting site.
  - o Impaired speech and drowsiness.
  - o Nose, mouth, and throat itching.
  - o Generalized/localized muscle spasms.
  - o Respiratory distress.

NOTE

Scorpion stings of the deadly species normally do not cause swelling or discoloration.

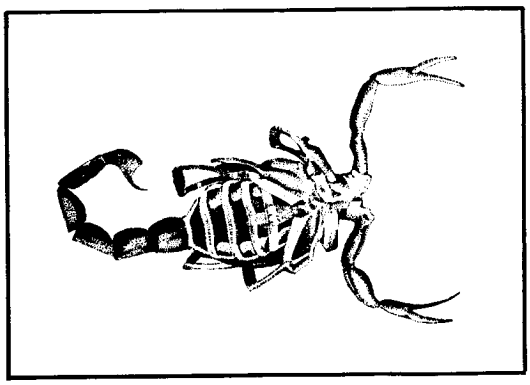

Figure 19-6. Scorpion.

c. Treatment for a scorpion sting.

NOTE

If a person is stung by a scorpion on the face, neck, or genital organs, he should be treated immediately by a medical officer.

(1) Immobilize the patient. Apply a constricting band proximal to the sting site. The band is sufficiently tight when one finger can be inserted between the band and the body part.

(2) Pack the area with ice and extend it beyond the constricting band. This is done to restrict venous flow but not to stop arterial flow.

(3) Remove the constricting band after 5 minutes.

(4) Monitor the patient's vital signs.

d. Record the treatment given.

e. Evacuate the patient to the nearest MTF, if necessary.

19-25. Bees, Wasps, Hornets, and Yellow Jackets

a. The bee has a characteristic rounded abdomen. When it stings, its stinger remains in the victim. The bee will fly away and die. On the other hand, a wasp, hornet, or yellow jacket has a slender, elongated body and retains its stinger and can sting repeatedly (Figure 19-7).

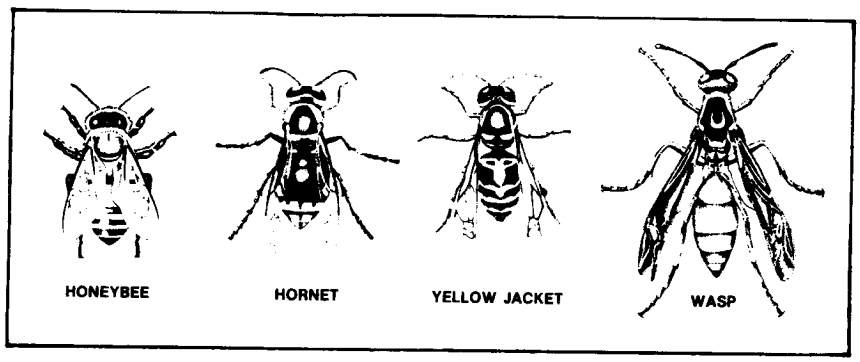

Figure 19-7. Bee, hornet, yellow jacket, and wasp

b. Signs and symptoms of bee, wasp, hornet, and yellow jacket stings.

- Pain at the sting site.
- Development of a wheal and redness at the sting site. Intense swelling may develop in the area of the sting.
- Itching and anxiety indicate a mild reaction.
- Wheezing, vomiting, dizziness, abdominal pain, tightness in the chest, or generalized edema. Any of these signs/symptoms indicate a moderate reaction which usually appears within 20 minutes.
- Labored breathing, difficulty in swallowing, and confusion indicate a severe reaction.
- Shock. If present, immediately initiate treatment for anaphylactic shock.

c. Treatment for bee, wasp, hornet, and yellow jacket stings.

(1) Remove the stinger from the sting site (bee stings), by gently scraping it with the fingernail, a knife blade, or a thin metal object. (Removal prevents further venom injection from the venom sac.) Do not jerk the stinger out as this action releases more venom.

(2) Wash the sting site with soap and water.

(3) Apply an ice pack or a solution of 10 percent ammonia.

(4) Treat for shock, if necessary.

d. Record the treatment given.

e. Evacuate the patient to the nearest MTF, if necessary.

19-26. Fire Ants

a. The fire ant was brought into the United States from South America in earth used as buoyance in cargo ships. They were first found in the Mobile, Alabama area. Since there are no natural enemies to this insect in the United States, they have invaded all of the Gulf Coast States.

b. Signs and symptoms of fire ant bites.

- Severe burning pain at the bite site.
- Wheal formation. The wheal will usually last a few minutes.
- A clear, fluid-filled bubble at the bite site. This bubble usually forms within minutes of the bite.
- A cloudy, fluid-filled bubble at the bite site. This bubble usually appears 2 to 4 hours after the bite.
- A bubble with a red base. This bubble usually appears 8 to 10 hours after the bite.
- Tenderness at the bite site.
- A lesion at the bite site. The lesion usually appears 3 to 8 days after the bite and may leave a scar.

c. Treatment for fire ant bites.

(1) Wash the bite site with soap and water.

(2) Apply an ice pack or cold compress to the bite site.

(3) Treat for anaphylactic shock, if necessary.

d. Record the treatment given.

e. Evacuate the patient to the nearest MTF, if necessary.

19-27. Ticks

a. Ticks are common in woods and fields throughout the United States. They are divided into two groups: the hard ticks and the soft ticks. The hard tick has a hard shield on its back, and its mouth parts can be seen from above (Figure 19-8). The soft tick does not have a hard shield on its back, and its mouth parts cannot be seen from above (Figure 19-9).

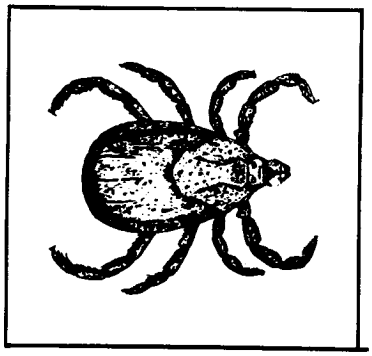

Figure 19-8. Hard ticks.

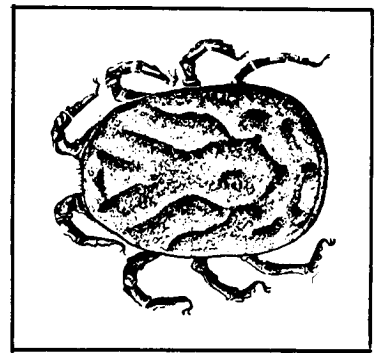

Figure 19-9. Soft ticks.

b. Signs and symptoms of tick bites.

- Tick with mouth parts inbedded in patient's skin.
- Itching and/or redness at the bite site, tick already removed.
- Pain in patient's arms or legs.

NOTE

After several days, the patient may develop tick paralysis which could result in respiratory failure.

- Breathing difficulties a few days following the tick bite.

CAUTION

Some species of ticks transmit Rocky Mountain Spotted Fever which may appear 3 to 12 days after the bite.

c. Treatment for tick bites.

(1) Perform rescue breathing immediately if breathing difficulties are present.

(2) Remove the tick by—

(a) Soaking a tissue/gauze pad with mineral, salad, or machine oil, or alcohol and covering the tick (at the bite site). This blocks the tick's breathing pores, causing it to withdraw.

(b) If the tick does not disengage after ½ hour, remove it with tweezers or forceps. Grasp it as close to its mouth as possible. Do not grasp the tick's abdomen since germs may be injected into the patient by the pressure.

(3) Wash the bite site with soap and water.

d. Record the treatment given.

e. Evacuate the patient to the nearest MTF, if necessary.

19-28. Unknown/Nonspecific Insect Bites

a. Many insects not involved in disease transmission are medically important because of their bite or sting and cause concern by their presence.

b. Signs and symptoms of unknown/nonspecific insect bites.

- Breathing difficulties.
- Possible shock.
- Swelling at the bite site.
- Pain at the bite site.

c. Treatment for unknown/nonspecific insect bites.

(1) Perform rescue breathing, if necessary.

(2) Perform anaphylactic shock treatment, if necessary.

(3) Wash the bite site with soap and water.

(4) Apply an ice pack or cold compress to the bite site.

(5) Monitor the patient's vital signs.

d. Record the treatment given.

e. Evacuate the patient who shows signs of respiratory distress and/or shock and who is not responding to initial treatment given.

19-29. Types of Snakes

a. Except for a few species in Southeast Asia and Africa, snakes are shy and will usually avoid contact with humans unless injured, trapped, or disturbed. However, both poisonous and nonpoisonous snakes show some

agressiveness during their breeding periods. All species of snakes can swim and many are able to stay under water for long periods without drowning. Snakebites sustained in water are as dangerous as those sustained on dry land.

b. Nonpoisonous snakes (Figure 19-10) have four to six rows of teeth and do not have fangs.

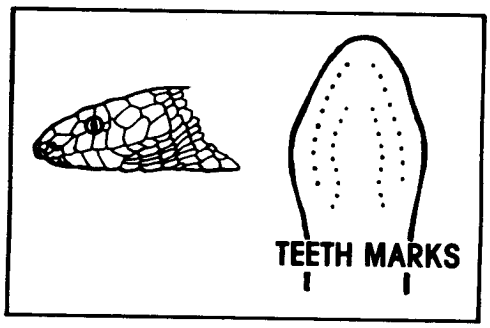

Figure 19-10. Tooth marks of nonpoisonous snakes.

c. Poisonous snakes include the pit vipers (rattlesnakes, water moccasins, and copperheads) and coral snakes.

(1) Pit vipers (Figure 19-11) have two rows of teeth and fangs that create puncture wounds.

(a) North American pit viper snakes are also characterized by vertical pupils, a flat triangular-shaped head distinct from the neck, and a deep pit between the eyes and nostrils.

(b) These snakes may be more than 5 feet in length, and all are capable of injecting hemotoxin venom. This venom can disintegrate red blood cells in humans and animals. The cottonmouth water moccasin can inject both hemotoxin and neurotoxin venom.

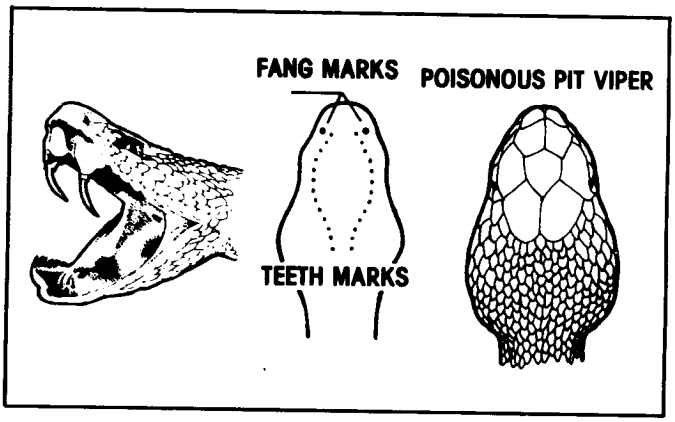

Figure 19-11. Fang marks of poisonous pit viper snakes.

(2) Coral snakes have different markings and colors, depending upon their variety. The average coral snake is usually less than 2 feet long with a body diameter of about ½ inch, and has short, rigid, grooved fangs. The Eastern coral, Texas coral, and Barber's coral have broad alternating bands of red and black separated by narrow bands of yellow circling their bodies in a regular pattern. These snakes have round pupils. The Sonora coral has broad alternating bands of red and black, separated by narrow white bands circling its body in a regular pattern. The coral snake venom is a neurotoxin (destroys nerve tissue).

d. Signs/symptoms of snakebites.

- Immediate pain.
- Progressive swelling at the bite site.
- General skin discoloration (bluish).
- Dizziness.
- Blurred vision.
- Hearing difficulty.
- Fever and/or chills.
- Severe headache.
- Vomiting and nausea.
- Breathing difficulty.

NOTES

1. The patient may exhibit one or all of the above signs/symptoms.
2. If the snake can be killed without risking another bite, it should be brought to the MTF for identification.
3. Some snakebite symptoms may not develop until 6 to 8 hours later.

e. Treatment for a nonpoisonous snakebite.

(1) Cleanse the bite area using soap and water or an antiseptic solution (such as iodine).

(2) If the patient does not have a current immunization, tetanus toxoid, refer him to an MTF for the immunization.

(3) Return the patient to duty.

NOTE

If the bite cannot be positively identified as nonpoisonous, treat it as a poisonous snakebite.

f. Treatment for a poisonous snakebite.

(1) Place the patient in a prone position (preferred).

(2) Keep him as calm as possible.

(3) Tell him not to move.

(4) Explain what you are doing.

(5) Tell him that evacuation will be accomplished as soon as possible.

(6) Expose the wound as necessary by removing patient's clothing, shoes, and jewelry.

(7) If the patient has been bitten on an extremity, keep the bitten part at or below the heart level to slow down the spread of the poison to the heart.

(8) Exercise caution regarding placement of the arm if the patient is being moved by a stretcher. If the bite is on the hand or arm, it may already be swelling and stretcher straps will increase the pressure and possibly cut off circulation.

CAUTION

Do not give the patient any medication containing alcohol or sedatives. While certain analgesics may decrease the pain, they may also increase the effects of the toxin. Do not allow the the patient to eat or smoke.

(9) Place constricting bands (Figure 19-12) one or two fingers' width above and below the bite site. These bands should be only tight enough to stop superficial venous and lymphatic circulation but not interfere with the arterial pulse. You should be able to insert one finger between the constricting bands and the skin with minimal pressure. If the bite is on the hand or foot, only one band should be placed above the ankle or the wrist (depending on the location of the bite).

(10) If swelling spreads, move the bands beyond the edges of the swelling.

(11) Cleanse the wound area, using soap and water or an antiseptic solution.

(12) DO NOT cut the wound.

(13) Place an ice bag or a chemical ice bag over the bite area, but not in direct contact with the skin. The ice bag should remain over the area until the patient reaches the MTF, but no longer than a few hours. Do not use dry ice, ethyl chloride, or wet ice brine. Be careful not to freeze the area or severe damage can result to the vascular structures and limbs. Only a cooling is to be attempted.

(14) Monitor the patient to prevent cold injury.

NOTES

1. If signs/symptoms of poisonous (envenomation) snakebite are present, and the snake has been identified, a medical specialist who is authorized to use and carry antivenin should administer it. However, this should be done only if you can positively identify the snake. Its use presents risks and only those with specialized training should attempt using the antivenin. Test the patient for sensitivity. The method of administration should follow package instructions. The medical specialist should also be able to deal with severe hypersensitivity reactions to the serum.

2. A possible complication is respiratory failure. If the patient stops breathing, perform rescue breathing. If there is no pulse, perform cardiopulmonary resuscitation (CPR).

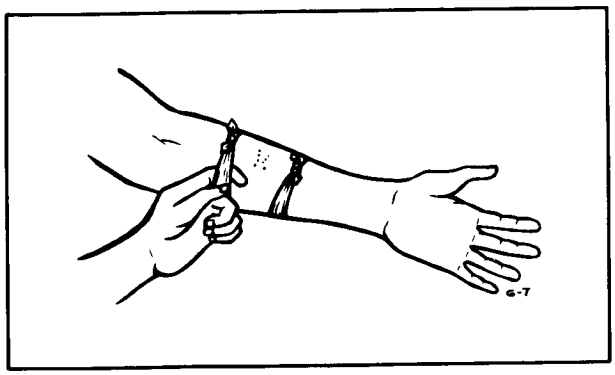

Figure 19-12. Placing constricting bands.

g. Record the treatment given.

h. Evacuate the poisonous snakebite patient to the nearest MTF.

Section VII. POISONOUS PLANTS

19-30. General

a. Contact poisoning is a skin eruption which is caused by direct or indirect contact with the sap (or juice) of poisonous plants. In the United States alone, several thousand cases of contact poisoning occur each year. The most common plants which cause these skin eruptions are poison ivy, poison oak, and poison sumac.

b. These skin eruptions can be prevented by learning how to identify poisonous plants and by taking the proper control measures.

(1) The skin eruptions first appear as redness and swelling accompanied by severe burning and itching.

(2) Blisters appear later.

c. Poisonous plants are most likely to exist in areas of dense vegetation. Poison ivy, poison oak, and poison sumac contain a sticky sap which has a toxic ingredient known as urushiol.

(1) Urushiol is contained in all parts of these plants and is even present in their dead stems and roots.

(2) Urushiol is the agent that causes the skin irritation. Contact with urushiol may also be made indirectly by touching urushiol-contaminated tools, weapons, clothing, and pets, and from another person having urushiol on the skin or clothing. Even smoke from plants that are burning contain droplets of urushiol which can get on the skin or enter the nose, throat, and lungs.

19-31. Preventive Measures for Poisonous Plant Injuries

a. Be able to identify the plants which cause contact poisoning.

b. Avoid selecting bivouac areas which are infected with poisonous plants.

c. Wear gloves and be fully clothed (with sleeves unrolled and buttoned and collar buttoned) when working in an area likely to have poisonous plants.

d. Wash all exposed skin areas with a strong soap solution or with alcohol if exposure to poisonous plants is known or suspected.

e. Use hot water and soap to wash all clothing and equipment known or suspected to be contaminated.

f. Burn poisonous plants on the DOWNWIND side of the bivouac or troop area to avoid contamination with the smoke which contains urushiol droplets.

CAUTION

Urushiol droplets contained in the smoke will cause internal swelling which could result in extreme breathing difficulty.

19-32. Treat Poisonous Plant Injuries

a. Recognize the poison ivy (Rhus radicans) plant (Figure 19-13).

(1) Poison ivy grows as a small plant, either vine, or shrub.

(2) It grows everywhere in the United States except California and parts of the adjacent states. Eastern oak leaf ivy is one of its varieties.

(3) The leaves of this plant always consist of three glossy leaflets.

(4) This plant may also be known as three-leaf ivy, poison creeper, climbing sumac, poison oak, and mercury.

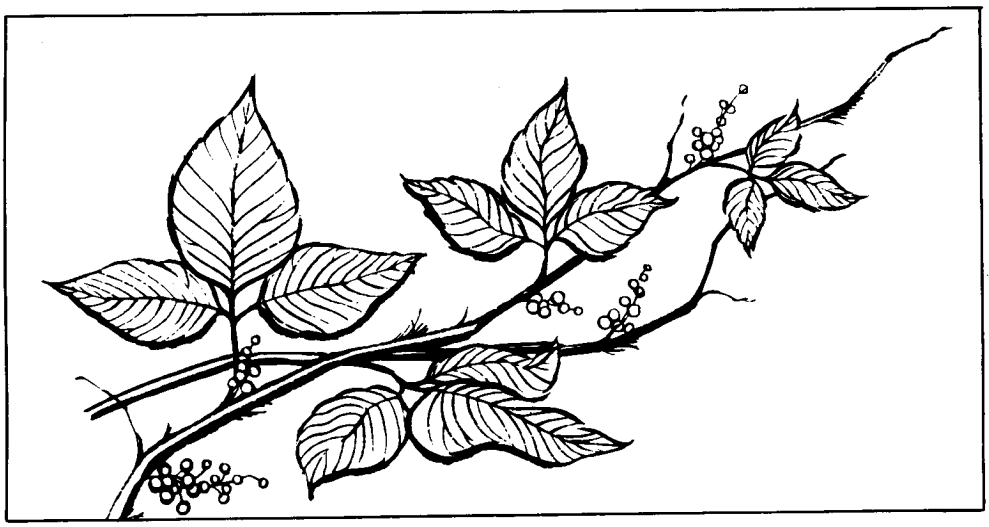

Figure 19-13. Poison ivy.

b. Recognize the poison oak (Rhus diversiloba) plant (Figure 19-14).

(1) Poison oak grows as a shrub and sometimes as a vine.

(2) It grows throughout the United States.

(3) It is sometimes called poison ivy.

(4) Its leaves always consist of three smaller leaflets.

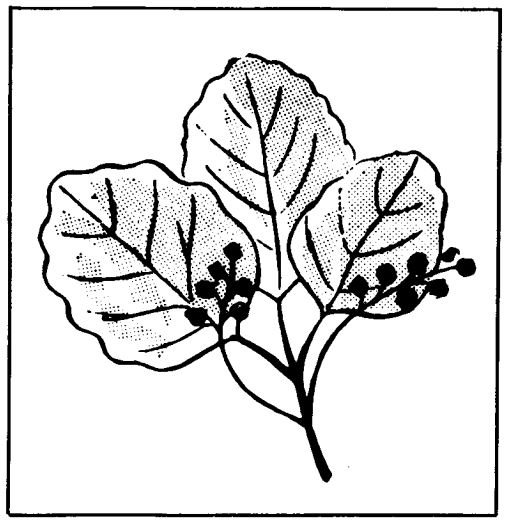

Figure 19-14. Poison oak.

c. Recognize the poison sumac (Rhus vernix) plant (Figure 19-15).

(1) Poison sumac grows as woody shrubs or small trees having compound leaves and clusters of small greenish flowers, succeeded by red, hairy fruits.

(2) It grows in most of the eastern third of the United States.

(3) This plant may also be known as swamp sumac, poison dogwood, and thunderwood.

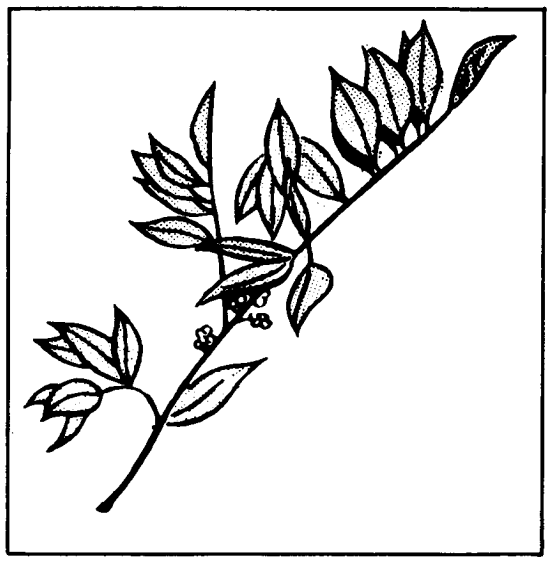

Figure 19-15. Poison sumac.

d. Signs and symptoms of contact poisoning.

- Redness and swelling of involved skin.
- Headache.
- Burning sensation on involved parts of the body.
- Skin eruptions (rash).
- Skin itching.

NOTE

The rash may appear from within a few hours to as many as 48 hours after exposure.

- Blisters on the involved skin. The blisters break after 2 to 4 days and leave a raw surface which becomes encrusted. They will usually heal within 2 weeks.

NOTE

The redness and swelling generally appear first, followed by the blisters.

e. Treatment for contact poisoning.

(1) Thoroughly wash the exposed area(s) of the patient's skin with soap and water or with alcohol to remove or reduce the amount of urushiol on the skin.

(2) Confine the washing to the affected area to avoid spreading the poison to other parts of the body.

(3) Wash the area several times in succession. Use a fresh solution for each wash.

(4) Apply alcohol to the affected area to further cleanse it and to help prevent secondary infections.

(5) Apply Calamine lotion to soothe the contaminated area and help in healing. DO NOT apply Calamine lotion to raw areas, as this may cause infection.

(6) Administer Benadryl to decrease the allergic reaction.

(7) Do not dress the affected area, as this will cause retention of moisture and will not allow the contaminated area to dry.

(8) Avoid contact with the contaminated water in the event you are allergic to the source.

(9) Thoroughly wash your hands and any part of your body which may have come in contact with the urushiol; also, remove all of your clothing exposed to urushiol. This will help in preventing your contracting the poison following the administration of treatment to the patient.

f. Record the treatment given.

g. Evacuate the patient, if necessary. Depending on the severity of the contamination, limited duty or evacuation to an MTF may be necessary.

CHAPTER 20

NUCLEAR, BIOLOGICAL, AND CHEMICAL INJURIES

Section I. INTRODUCTION

20-1. General

The introduction of nuclear, biological, or chemical (NBC) warfare on the battlefield will greatly strain the capabilities of the medical specialist in his role as the first level of medical care to combat forces.

20-2. Employment of NBC Weapons

The enemy may use one or more types of warfare agents in the same area of operations. You may encounter patients suffering from the effects of radiation and chemical agents at the same time. Sections II through IV discuss the types of injuries you will see and will need to provide care for. Additionally, you will continue to see injuries and illnesses caused by other sources in addition to those caused by NBC warfare.

Section II. NUCLEAR CASUALTIES

20-3. General

Nuclear injuries can be divided into three types: blast, thermal, and radiation sickness. Each type of injury can occur without the others, all three can occur at the same time, or in a combination of any two.

20-4. Blast Injuries

a. The types of blast injuries caused by nuclear weapons are more varied than those caused by conventional weapons. Blast injuries are the result of the direct action of the blast wave over pressure, the indirect action of flying debris, or the violent slamming of individuals against other objects. Blast injuries may be complicated by thermal and/or radiation injuries.

b. Signs and symptoms of blast injuries are—

- Wounds.
  - o Cuts.
  - o Abrasions.
- Impalements.
- Soft tissue cavitation (with or without perforating wounds of the chest or the abdomen).

c. The treatment for nuclear blast injuries is the same as for any other type of blast injury caused by day to day accidents or conventional weapons. (See Chapter 13 for treatment of trauma injuries.)

20-5. Thermal Injuries

a. Large numbers of burn casualties from most conventional weapons are uncommon. However, in nuclear warfare, burns are frequently seen injuries. This creates a very serious problem for health service support personnel.

b. The signs and symptoms of thermal injuries are the same as for burns from any other heat source and include discoloration, blisters, charred skin and tissue, and severe edema in all burn areas. Clothing may be stuck to the skin over large areas of the body. The respiratory track may be involved due to inhalation of heat with burns extending deep into the alveoli.

c. The treatment for thermal injuries is the same as for non-nuclear burns. See Chapter 13 for treatment procedures.

20-6. Radiation Injuries

a. Radiation injury (sickness) can result from—

- A single exposure to radiation at the time of detonation of a nuclear weapon, *or*
- An exposure to high levels of fallout radiation, *or*
- Exposure to induced radiation, *or*
- A repeated exposure to any of these sources.

b. The sickness pattern is manifested in three syndromes. These are the hematopoietic, gastrointestinal, and central nervous system syndromes. The hematopoietic (bone-marrow depression) syndrome occurs at lower doses than the others and is the most common form of radiation sickness seen in nuclear combat. As the lethality probability nears 100 percent with higher doses, the gastrointestinal syndrome will dominate. This syndrome develops from a combination of bone-marrow depression and gastrointestinal tract damage. The central nervous system syndrome appears when supralethal doses are absorbed. Aircrews exposed to prompt nuclear radiation from high level detonation and personnel protected from blast and thermal effects by below surface sites are more susceptible to this syndrome.

c. The signs and symptoms of radiation sickness follow similar patterns as the syndromes. They can be divided into three phases.

(1) *Acute incapacitation.* The initial phase of transient acute incapacitation is during the first few hours of exposure and is characterized by the rapid onset of nausea, vomiting, and malaise. This phase only lasts for a few hours and should not be severe enough to require evacuation if exposure is to low doses of radiation.

(2) *Latent period.* Following recovery from the initial phase there will be a period during which the exposed individual will be symptom-free. The length of this period varies with the dose and nature of the initial phase. The longest period is 2 to 6 weeks preceding bone-marrow depression. Prior to the gastrointestinal syndrome, it lasts from a few days to a week. It is shortest preceding the nervous system syndrome, lasting from a few hours to 3 days.

(3) *Clinical period.* During the gastrointestinal syndrome there will be a severe fluid loss and bloody diarrhea; the bone-marrow depression syndrome will follow. The bone-marrow depression will be manifested by problems of bleeding, anemia, and decreased resistance to infection.

d. The central nervous system syndrome is associated with higher acute doses of radiation. The clinical picture for this syndrome is a steadily deteriorating state of consciousness with eventual coma and death.

e. Treatment for radiation sickness by the medical specialist consists of fluid replacement when fluid loss is significant and symptomatic care until the patient is evacuated to an MTF for definitive care/treatment.

Section III. BIOLOGICAL AGENT CASUALTIES

20-7. General

The microorganisms used for the production of biological agents are disease-producing organisms which may have been altered or may actually be the disease organism as found in every day life. Other biological agents, such as yellow rain, are laboratory made. The synthesized agents are known as micro-toxins (toxins). The biological agents may be delivered to the battlefield by the use of modern weapons, as well as through contaminated food products, water, and insect vectors.

20-8. Signs and Symptoms of Biological Agent Casualties

The signs and symptoms of biological agents are as unlimited as the sources of infective disease organisms. The signs and symptoms are the same as for nonwarfare-agent infections and diseases. (FM 8-33 provides the signs and symptoms for most disease-producing organisms.) The signs and symptoms for some toxins are massive mucous membrane tissue hemorrhage and severe skin rashes.

20-9. Treatment for Biological Agent Casualties

Treatment for biological agent patients may be the same as for nonwarfare-agent patients with the same type of illness. Example: biological agent-induced typhoid fever would be treated the same as for nonwarfare-agent-induced typhoid. (See FM 8-33 for specific treatment.) The treatment for toxins is symptomatic.

Section IV. CHEMICAL AGENT CASUALTIES

20-10. General

Chemical warfare agents affect specific body functions and systems. The agents are classified by their physiological action and military use.

a. Physiological Action.

- Nerve agents such as Soman (GD), Tabun (GA), Sarin (GB), and VX inhibit cholinesterase enzymes throughout the body. Since the normal function of these enzymes is to hydrolyze acetylcholine wherever this compound is liberated, such inhibition results in the accumulation of excessive concentrations of acetylcholine at its various sites of action. These include:

  o The endings of the parasympathetic nerves to the smooth muscle of the iris, ciliary body, bronchial tree, gastrointestinal tract, bladder, and blood vessels; to the secretory glands of the respiratory tract; to the cardiac muscle; and to the endings of the sympathetic nerves to the sweat glands.

  o The endings of motor nerves to voluntary muscles and of nerves to autonomic ganglia.

  o The central nervous system.

- Blister agents (vesicants, which include the mustards, arsenicals (Lewisite), and phosgene oxime) produce the following:

  o Local irritation and damage to the skin and mucous membranes.

  o Pain and injury of the eyes.

  o Reddening and blistering of the skin.

Also, when inhaled, blister agents damage the respiratory tract, with resultant development of bronchopneumonia. If tissue damage is severe, shock may occur. Systemic absorption of the vesicant may also be followed by bone-marrow depression.

- Choking agents, such as phosgene, irritate and damage the lower respiratory tract, resulting in pulmonary edema and possibly secondary pneumonia.

- Blood agents (cyanides) stop essential physiological processes. Blood agents such as hydrocyanic acid (AC) and cyanogen chloride (CK) are absorbed into the blood and are carried to all body tissues where the action is a local one inhibiting oxidative processes so that oxygen cannot be transferred from red blood cells to tissue cells. With hydrogen cyanide, respiration is first stimulated and then depressed; convulsions may occur. Cyanogen chloride rapidly causes dyspnea (labored breathing) and has an additional local irritant action on the nose, throat, eyes, and respiratory tract.

b. Military Use.

- Toxic chemical agents are used to produce serious injury or death. They include nerve agents, blister agents, and blood agents.

- Incapacitating agents are used to produce temporary physical or mental effects, or both.

20-11. Protective Measures and Handling of Casualties

a. The protective mask with hood must be put on at once when the alarm or the command is given, or when any of the following conditions are observed:

- Your position is hit by a concentration of artillery, mortar, or rocket fire, or by aircraft bombs.
- Your position is under attack by aircraft spray.
- Smoke or mist of an unknown source is present or approaching.
- A suspicious liquid is present.
- You are entering an area known to be or suspected of being contaminated with a toxic chemical.
- You have several of the following symptoms:
  - o An unexplained runny nose combined with-
  - o A feeling of choking or tightness in the chest or throat.
  - o Dimming of vision and difficulty in focusing the eyes on close objects.
  - o Irritation of the eyes (could be caused by presence of several toxic chemical agents).
  - o Unexplained difficulty in breathing or increased rate of breathing.
- Inappropriate laughter or unusual behavior noted in others, or a sudden feeling of depression, dread, anxiety, restlessness, muscle tightness, dizziness or light-headedness, slurred speech, stumbling, or dryness of mouth noted in yourself.

b. Hold your breath until the mask is on and the facepiece is cleared and checked. The mask should be worn until test procedures indicate that no chemical agent is in the air and the "all clear" signal is given. (See FM 21-40 for unmasking procedures.) If vomiting occurs, the mask should be lifted momentarily, with the eyes closed and the breath held, and replaced, cleared, and properly checked before another breath is taken.

c. Casualties contaminated with a chemical agent will endanger unprotected personnel. Handlers of these casualties must wear the chemical protective overgarment, mask, and gloves.

d. Most chemical agents can poison water and food. They can make supplies or equipment dangerous to handle without wearing a mask and rubber gloves. Water and food supplies suspected of contamination should be examined by chemical test procedures before consumption. The water should be decontaminated, if necessary. Contaminated food should be discarded or the outer layers removed (see TM 3-220) and the residue examined before it is used. The contaminated material should be washed thoroughly with copious

amounts of water (or otherwise decontaminated) by personnel wearing masks, impermeable protective gloves, chemical protective overgarments, and impermeable shoes or boots.

e. Military commanders and medical personnel should be continually on the alert for the possibility of anxiety (combat stress) reactions among combat personnel during toxic chemical attacks. All possible steps must be taken to prevent or control the anxiety situations.

20-12. Personal Decontamination

Following contamination of the skin, clothing, or eyes with a chemical agent, personal decontamination must be carried out immediately since there is a definite time limit after which decontamination is useless. Decontamination consists of either removal or neutralization of an agent, or both, before serious injury occurs. For step by step procedure, refer to TM 8-285 or FM 8-9.

20-13. Nerve Agents

a. Chemical nerve agents are very fast-acting. A soldier exposed to a significant dose of these agents will be unable to aid himself and will need immediate care.

b. Nerve agents are among the deadliest of chemical agents. Nerve agents enter the body by inhalation, by ingestion, and through the skin. Depending on the route of entry and the amount, nerve agents can produce injury or death within minutes and achieve their effects with small amounts. Nerve agents are absorbed rapidly and the effects are felt immediately upon entry into the body.

c. Signs and symptoms of nerve agent poisoning.

(1) Early symptoms in the usual progression.

- Runny nose.
- Red, tearing eyes.
- Sudden headache.
- Excessive flow of saliva (drooling).
- Tightness in the chest, creating difficulty in breathing.
- Reduced vision.
- Muscular twitching in the area of exposed/contaminated skin.
- Stomach cramps.
- Nausea.

(2) Severe symptoms. A nerve agent casualty in the SEVERE stage may exhibit all or most of the following symptoms, plus any of the EARLY symptoms.

- Strange and confused behavior.
- Gurgling sounds made when breathing.
- Severely pinpointed pupils.
- Severe muscular twitching.
- Loss of bladder/bowel control.
- Convulsions.
- Not breathing.
- Vomiting.

NOTE

Soldiers exhibiting severe symptoms will NOT be able to care for themselves.

d. Treatment for nerve agent poisoning.

(1) Mask the patient, if necessary.

(a) Position the patient face up (Figure 20-1).

(b) Open the *patient's mask carrier* and remove the mask.

(c) Situate yourself near the patient's head.

(d) SQUAT (do not kneel) low behind the patient's left shoulder, facing his feet.

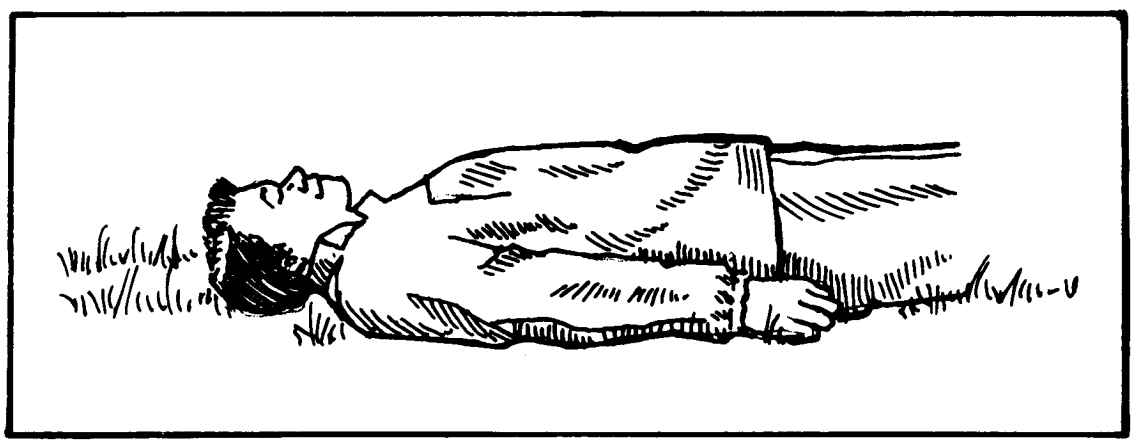

Figure 20-1. Positioning the patient.

(e) Open the mask.

- Grasp the mask with your thumbs outside and your fingers inside the cheek pouches (Figure 20-2).

- Spread the mask open and position it on the patient's chin.

(f) Lift the head and slide the head harness over it as follows:

- Position your thumbs through the two bottom straps of the head harness.

- Cup the patient's head with the fingers of your hands and lift it slightly.

Figure 20-2. Opening the mask.

- Move your thumbs back and down behind the patient's ears.

- Make sure the head pad is centered in the middle of the back of the head.

NOTE

If the casualty is able to follow directions, instruct him to clear his mask.

(g) Check for a complete mask seal by covering the mask's inlet valves. The mask will collapse if properly fitted, indicating a good seal.

NOTE

There is no way to be sure that an unconscious, nonbreathing casualty's mask has a good seal.

(h) Pull the protective hood over the head, neck, and shoulders.

(2) Administer the nerve agent antidote.

(a) Position yourself near the patient's left thigh (this will make it easier to reach into his mask carrier).

NOTE

If the patient has already received three doses of antidote, proceed to step (2)*(p)* below.

(b) Remove one set of antidote autoinjectors (Figure 20-3) from the inside pocket of the patient's mask carrier.

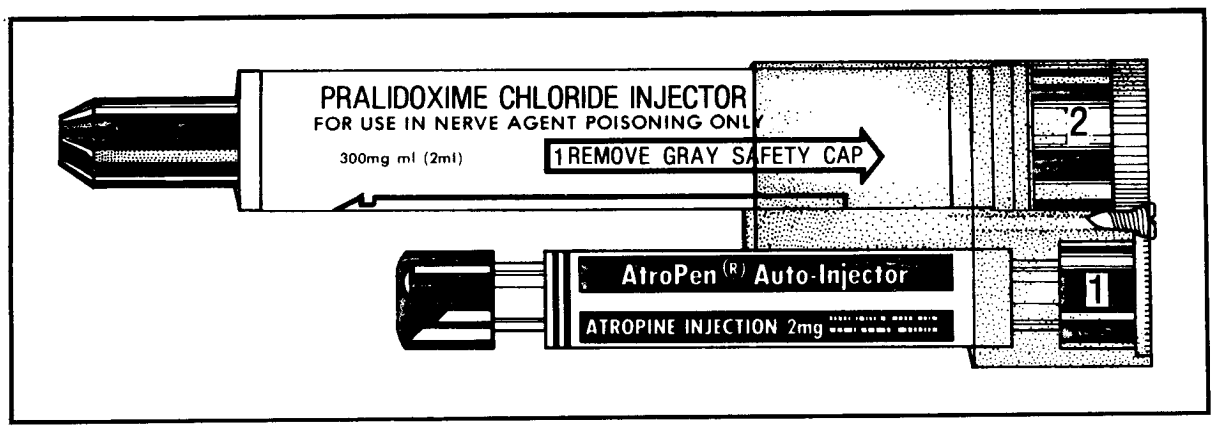

Figure 20-3. Nerve agent antidote autoinjectors.

NOTE

Do not use your autoinjector on a casualty. If you do, you may not have any antidote for self-aid.

(c) Hold the set of injectors by the plastic clip (Figure 20-4), with the big injector on top and in front of your body at eye level.

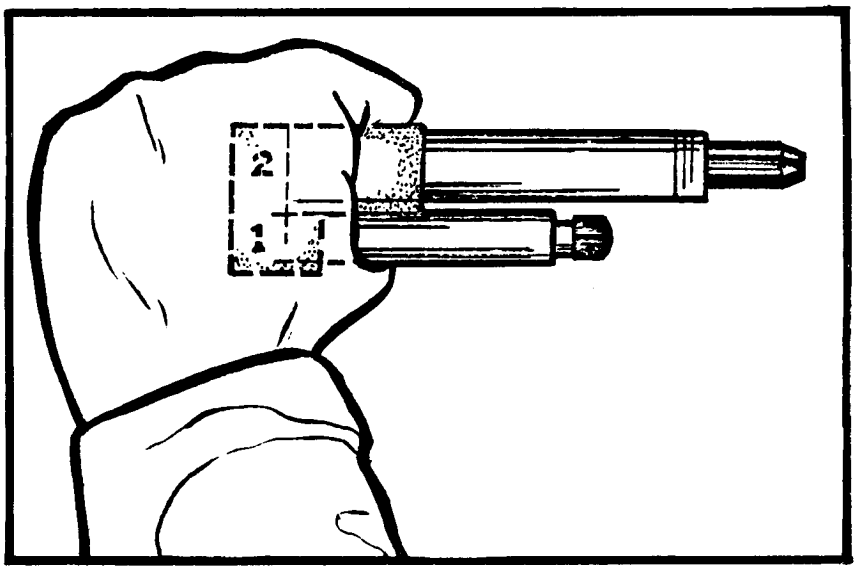

Figure 20-4. Holding the set of injectors.

(d) Grasp the atropine autoinjector (the smaller of the two injectors) with your thumb and first two fingers of your other hand (Figure 20-5).

CAUTION

Do not cover/hold the needle end with your hands or fingers— you may accidentally inject yourself.

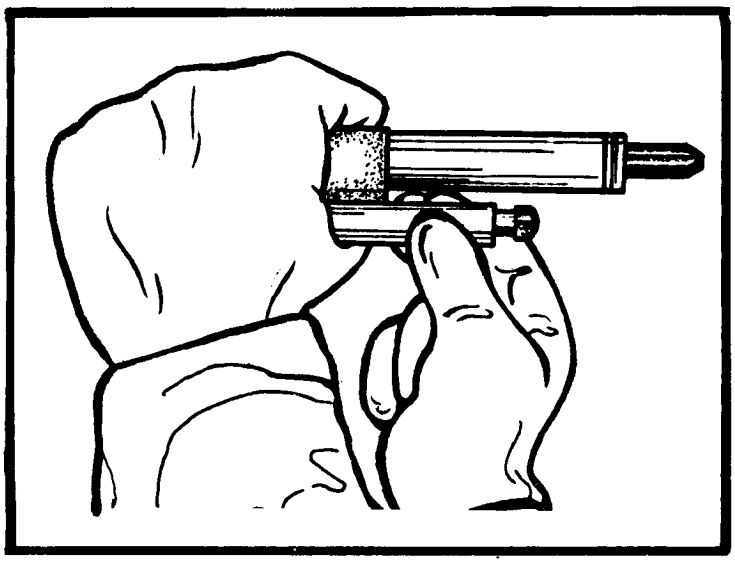

Figure 20-5. Grasping the injectors.

(e) Pull the injector out of the clip with a smooth motion.

(f) Form a fist around the injector.

(g) Place the green (needle) end of the injector against the patient's outer thigh muscle (Figure 20-6).

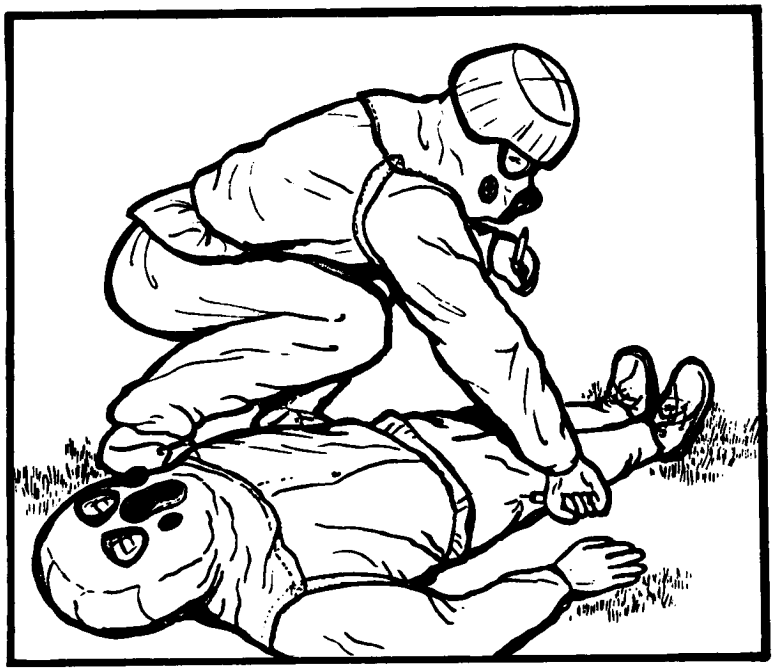

Figure 20-6. Injecting the patient's thigh.

(h) Apply firm, even pressure to the injector until it functions by pushing the needle into the patient's muscle, making sure you do not hit any objects in his pocket.

CAUTION

Do not use a jabbing motion to inject the patient.

(i) Hold the injector in place for at least ten seconds by counting one thousand one, one thousand two, and so forth.

(j) Remove the injector.

CAUTION

Watch out for the needle. Do not accidentally inject yourself.

NOTE

If the individual is very thin, you can inject him in the buttocks. Be careful to inject him only in the upper outer part of the buttocks (either side) because there is a nerve that crosses the buttocks and hitting this nerve can cause paralysis (Figure 20-7).

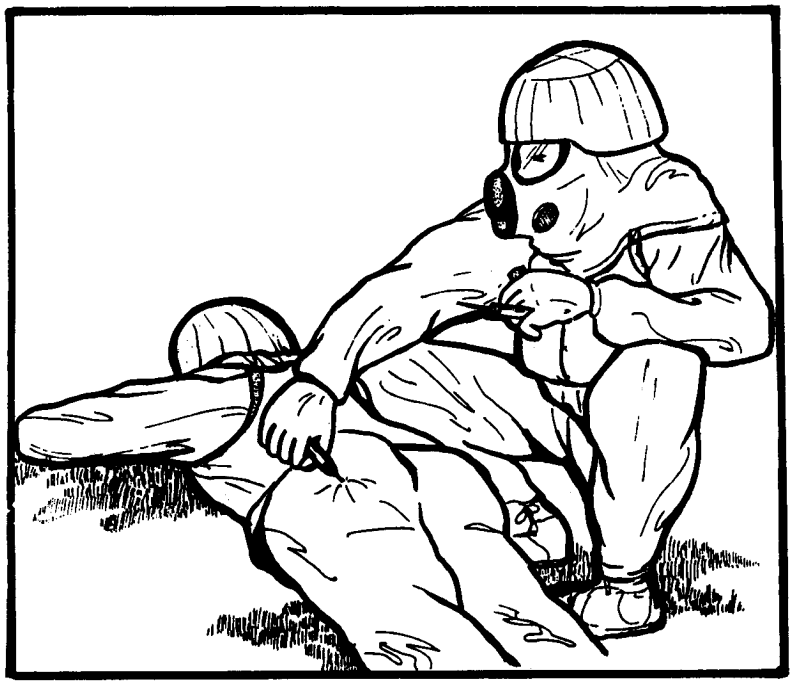

Figure 20-7. Buttock injection sites.

(k) Place the used injector carefully between the last two fingers of the hand that is holding the clip (Figure 20-8).

(l) Pull the 2 PAM C1 injector (the larger of the two injectors) (Figure 20-9) from the clip and inject the patient in the same manner as steps *(e)* through *(j)* above, holding the black (needle) end against the patient's outer thigh (or buttock).

(m) Drop the clip without dropping the used injectors.

(n) Attach the used autoinjectors to the patient's clothing by—

- Pushing the needles of the used injectors, one at a time, through the left pocket flap. This will tell other medical personnel how many injectors were administered to the patient.

- Bend the needle to form a hook. Be careful not to tear your protective gloves while bending the needle.

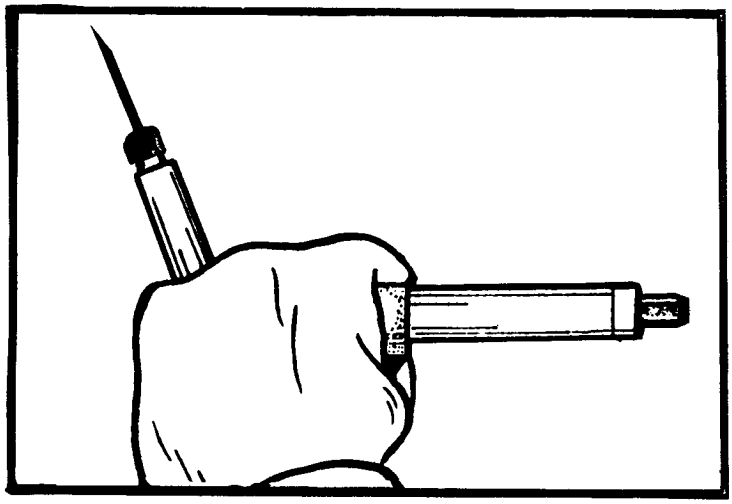

Figure 20-8. Placing the used injector between the last two fingers.

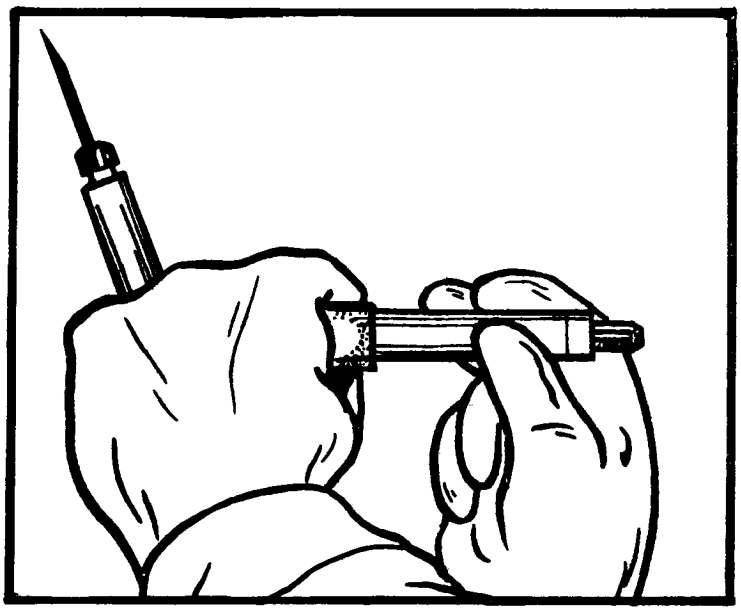

Figure 20-9. Pulling out the 2 PAM Cl injector.

(o) Immediately repeat the above steps, using the second and third sets of antidote autoinjectors.

NOTE

If a patient requires additional antidote, administer atropine only until his heart rate is above 90 beats a minute.

(p) Administer artificial respiration if needed or oxygen if available.

(q) Administer anticonvulsant medication if convulsions are not controlled by atropine.

(3) Evacuate the patient if necessary.

20-14. Blood Agents

a. Blood agents (cyanides) are very fast-acting chemical poisons. A soldier exposed to a significant dose will be unable to aid himself and will need immediate care.

b. Blood agents produce their effects by interfering with the body cells' absorption of oxygen. Inhalation is the usual route of entry. Hydrocyanic acid (AC) and cyanogen chloride (CK) are the important agents in this group. Cyanogen chloride also acts as a choking agent.

c. The standard protective mask gives adequate protection against field concentrations of blood agents. The chemical protective overgarment, as well as the mask, is needed to protect individuals from liquid AC.

d. Signs and symptoms of blood agent casualties.

NOTE

Other chemical agents may be mixed with blood agents during a chemical attack.

- A fast breathing rate (blood agents affect the circulatory and respiratory systems by preventing body cells from using oxygen).
- Dizziness and headache.
- Cherry red skin.
- Heart rate slows down.
- Convulsions.
- Eyes, nose, throat, and lungs have a stinging sensation.

CAUTION

Cyanogen chloride (CK) also causes damage to the tissues in the lungs. Any damage to the respiratory tract may result in fluid in the lungs and blood-tinted frothing at the mouth.

- Reddish fluid will be coming from the mouth.
- Hyperventilation, followed by a depressive phase of hypotension, and shallow respiration.
- Respiratory arrest.

e. Treatment for blood agent casualties.

(1) Immediately mask the casualty, if necessary. Determine whether or not he is breathing. If he is not breathing, put his mask on first (paragraph 20-13*d*(1) above) and then apply the back-pressure, arm-lift method of artificial respiration.

CAUTION

Place the patient on an uncontaminated surface if possible (such as, poncho or plastic bag).

(2) Administer antidote. Administer sodium nitrite and sodium thiosulfate intravenously, if available. The recommended treatment is an intravenous injection of sodium nitrite 4 to 5 mg/kg of body weight followed by a slow injection of sodium thiosulfate 200 mg/kg of body weight.

NOTE

Above antidotes to be administered by medical personnel only. This is not self-aid or buddy aid treatment.

20-15. Blister Agents

a. Blister agents (vesicants) are mustard (HD), nitrogen mustards (NH), Lewisite (L), and other arsenicals; mixtures of mustards and arsenicals; and phosgene oxime (CX).

b. Vesicants act on the eyes, lungs, and skin. They burn and blister the skin or any other part of the body that they touch. They damage the respiratory tract when inhaled and cause vomiting and diarrhea when absorbed. The nitrogen mustards and the arsenicals are the most dangerous in causing vomiting and diarrhea.

c. Some vesicants often have a more serious effect than is immediately apparent. Vesicants are insidious in action with little or no pain at the time of exposure, except Lewisite and phosgene oxime which cause immediate pain on contact. The physiological effects of blister agent exposure usually take a few hours to appear. The soldier may be exposed to a blister agent for a long time and not realize it. However, when the symptoms do appear, they are usually widespread.

d. In the event of exposure to a blister agent, decontamination must begin immediately; speed is absolutely essential. Every soldier is responsible for his own personal decontamination if he is physically capable. If he is incapacitated, decontamination must be performed by others as soon as possible.

e. Signs and symptoms of blister agent eye burns.

(1) The eyes are the most vulnerable body part to blister agents (vesicants) and are usually the first to be affected. The symptoms are—

- Inflammation of the inner eyelids.
- Redness of the eyes.
- Swelling of the eyelids.
- Watery eyes.

f. Treatment for blister agent eye burns. Decontaminate the eyes as follows:

(1) Remove the patient's canteen and open it.

CAUTION

Patient must be masked in order to avoid inhaling contaminated air.

(2) Have him take a deep breath and hold it. He must NOT breathe while the mask is off. The breath should be held as long as possible. The mouth should be kept closed during the decontamination procedure to prevent absorption of the contaminant through the mucous membranes.

(3) Lift the mask from his chin to expose his eyes.

(4) Flush or irrigate one eye at a time.

- Insure that all liquid blister agents are flushed. The risk of leaving the agents in the eyes is much greater than the risk of eye exposure to blister agent vapors.
- If the patient is wearing contact lenses, remove them before treating the eyes.
- Tilt his head to one side and have him look up.
- Slowly pour water into each eye so that the water will run off without further contamination.

(5) Reseal and clear the patient's mask.

g. Signs and symptoms of blister agent injuries involving the skin and respiratory tract do not occur immediately after exposure. They usually occur 4 to 6 hours after exposure. However, symptoms may appear from 24 to 48 hours later. Skin contamination may be detected with M8 chemical detector paper or visually by observing for swelling, redness, or blisters. Contamination of the skin or face may also be indicated by signs of extreme pain exhibited by the casualty. The severity of a chemical burn is directly related to the concentration of the agent and the duration of the contact with the skin.

(1) Skin:

- Swelling, inflammation.
- Redness, sunburn-like.
- Itching, burns, and/or blisters (usually large).

(2) Respiratory tract:

- Throat burns and feels dry.
- Voice becomes hoarse.
- A dry, harsh cough develops.
- Respiratory tract becomes inflamed.

(3) Other signs/symptoms:

- Headache.
- Nausea.
- Runny nose.
- Frequent sneezing.

h. Treatment for blister agent skin and respiratory tract injuries.

(1) Do not put field dressings over injured (blistered) areas. Such action may spread the contamination or cause pain to the patient.

(2) If necessary, have the patient decontaminate himself using his M258A1 kit. The key to successful use of the decontamination kit is IMMEDIATE action upon finding the contamination. Decontamination procedures should begin within 60 seconds of contamination; otherwise, this procedure may be of little use. Decontamination of the skin should be done in a sheltered area. A sheltered area provides protection from further contamination by a blister agent. The medical specialist should stress the importance of the buddy system for decontaminating the skin that cannot be reached or seen by the individual.

CAUTION

If blisters have already appeared, do not decontaminate the blistered area.

(3) Treatment for respiratory tract injuries are to maintain the airway until the patient can be evacuated.

20-16. Choking Agents

a. Choking agents are chlorine and phosgene. The main lethal effect is that they disrupt the alveolar capillary integrity of the lungs and cause a leaking of plasma and fluids into the alveoli. This results in a progressive oxygen shortage and can cause death due to pulmonary edema. This form of death has been called "DRY LAND DROWNING."

b. The early symptoms of choking agent poisoning are—

- Local irritation.
- Dry throat.
- Coughing.
- Tightness in chest.
- Nausea.
- Vomiting.
- Headache.

NOTE

The early signs and symptoms will subside rapidly and the individual can continue his mission without incapacitation. These symptoms are very general and in some instances of little value in prognosis. Some patients with severe cough fail to develop serious lung injury, while others with no signs or symptoms go to fatal pulmonary edema, so it is vital that the medical specialist observe all individuals for possible signs of respiratory distress even though the mission is being carried on.

c. Delayed severe signs and symptoms of choking agent poisoning usually appear 4 to 12 hours after initial contact or exposure and are—

- Anxiety.
- Severe coughing.
- Rapid shallow breathing.
- Chest wall retraction.
- Tachycardia.
- Cyanosis.
- Production of frothy, blood-tinted sputum.

- Shock.
- Respiratory arrest.

NOTE

Death can occur within 48 hours. A casualty who survives for more than 48 hours usually recovers without after effects.

d. Treatment for choking agent poisoning.

(1) Treat symptomatic conditions as they develop.

(2) For patients with severe symptoms, movement should be limited; they should be kept comfortable and warm until evacuated.

(3) Administer oxygen, if available.

(4) Evacuate the patient.