CHAPTER 22

POISONING AND DRUG ABUSE

INTRODUCTION

A Hospital Corpsman (HM) may encounter patients who have poisoning or drug overdose incidents. Patients may initially present with no symptoms or with varying degrees of over-intoxication. The asymptomatic patient may have been exposed to or ingested a lethal dose of a substance but not exhibit any manifestations of toxicity. A patient with mild symptoms may deteriorate rapidly requiring close observation.

Potentially significant exposures should be observed in a medical treatment facility whenever possible. HMs are not always in a treatment facility environment and must be prepared to deal with a medical situation should one present itself.

This chapter will outline the assessment and treatment for ingested, inhaled, absorbed, and injected poisons.

NOTE:

Prior to deployments and operational commitments, commands are strongly recommended to contact the area Environmental Preventive Medicine Unit (EPMU) for current, specific, medical intelligence, and surveillance data. With this information at hand, the local preventive medicine authority can identify, prevent, and treat conditions not common to the homeport area.

The cognizant Environmental Preventive Medicine Unit will provide data through the Medical, Environmental, Diagnosis, Intelligence and Counter-measure (MEDIC) CD-ROM which is a comprehensive management tool. It is an invaluable aid for identifying at-risk communicable diseases, immunization requirements, local pests and environmental dangers.

POISONING

LEARNING OBJECTIVE:

*Explain assessment and treatment procedures for ingested, inhaled, absorbed, and injected poisons.*

A *poison* is a substance that, when introduced into the body, produces a harmful effect on normal body structures or functions. They come in solid, liquid, and gaseous forms; and may be ingested, inhaled, absorbed, or injected into the body.

The effects of poisons may be local, remote, or a combination of both effects. A local effect is produced when a poison only affects the area in which it is applied, i.e. poison ivy reaction. A remote effect is produced when a poison affects parts of the body that are remote to the site of application or point of introduction, i.e. allergic reaction to a bee sting resulting in cardiopulmonary arrest. Poisons do not always show an effect until several doses have been taken. Then, an effect is produced that is nearly equal to the effect produced by taking the whole amount at one time and is known as a cumulative effect.

Toxicology is the science of poisons, their actions, their detection, and the treatment of the conditions produced by them. Every chemical in a sufficient dose can cause toxic effects in a human or other organism. The amount or concentration of a chemical and the duration of exposure to it are what determine the chemical's dose and toxicity. A 16th century quotation from Paracelsus states, "The dose makes the poison . . . . All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy."
A poisoning is defined as the presence of signs or symptoms associated with exposure or contact with a substance. If there are no clinical manifestations or toxic effects, the incident is simply an "exposure" or a contact with a potentially poisonous substance. Just being exposed to a chemical does not mean that a poisoning has or will occur. It is a matter of dose and a few other variables (e.g., age, sex, individual resistance, and state of health) that determine if, or what, toxic effects will occur.

**ASSESSMENT AND TREATMENT OF PATIENT**

In most cases, ASSESSMENT AND TREATMENT OF THE PATIENT IS MORE IMPORTANT THAN EFFORT TO IDENTIFY AND TREAT A SPECIFIC POISON. Supportive therapy managing the ABCs (Airway, Breathing, and Circulation) of basic life support and treating the signs and symptoms are safe and effective in the vast majority of poisonings. Extraordinary means to enhance elimination of the poison (hemodialysis and hemoperfusion) are seldom needed. Except for agents with a delayed onset of toxicity (such as acetaminophen), most ingested poisons produce signs and symptoms in less than four hours. Most efforts to decontaminate the stomach through gastric lavage or activated charcoal to remove an ingested poison have little value more than one hour after ingestion.

In acute poisonings, prompt treatment is indicated. After the patient has been evaluated and stabilized, general poison management can be initiated.

There are six steps in the initial evaluation and follow-on poison management:

1. **Stabilization**: consists of a brief evaluation and assessment directed toward identifying the measures required to maintain life and prevent further deterioration of the patient.
   a. Observe the ABC + D & E.
      i. Airway, Breath, and Circulation.
      ii. Drug-induced central nervous system (CNS) depression.
      iii. Expose (undress/uncover) the patient for disabilities/injuries to ensure areas of contact or exposure to a chemical can be properly visualized and assessed.
   b. Complete basic neurologic exam; be sure to check the pupils for size and reactivity to light.
   c. Administer oxygen as needed.
   d. Start an IV.
   e. Watch for signs and symptoms of anaphylaxis.

2. **Evaluation**: must be performed once the patient is stabilized.
   a. Include a full history, physical exam, and ordering of appropriate tests (i.e. labs, EKG, x-rays) directed toward identification of toxic agent(s), evaluating the severity of toxic effects, and searching for trauma and complications.
   b. Periodically reassess the patient. Look for changes. Monitor vital signs, urine output (UOP), and cardiac rhythm.
   c. Record the findings (including time) and respond to important changes appropriately.

3. **Prevention or limitation of absorption**: through skin decontamination, flushing of eyes, ventilation, stomach emptying, and administration of charcoal and cathartics.
4. **Elimination enhancement**: through serially administered activated charcoal, ion-trapping (pH adjustment of the urine to promote excretion of certain poisons), hemodialysis, and hemoperfusion (similar to hemodialysis, but used for larger size molecules).

5. **Administration of specific antidotes**: Less than 5 percent of poisons have specific antidotes. All patients who present should receive glucose, thiamine, and naloxone. Consider supplemental oxygen.

6. **Continuing care and disposition**: including a period of observation and education (i.e. poison prevention) or psychiatric counseling. Establish follow-up.

**THE DIAGNOSIS OF POISONING**

In many situations, the treatment of a poisoning victim will be under the direction of a medical officer. However, the HM must be ready to treat the victim.

Poisoning should be suspected in all cases of sudden, severe, and unexpected illness. The HM should investigate by ascertaining, as quickly and thoroughly as possible, the answers to the following questions:

- What are the signs and symptoms of the illness?
- What was happening before the illness occurred? (There may have been a chronic exposure over time with the signs and symptoms just becoming apparent.)
- What substance(s) were in use?
- Is there a container of the suspected substance?
  - If so, how much was there initially, and how much is there now?
  - If possible, have the container brought to the treatment facility. The label will often identify the contents and the recommended precautions and treatment. The label may also list a contact number for emergency advice.
- Other people including the HM may become contaminated through contact with the container. Handle it carefully.
  - When did the exposure happen?
  - What was the duration of exposure?
  - What is the location of the bite or injury (if applicable)?
  - Has this happened before?
  - Are there other people involved?
  - Does the patient have a significant past medical history?
  - Is the patient’s condition improving or deteriorating?

The presence of a toxic syndrome or toxiidrome can help establish that a poison has been involved by suggesting the class of poison(s) to which the patient may have been exposed. Table 22-1 provides a list of commonly encountered toxiromes, their sources and symptoms.
<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Sources</th>
<th>Signs &amp; Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narcotic</td>
<td>opiates, benzodiazepines, barbiturates</td>
<td>&quot;beady eyes,&quot; sunglasses, decreased blood pressure, CNS and respiratory depression</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>alcohol, barbiturates, benzodiazepines, narcotics, sedative-hypnotics</td>
<td>diarrhea, dilated pupils, goose bumps, increased heart rate, tearing, yawning, stomach cramps, hallucinations</td>
</tr>
<tr>
<td>Sympathomimetic</td>
<td>theophylline, caffeine, LSD, PCP, amphetamine, cocaine, decongestants</td>
<td>CNS excitation (confusion, in-coordination, agitation, hallucination, delirium, seizures), increased blood pressure and heart rate</td>
</tr>
<tr>
<td>Anticholinergic</td>
<td>antihistamines, atropine, scopolamine, antidepressants, anti-Parkinson L, antipsychotics, antispasmodics, muscles, hallucinogens, antidepressants</td>
<td>dry skin, increased heart rate, dilated pupils, fever, urinary retention, decreased bowel sounds, CNS excitation</td>
</tr>
<tr>
<td>Cholinergic</td>
<td>organophosphates, carbamates, physostigmine, neostigmine, endrophonium</td>
<td>&quot;SLUDGE,&quot; increased salivation, lacrimation, urination, defecation, GI cramping, emesis; CNS (headache, restless, anxiety, confusion, coma, seizures); muscle weakness and fasciculation</td>
</tr>
</tbody>
</table>

Table 22-1.—Commonly Encountered Toxidromes

GENERAL TREATMENT

Once poisoning has been established, the general rule is to quickly remove as much of the toxic substance from the victim as possible. The method of removal of the poison varies depending upon how the poison was introduced:

- **Ingested poisons**: There is a choice between emetics and gastric lavage, followed by absorption and cathartics
- **Inhaled poisons**: Oxygen ventilation is the method of choice
- **Absorbed poisons**: Removal of the poison is primarily attained by cleansing the skin
- **Injected poisons**: Antidotal medications are recommended

Ingested Poisons

Ingested poisons are those poisons which have been consumed, whether accidentally or intentionally, by the victim. Ingestion is the most common route of exposure.

The local actions of an ingested poison can have irritant, acidic (corrosive), or basic (caustic) effects at the site of contact. Ingested substances can be absorbed into the body and transported to a distant site with systemic action(s). The poisonous substance may cause few effects or even no effect at the site of contact or absorption, but it may have severe systemic effects.

Ingestion of substances that do not produce local effects can be divided into two types:

- **Nontoxic substances** (latex paint, dirt, silica gel, spider plant)
- **Potentially toxic substances** (poisonous fish, medications, heavy metals (lead, mercury), pesticides, and personal care products)

Episodes involving the ingestion of nontoxic substances do not require decontamination of the stomach. Swallowing a non-toxic foreign body, like a coin or button battery in a child, may result in choking and require prompt medical intervention.
The toxicity range of absorbed poisons extends from non-toxic to extremely toxic. Ingestion substances with a low order of toxicity may result in the production of only minor systemic effects that are mild, self-limiting, and do not require significant medical intervention including nausea, vomiting, and/or diarrhea.

NOTE:
Do not induce unnecessary vomiting to discourage a patient from repeating a voluntary ingestion.

Noncorrosives

Many noncorrosive substances have the common characteristic of irritating the stomach. They produce nausea, vomiting, convulsions, and severe abdominal pain. The victim may complain of a strange taste, and the lips, tongue, and mouth may look different than normal. Shock may occur. Examples of noncorrosives are listed in Table 22-2.

<table>
<thead>
<tr>
<th>Irritant</th>
<th>Sources of Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Dyes, insecticides, paint, printer sink, wood preservatives</td>
</tr>
<tr>
<td>Copper</td>
<td>Antifouling paint, batteries, canvas preservative, copper plating, electroplating, fungicides, insecticides, soldering, wood preservatives</td>
</tr>
<tr>
<td>Iodine</td>
<td>Antiseptics</td>
</tr>
<tr>
<td>Mercury</td>
<td>Bactericides, batteries, dental supplies and appliances, disinfectants, dyes, fungicides, ink, insecticides, laboratories, photography, wood preservatives</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Incendiaries, matches, pesticides, rat poison</td>
</tr>
<tr>
<td>Silver nitrate</td>
<td>Batteries, cleaning solutions, ink, photographic film, silver polish, soldering</td>
</tr>
<tr>
<td>Zinc</td>
<td>Disinfectants, electroplating, fungicides, galvanizing, ink, insecticides, matches, metal plating and cutting, paint, soldering, wood preservatives</td>
</tr>
</tbody>
</table>

Table 22-2.—Common Stomach Irritants and Possible Sources of Contact

First aid for most forms of noncorrosive poisoning centers on quickly emptying the stomach of the irritating substance(s). The following steps are suggested:

1. Maintain an open airway. Be prepared to give artificial ventilation.
2. Dilute the poison by having the conscious victim drink one to two glasses of water or milk.
3. Empty the stomach using an emetic, gastric lavage, adsorbent, and/or cathartic.

   a. Giving an emetic is a preferred method for emptying the contents of the stomach. It is quick and (except in cases of caustic or petroleum distillate poisoning, or when an antiemetic has been ingested) can be used in almost every situation when the victim is conscious.

      i. Ipecac syrup is the most commonly used substance to which an HM will have access.

         1. This emetic acts locally by irritating the gastric mucosa and centrally by stimulating the medullary vomiting center in the brain.

         2. The usual adult dose is 15-30 ml, and the dose for a child (age 1 to 12 years) is 15 ml.

      ii. The dosage should be followed immediately by a glass of water. Most people will vomit within 30 minutes.

      iii. The amount of stomach contents (and poison) recovered will vary.

      iv. In an emergency room, the medical officer can rapidly induce vomiting by the injection of various medications.

      v. As a last resort, tickle the back of the victim’s throat with a finger or a blunt object. This procedure should induce vomiting.
b. Trained personnel may use gastric lavage by itself or after two doses of ipecac syrup has failed to induce vomiting.
   i. After passing a large caliber nasogastric tube, aspirate the stomach contents.
   ii. Instill 100 ml of normal saline into the stomach.
   iii. Aspirate it out again.
   iv. Continue this flushing cycle until the returning fluid is clear. Gastric lavage is preferred when the victim is unconscious or as in the case of strychnine poisoning is subject to seizures.

c. Activated charcoal (AC) adsorbs many substances in the stomach and prevents absorption into the body.
   i. After the substance is adsorbed to the AC, the bound substance moves through the stomach and is eliminated with the production of a charcoal-black bowel movement.
   ii. AC may be administered after emesis or lavage, or it may be used alone.

d. A cathartic (magnesium sulfate or sorbitol) may be used to “speed” the movement of the bound substance and minimize absorption.

4. Collect the vomitus for laboratory analysis.

5. Soothe the stomach with milk or milk of magnesia.

6. Transport the victim to a definitive care facility if symptoms persist.

**Corrosives**

Acids and alkalis (bases) produce actual chemical burning and corrosion of the tissues of the lips, mouth, throat, and stomach. Acids do most of their damage in the acidic stomach environment, while alkalis primarily destroy tissues in the mouth, throat, and esophagus. Stains and burns around the mouth, and the presence of characteristic odors provide clues as to an acid or base ingestion. Swallowing and breathing may be difficult, especially if any corrosive was aspirated into the lungs. Stridor, a high-pitched sound coming from the upper airway, may be heard. The abdomen may be tender and swollen with gas and perforation of the esophagus or stomach may occur.

**NEVER ATTEMPT TO TREAT AN ACID OR BASE INGESTION BY ADMINISTERING A NEUTRALIZING SOLUTION BY MOUTH. GIVE WATER ONLY, UNLESS DIRECTED BY A POISON CONTROL CENTER (PCC) OR MEDICAL OFFICER.** Monitor the ABC+D&Es, and watch for signs of shock. Examples of corrosive agents and sources of contact are listed in Table 22-3.
<table>
<thead>
<tr>
<th>Agent</th>
<th>Sources of Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACIDS</strong></td>
<td></td>
</tr>
<tr>
<td>Hydrochloric</td>
<td></td>
</tr>
<tr>
<td>Nitric</td>
<td></td>
</tr>
<tr>
<td>Oxalic</td>
<td></td>
</tr>
<tr>
<td>Sulfuric</td>
<td></td>
</tr>
<tr>
<td><strong>ALKALIES</strong></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td></td>
</tr>
<tr>
<td>Lime</td>
<td></td>
</tr>
<tr>
<td>Lye</td>
<td></td>
</tr>
<tr>
<td>Carbolic</td>
<td></td>
</tr>
<tr>
<td>Phenols</td>
<td></td>
</tr>
</tbody>
</table>

Table 22-3.—Examples of Common Acids, Alkalies, and Phenols, with Possible Sources of Contact

When providing treatment for the above poisons, DO NOT INDUCE VOMITING. The damage to the mouth and esophagus will be compounded. In addition, the threat of aspiration during vomiting is too great. *Gastric lavage* could cause perforation of the esophagus or stomach. Therefore, use it only on a doctor's order. First aid consists of diluting the corrosive and keeping alert for a patent airway and shock. If spontaneous vomiting occurs, administer an antinaemic.

**Irritants**

Substances such as automatic dishwasher detergent, diluted ammonia, and chlorine bleach can produce local irritation to the mucous membranes and potentially cause mild chemical burns. The pH of irritants may be slightly acidic or basic. If a patient has ingested an irritant, direct the patient to spit the product out and rinse the mouth repeatedly with water. Spit the rinse water out also. Do NOT administer anything other than water unless directed by a PCC or physician.

**Petroleum Distillates or Hydrocarbons**

Volatile petroleum products (such as kerosene, gasoline, turpentine, and related petroleum products like red furniture polish) usually cause severe chemical pneumonia as well as other toxic effects in the body. Signs and symptoms include abdominal pain, choking, gasping, vomiting, and fever. These products may be identified by their characteristic odor. Mineral oil and motor oil are not as serious as they usually do nothing more than cause diarrhea.

When providing treatment for the ingestion of petroleum distillates, DO NOT INDUCE VOMITING unless told to do so by a PCC or physician. Vomiting may cause additional poison to enter the lungs. However, the quantity of poison swallowed or special petroleum additives may make gastric lavage or the use of cathartics advisable. If a physician or PCC cannot be reached, give the victim 30 to 60 ml of vegetable oil. Transport the victim immediately to a medical treatment facility.
Food Poisoning

Food poisoning can occur from ingesting animal or plant materials, or even from the chemicals that are used in raising, processing, or preserving crops and livestock. Most bacterial and viral food poisonings appear within eight hours of ingesting food. The signs and symptoms of poisoning include nausea, vomiting, diarrhea, muscle aches, and low-grade fever.

The general treatment is supportive and directed at preventing dehydration through the administration of fluids. If diarrhea persists more than 24 hours, or the patient is unable to keep fluids down, further definitive medical care is necessary. Food poisoning can also occur from ingestion of parasites.

INHALATION POISONS

In the Navy and in other industrial settings, inhalation is the more common route of exposure to toxic substances. The irritants and corrosives mentioned in Tables 22-2 and 22-3 are more often a source of poisoning by means of inhalation rather than by ingestion. An inhaled poison can act directly on the upper respiratory tract or lungs with immediate, delayed, or chronic effects or the substance can use the pulmonary system to gain entry into the body, be absorbed into the blood, and cause toxic effects (systemic toxicity) at a distant site of action.

The handling of large quantities of petroleum products (fuel oil and gasoline, in particular) constitutes a special hazard, since all of these products give off hazardous vapors. Other poisonous gases are by-products of certain operations or processes: exhaust fumes from internal combustion engines; fumes or vapors from materials used in casting, molding, welding, or slating; gases associated with bacterial decomposition in closed spaces; and gases that accumulate in voids, double bottoms, empty fuel tanks, and similar places. Some sources of inhalation chemical poisoning are listed in Table 22-4.

<table>
<thead>
<tr>
<th>Inhaled Substance</th>
<th>Source of Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone, isopropyl alcohol, amyl acetate</td>
<td>Nail polish remover</td>
</tr>
<tr>
<td>Aliphatic hydrocarbons</td>
<td>Fuels, Stoddard solvent, PD-680, mineral spirits, naphtha</td>
</tr>
<tr>
<td>Butane</td>
<td>Throw-away lighters</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Fire suppression/fighting, evaporation of dry ice, wells and sewers</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>Fires, lightning, heating and fuel exhausts</td>
</tr>
<tr>
<td>Chlorinated hydrocarbons</td>
<td>Shoe polish</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Water purification, sewage treatment</td>
</tr>
<tr>
<td>Chlorofluorocarbons (CFCs)</td>
<td>Refrigerants, degreasers, propellants (old)</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>Sewer, decaying materials, CHT system</td>
</tr>
<tr>
<td>Methylethylketone</td>
<td>Paint</td>
</tr>
<tr>
<td>Methylene chloride</td>
<td>Paint stripper, solvent, dyes</td>
</tr>
<tr>
<td>N-hexane</td>
<td>Rubber cement</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Aerosol can propellant</td>
</tr>
<tr>
<td>Tetrachloroethylene (perchloroethylene)</td>
<td>Dry cleaning</td>
</tr>
<tr>
<td>Toluene</td>
<td>Plastic adhesive, acrylic paint, shoe polish</td>
</tr>
<tr>
<td>Trichloroethane (methylchloroform)</td>
<td>Solvent, degreaser</td>
</tr>
</tbody>
</table>

Table 22-4.—Sources of Inhalation Poisoning
Carbon monoxide is the most common agent of gas poisoning. It is present in exhaust gases of internal combustion engines as well as in sewer gas, lanterns, charcoal grills, and in manufactured gas used for heating and cooking. It gives no warning of its presence as it is completely odorless and tasteless. The victim may lose consciousness and suffer respiratory distress with no warning other than slight dizziness, weakness, and headache. The lips and skin of a victim of carbon monoxide poisoning are characteristically cherry red. Death may occur within a few minutes.

Most inhalation poisoning causes shortness of breath and coughing. The victim's skin will turn blue. If the respiratory problem is not corrected, cardiac arrest will follow due to hypoxia.

Inhaling fine metal fumes can cause a special type of acute or delayed poisoning. These metal fumes are generated from heating metal to boiling and evaporation during hot metal work in such operations as metal cutting or welding. The resulting illness is called metal fume fever (MFF). In the Navy, the most common cause of MFF is the inhalation of vaporized zinc found in the galvanized covering of iron and steel. Proper local and general ventilation and or the use of respiratory protection are necessary to prevent this illness. The first stage of treatment for an inhalation poisoning is to remove the victim from the toxic atmosphere immediately.

**WARNING:**
Never try to remove a victim from the toxic environment without the proper protective mask or breathing apparatus, or if the individual is not trained in its use.

**WARNING:**
Inhaled substances can cause olfactory fatigue.

After a few minutes of exposure, the smell is no longer detected, fooling the individual into believing the substance is no longer there and, thus, no longer a danger.

If trained rescuers are not immediately available and the HM can reach and rescue the victim; this can be accomplished by taking a deep breath, holding it, entering the area, and pulling the victim out.

Immediately after pulling the victim out, follow the steps below:

1. Start basic life support (the ABC+D&Es).
2. Remove clothing to expose the victim (if chemical warfare agents or volatile fuels were the cause).
3. Keep the victim calm, detect and treat for life-threatening conditions to include administering oxygen.
4. Perform focused history and physical exam.
5. Transport the victim to a treatment facility for further treatment with all containers, bottles and labels of substance if available.

**ABSORBED POISONS**

Some substances cause tissue irritation or destruction by contact with the skin, eyes, and lining of the nose, mouth, and throat. These substances include acids, alkanes, phenols, and some chemical warfare agents. Direct contact with these substances will cause inflammation or chemical burns in the affected areas. Consult the "Chemical Burns" and "Chemical Agents" sections of Chapter 23 of this manual for treatment guidelines.

**INJECTED POISONS AND ENVENOMATIONS**

Injection of venom by stings and bites from various insects and arthropods, while not normally life-threatening, can cause an acute allergic reaction that can be fatal. Poisons may also be injected by snakes and marine animals.

**Bee, Wasp, and Fire Ant Stings**

Stings from bees, wasps, and ants account for more poisonings than stings from any other insect group. Fortunately, they rarely result in death.
The vast majority of stings cause a minor local reaction at the injection site, with pain, redness, itching, and swelling. These symptoms usually fade after a short time. A small percentage of these stings can cause an allergic reaction and anaphylactic reactions, presenting with itching, swelling, weakness, headache, difficulty breathing, and abdominal cramps. Shock may follow quickly, and death may occur.

The following first aid measures are recommended for all but minor, local reactions to bites or stings:

1. Closely monitor vital signs.
2. Due to edema of soft tissue, remove all rings, bracelets, and watches.
3. Remove stingers without squeezing additional venom (remaining in poison sacs attached to stingers) into the victim. To do this, scrape along the skin with a dull knife (as if shaving the patient). The dull blade will catch the stinger and pull it out.
4. Place an ice cube or analgesic-corticosteroid cream or lotion over the wound site to relieve pain.
5. For severe allergic reactions (generalized itching or swelling, breathing difficulty, feeling faint or clammy, unstable pulse or blood pressure), immediately give the victim a subcutaneous injection of 1:1000 aqueous solution of epinephrine. Dosage is 0.5 ml for adults and ranges from 0.1 to 0.3 ml for children.

**NOTE:**
Patients with a documented history of severe allergic reactions will commonly have an auto-injector syringe with epinephrine in it. If convenient, locate and use it.

6. Patients with severe allergic reactions should be evacuated immediately to a medical treatment facility.

**Scorpion Stings**

About 40 species of scorpions (Fig. 22-1) exist in America. *Centruroides exilicauda,* also called "bark scorpion," is the scorpion found in Mexico and the southwest region of the United States and may cause severe effects.

![Scorpion](image)

**Figure 22-1.—Scorpion**

Most dangerous species are found from North Africa to India. Scorpion stings vary in severity, depending on the species of the scorpion and the amount of poison actually injected. They cause severe pain in the affected area. Mild reactions may include local swelling, skin discoloration, swollen lymph nodes near the sting area, itching, paresthesia ("pins and needles," numbness), and even nausea and vomiting. The duration of symptoms is less than 24 hours. The following first aid treatment should be given for scorpion stings:

1. Place ice over the sting site (cool the area for up to 2 hours). Do NOT use tobacco juice, saliva, or other concoctions.
2. Elevate the affected limb to approximately heart level to help reduce swelling.
4. Calcium gluconate, 10 ml of 10 percent solution, may be given intravenously to relieve muscle cramps.
5. Benzodiazepines (Valium and Midazolam) may be used to control excitability and convulsions.
6. Antivenom is available for severe stings by Centruroides exilicauda. It is available from the Good Samaritan Poison Center in Phoenix (602-253-3334) and Banner Poison Control Center Hotline at 1-800-222-1222.

CAUTION:
Morphine and meperidine hydrochloride may worsen the respiratory depression from the venom of Centruroides exilicauda.

Spider Bites

Spiders in the United States are generally harmless, with several exceptions. The most notable are the black widow (Latrodectus mactans) and brown recluse (Loxosceles reclusa, also found in South America) spiders. Their bites are serious but rarely fatal. Wandering spiders (Phoneutria species, found in South America), funnel web spiders (Atrax species, found in Australia), and more widely distributed spiders of the Chiracanthium species may also cause moderate to severe human reactions. Check the current MEDIC CD-ROM (available at Environmental Preventive Medicine Units) for management of specific situations and venues.

The female black widow spider is identified by the red hourglass-shaped spot on its belly (Fig. 22-2). Its bite causes a dull, numbing pain, which gradually spreads from the region of the bite to the muscles of the entire torso. The pain becomes severe, and a board-like rigidity of the abdominal muscles is common. Nausea, vomiting, headache, dizziness, dyspnea, edema, rash, hypotension, and anxiety are frequently present.

![THE "BLACK WIDOW" SPIDER](image)

![A. TOP VIEW](image)

![B. UNDERSIDE](image)

![BROWN RECLUSE](image)

Figure 22-2.—Black Widow and Brown Recluse Spiders

The bite site can be very hard to locate (there is little or no swelling at the site), and the victim may not be immediately aware of having been bitten. The buttocks and genitalia should be carefully examined for a bite site if the suspected victim has recently used an outside head.

The following first aid treatment steps are suggested:

1. Place ice over the bite to reduce pain.
2. Hospitalization for patients with respiratory distress; cardiovascular symptoms; protracted (deep) pain; pediatric and elderly patients, pregnant patients, or patients with cardiac history.
3. Be prepared to give antivenom in severe cases.

The brown recluse spider (Fig. 22-2) is identified by its violin-shaped marking. Its bite may initially go unnoticed, but after several hours, a bleb develops over the site, and rings of erythema begin to surround the bleb. Other symptoms include restlessness, fever, chills, nausea, vomiting, pain and shock.
A progressively enlarging necrotic ulcerating lesion eventually develops. Intravascular hemolysis is most often seen in children and may be fatal. Antivenom is not currently available.

Treatment for brown recluse spider bites includes the following:
1. Debridement of lesion, followed by peroxide cleansing and Aluminum Acetate solution soaks.
3. Treat with appropriate oral antibiotics as directed by the physician.

Snakebites

Poisonous snakes are found throughout the world, with the exception of certain islands and the Antarctic. There are five venomous families of snakes.

- **Viperidae**: Includes rattlesnakes, moccasins, South American lance-headed vipers and bushmasters, Asian pit vipers, African and Asian vipers and adders, European adders, and saw-scaled vipers (Middle-eastern). Death results mainly by coagulopathy (a blood clotting disorder) and shock.

- **Elapidae**: Includes cobras, kraits, mambas, and coral snakes. Death results from neurotoxic venom that causes respiratory failure, paralysis, and cardiac failure.

- **Hydrophidae**: Includes sea snakes and venomous snakes from the islands of the southern Pacific Ocean, including Australia, New Zealand, Guam, and New Guinea. Also kills from neurotoxic venom.

- **Colubridae**: Includes most of the common nonvenomous species, as well as the boomslang, and vine/twig/bird snake (Africa); Japanese yamakagashi; Southeast Asian red-necked_callback. Venom method of toxic action varies according to type of snake.

- **Atractaspidae**: Includes the burrowing asps/mole vipers, stiletto snakes, and adders. Venom method of toxic action varies according to type of snake.

Within the United States, poisonous snakes are Crotalids (rattlesnakes, copperheads, and moccasins) and the Elapids (coral snakes).

**CROTALIDS**—are of the Viperidae (viper) family and are called "pit vipers" because of the small, deep pits between the nostrils and the eyes (Fig. 22-3). They have two long, hollow fangs. These fangs are normally folded against the roof of the mouth, but they can be extended when the snake strikes. Other identifying features include thick bodies; slit-like pupils of the eyes; and flat, triangular heads. The most identifying feature of a pit viper is the relative width of the snake head compared to the thickness of the body. The head will be much wider than the body, giving the appearance of an arrowhead. The difference in size is so obvious that identification of a snake as a pit viper can usually be made from a safe distance.

![Figure 22-3.—American Pit Viper](image)

Further identification can be made by examining the wound for signs of fang entry in the bite pattern. Pit viper bites leave two puncture marks (sometimes only one, and sometimes more). Nonvenomous snakes (for example, garter snakes) leave a series, often in a curve or semi-circle, of tiny scratches or punctures.
Individual identifying characteristics include rattles on the tails of most rattlesnakes, and the cotton-white interior of the mouths of moccasins.

**ELAPIDS.**—Coral snakes are of the family Elapidae and related to the cobra, kraits, and mamba snakes in other parts of the world (Fig. 22-4). Corals, which are found in the Southeastern United States, are comparatively thin snakes with small bands of red, black, and yellow (or almost white). Some nonpoisonous snakes have similar coloring.

![Coral Snake Diagram](image)

**Figure 22-4.**—Corals, Cobras, Kraits, and Mambas

The North American coral snake, the red band always touches the yellow band, and the bands go all the way around the body. In some of the nonvenomous, similarly colored varieties, the bands are only on the back and sides, not the belly. There is a saying that only applies to NORTH American coral snakes: "Red on yellow, kill a fellow; red on black, venom lack." The coral snake has short, hollow fangs that chew into its victim and introduce the poison. Coral snake venom is dangerous, if the skin is broken, give antivenom before envenomation is evidenced by symptoms or findings.

Venom, which is stored in sacs in the snake’s head, is introduced into a victim through hollow or grooved fangs. An important point to remember, however, is that a bitten patient has not necessarily received a dose of venom. Snakes can control whether or not it will release the venom and how much it will inject. Baby snakes are unable to control the release of venom. Symptoms in a poisonous snakebite incident can be either severe, mild or not develop at all.

**Signs and Symptoms of Snakebites**

In a snakebite incident, every reasonable effort should be made to positively identify the snake; as the treatment of a nonpoisonous bite is far simpler and less dangerous to the victim than treatment of a poisonous bite. However, unless the snake can be POSITIVELY identified as nonpoisonous, CONSIDER ALL SNAKEBITES AS POISONOUS! SEEK CONSULTATION FROM AN EXPERT SOURCE.

Signs and symptoms of venomous snakebite include:

- A visible bite on the skin (possibly no more than a local discoloration)
- Pain and swelling in the bite area (may develop slowly, from 30 minutes to several hours)
- Continued bleeding from site of bite (often seen with viper bites)
- Rapid pulse
- Labored breathing
- Progressive weakness
- Dim or blurred vision
- Nausea and vomiting
- Drowsiness (or loss of consciousness)
Usually enough symptoms present themselves within an hour of a poisonous snakebite to erase any doubt as to the victim having been envenomated or not. The victim’s condition provides the best information as to the seriousness of the situation.

The aims of first aid for envenomated snakebites are to reduce - not stop - the circulation of blood through the bite area, delay absorption of venom, prevent aggravation of the local wound, maintain vital signs, and transport the victim as soon as possible to a treatment facility with minimum movement.

First Aid and Treatment

1. Try to identify the snake. Positive identification is important to selecting the correct antivenom for the treatment of the patient.

   **NOTE:**
   Do not risk further injury by attempting to kill the snake.

2. **GENTLY** wash the wound with soap and water (it may remove some of the venom). **Do NOT** rub vigorously, as it may cause the venom to be absorbed more rapidly.

3. Certain suction extractors have benefit (for example, the Sawyer® Extractor™), especially if used within the first 3 minutes. If available immediately, use the extractor and leave it on for 30 minutes. The cups may fill up. Empty and re-use them as necessary.

4. Place the victim in a comfortable position.

5. Tell the patient to remove any jewelry (especially rings and bracelets, as these may impede blood flow if there is swelling of the extremities). Assist, if necessary.

6. Start an IV.

7. Monitor vital signs (including ABC + D&Es) closely, responding appropriately as necessary.

8. Until evacuation or treatment is possible, ensure the victim lies quietly and does not move any more than necessary.

9. Do not allow the victim to smoke, eat, or drink any fluids. (Water is permissible if it is anticipated more than several hours will pass before arriving at a hospital and prior to establishing an IV line.)

10. Transport the victim to a treatment facility.

11. Apply a bandage, wrapped two to four inches above the bite (towards the heart), to help slow the venom. This should not cut off the flow of blood from a vein or artery. The band should be loose enough to slip a finger under it.

12. Splint the extremity at a level below the heart. **DO NOT ELEVATE THE EXTREMITY**

13. Hospitalize and observe all snakebites for at least 24 hours.

In the case of spitting cobras (found in Africa, Thailand, Malaysia, Indonesia, and the Philippines), which attempt to spray venom into victims’ eyes, rinse the eyes with large volumes of cool water with pressure similar to that of water coming from a water tap. Apply antibacterial eye ointment and a patch with just enough pressure to keep the eyelid from blinking. Other aid will be mainly supportive:

- Check pulse and respiration frequently. Give artificial ventilation, if necessary
- Treat for shock, including IV fluids (normal saline or Lactated Ringer’s solution)
- Clean the area of the bite with soap and water; cover the wound to prevent further contamination
- Give acetaminophen for pain if delay in hospital treatment is anticipated

**Antivenom** (also called antivenin) is available for many snakes, and is indicated for severe envenomations by *Viperidae* family snakes and snakes of the other poisonous families. Antivenom is best given as soon as possible after an envenomation, but may be of value up to a few days after a bite.
If possible, antivenom specific to the snake should be used. Otherwise, a polyvalent specific antivenom may be used. READ THE PACKAGE INSERT OF THE ANTIVENOM FOR VALUABLE INFORMATION.

Epinephrine and diphenhydramine must be available; as allergic reactions (including anaphylaxis) to antivenom have occurred (they are often prepared from horse serum, to which some people are allergic).

Antivenom is diluted (for example, 1:10) and given at 5 ml/minute IV, and the dose is based on stopping the progression of signs and symptoms, not the victim’s body weight (the child’s dose is the same as the adult dose). For neurotoxic snakebites, if there is no improvement in 30 minutes, the dose should be repeated. For Viperidae (which can cause bleeding disorders), spontaneous bleeding should stop after sufficient antivenom is given; continue giving antivenom until bleeding stops and progression of swelling is retarded. Because the HM may need to administer antivenom a number of times, one vial may not be enough to treat a patient.

Antivenom is available via PCCs and hospitals. It may be available at zoos and embassies.

**The “Don’ts” of Snakebite Treatment:**

~DO NOT use any ice or cooling on the bite
~DO NOT use a tourniquet. Obstructing blood flow can make local tissue injury much worse
~DO NOT use electric shock
~DO NOT make any cuts or incisions in the wound. Cuts at the bite site may impede circulation and promote infection and make local tissue injury much worse
~DO NOT try to suck venom out by mouth
~DO NOT give victim alcohol or narcotics

Further information may be obtained on an emergent basis from a PCC or from American Association of Poison Control, 1-800-222-1222.

**Bites, Stings, and Punctures from Sea Animals**

A number of sea animals are capable of inflicting painful wounds by biting, stinging, or puncturing. Except under rare circumstances, these stings and puncture wounds are not fatal. Major wounds from sharks, barracuda, moray eels, and alligators can be treated by controlling the bleeding, preventing shock, giving basic life support, splinting the injury, and transporting the victim to a medical treatment facility. Minor injuries inflicted by turtles and stinging corals require only that the wound be thoroughly cleansed and the injury splinted. Examples of fish that are known to be poisonous AT ALL TIMES are shown in Figure 22-5.

![Fish Images](image-url)

**Figure 22-5.—Poisonous Fish**

**Venomous Fish** (Excluding Stonefish, Zebradfish, Scorpionfish).—Identification of a fish following a sting is not always possible; however, symptoms and effects of venom do not vary greatly. Venomous fish are rarely aggressive and usually contact is made by accidentally stepping on or handling the fish. Dead fish spines remain toxic. Venom is generally heat-labile and may be decomposed by hot water.
Local symptoms following a sting may first include severe pain later combined with numbness or even hypersensitivity around the wound. The wound site may become cyanotic with surrounding tissue becoming pale and swollen. General symptoms include nausea, vomiting, sweating, mild fever, respiratory distress and collapse. The pain induced may seem disproportionately high to apparent severity of the injury. Medical personnel should be prepared for serious anaphylactic reactions from apparently minor stings or envenomation.

First Aid and Treatment

2. Lay patient down and reassure.
3. Observe for signs of shock.
4. Initially rinse wound with cold salt water or sterile saline solution. Surgery may be required to open up the puncture wound. Suction is not effective to remove this toxin.
5. Soak wound in hot water for 30 to 90 minutes. Heat may break down the venom.
   a. The water should be as hot as the victim can tolerate but not hotter than 114°F (45.6°C).
   b. Immersion in water not hotter than 114°F (45.6°C) for longer than a brief period may lead to scalding.
   c. Immersion in water not hotter than 114°F (45.6°C) should therefore be brief and repeated as necessary.
   d. Use hot compresses if the wound is on the face.
   e. Adding magnesium sulfate (Epsom salts) to the water offers no benefit.
6. Medication usage:
   a. Calcium gluconate injections, diazepam, or methocarbamol may help to reduce muscle spasms.
   b. Infiltration of the wound with 0.5 percent to 2.0 percent Xylocaine without epinephrine is helpful in reducing pain. **If Xylocaine with epinephrine is mistakenly used, local necrosis may result from both the toxin and epinephrine present in the wound.**
   c. Narcotics may also be needed to manage severe pain.
7. Clean and debride wound. Spines and sheath (covering of the spines) frequently remain. Be sure to remove the entire sheath as it may continue to release venom.
8. Injury site management:
   a. Tourniquets or ligatures are no longer advised.
   b. Use an antiseptic or antibiotic ointment and sterile dressing.
   c. Restrict movement of the extremity with immobilizing splints and cravats.
9. Administer tetanus prophylaxis as appropriate.
10. Treat prophylactically with topical antibiotic ointment. If delay in treatment has occurred, it is recommended that the wound be cultured prior to administering systemic antibiotics.

Stonefish, Zebrafish, Scorpionfish——Stings by stonefish, zebrafish, and scorpionfish have been known to cause fatalities. While many similarities exist between these fish and the venomous fish of the previous section, a separate section has been included because of the greater toxicity of their venom and the availability of an antivenin.
The antivenin is specific for the stonefish but may have some beneficial effects against the scorpionfish and zebrafish. Local symptoms are similar to other fish envenomation except that pain is more severe and may persist for many days. Generalized symptoms are often present and may include respiratory failure and cardiovascular collapse. These fish are widely distributed in temperate and tropical seas and in some arctic waters. They are shallow-water bottom dwellers. Stonefish (Fig. 22-6) and scorpionfish are flattened vertically, dark and mottled. Zebrafish are ornate and feathery in appearance with alternating patches of dark and light color.

Figure 22-5.—Stonefish


First Aid and Treatment:

1. Give the same first aid as that given for venomous fish.

2. Observe the patient carefully for the possible development of life-threatening complications.
   a. The venom is an unstable protein which acts as a myotoxin on skeletal, involuntary, and cardiac muscle.
   b. It may result in muscular paralysis, respiratory depression, peripheral vasodilation, shock, cardiac dysrhythmias, or cardiac arrest.

3. Clean and debride wound.

4. Antivenin is available from the Commonwealth Serum Lab, Melbourne, Australia. Utilize the medical chain of command to obtain.
   a. If antivenin is used, the directions regarding dosage and sensitivity testing on the accompanying package insert should be followed and the physician must be ready to treat for anaphylactic shock.
   b. In brief, one or two punctures require 2,000 units (one ampule); three to four punctures, 4,000 units (two ampules); and five to six punctures, 6,000 units (three ampules).
   c. Antivenin must be delivered by slow IV injection and the victim closely monitored for anaphylactic shock.

5. Institute tetanus prophylaxis, analgesic therapy, and antibiotics as described for other fish stings.

Stingrays—The stingray is common in all tropical, subtropical, warm, and temperate regions. It favors sheltered water and burrows into sand with only eyes and tail exposed. It has a bat-like shape and a long tail (Fig. 22-7). Approximately 1,800 stingray attacks are reported annually in the U.S. Most attacks occur when waders inadvertently step on a stingray, causing it to lash out defensively with its tail.

Figure 22-7.—Stingray

The spine is located near the base of the tail. Wounds are either of the laceration or puncture type and are extremely painful. The wound appears swollen and pale with a blue rim. Secondary wound infections are common. Systemic signs and symptoms may be present and can include fainting, nausea, vomiting, sweating, respiratory difficulty, and cardiovascular collapse.

**First Aid and Treatment**

1. Give the same first aid as that given for venomous fish. No antivenin is available.
2. Institute hot water therapy as described under fish envenomation.
3. Clean and debride wound.
   a. Removal of the spine may additionally lacerate tissues due to retropointed barbs.
   b. Be sure to remove integumental sheath as it will continue to release toxin.
4. Observe patient carefully for the possible development of life-threatening complications.
   a. Signs and symptoms can include cardiac dysrhythmias, hypotension, vomiting, diarrhea, sweating, muscle paralysis, respiratory depression, and cardiac arrest.
   b. Fatalities have been reported occasionally.
5. Institute tetanus prophylaxis, analgesic therapy, and broad-spectrum antibiotics as described for fish envenomation.

**Coelenterates** - Hazardous types of coelenterates include: Portuguese man-of-war, sea wasp or box jellyfish, sea nettle, sea blubber, sea anemone, and rosy anemone (Fig. 22-8). Jellyfish vary widely in color (blue, green, pink, red, or brown) or may be transparent. They appear to be balloon-like floats with tentacles dangling down into the water.

**Figure 22-8.—Portuguese Man-of-War**


The most common stinging injury is the jellyfish sting. Jellyfish can come into direct contact with a diver in virtually any oceanic region, worldwide. When this happens, the diver is exposed to literally thousands of minute stinging organs in the tentacles called nematocysts. Most jellyfish stings result only in painful local skin irritation. The sea wasp or box jellyfish and Portuguese man-of-war are the most dangerous types. The sea wasp or box jellyfish (found in the Indo-Pacific) can induce death within 10 minutes by cardiovascular collapse, respiratory failure, and muscular paralysis. Deaths from Portuguese man-of-war stings have also been reported. Even though intoxication from ingesting a poisonous sea anemone is rare, sea anemones must not be eaten.

**Avoidance of Tentacles** - In some species of jellyfish, tentacles may trail for great distances horizontally or vertically in the water and are not easily seen by the diver. Swimmers and divers should avoid close proximity to jellyfish to avoid contacting their tentacles, especially when near the surface.
Protection against Jellyfish - Wet suits, body shells, or protective clothing should be worn when diving in waters where jellyfish are abundant. Petroleum jelly applied to exposed skin (e.g., around the mouth) helps to prevent stinging, but caution should be used since petroleum jelly can deteriorate rubber products.

First Aid and Treatment

1. Without rubbing, gently remove any remaining tentacles using a towel or clothing.

2. For preventing any further discharge of the stinging nematocysts, use vinegar (dilute acetic acid) or a 3- to 10-percent solution of acetic acid. An aqueous solution of 20 percent aluminum sulfate and 11 percent surfactant (detergent) is moderately effective but vinegar works better.

3. What NOT to use:
   a. Do not use alcohol or preparations containing alcohol.
      i. Methylated spirits or methanol, 100 percent alcohol and alcohol plus seawater mixtures have all been demonstrated to cause a massive discharge of the nematocysts.
      ii. In addition, these compounds may also worsen the skin inflammatory reaction.
   b. Picric acid, human urine, and fresh water also have been found to either be ineffective or even to discharge nematocysts and should not be used.
   c. Rubbing sand or applying papain-containing meat tenderizer is ineffective and may lead to further nematocysts discharge and should not be used.

4. It has been suggested that isopropyl (rubbing) alcohol may be effective. It should only be tried if vinegar or dilute acetic acid is not available.

Symptomatic Treatment can include topical steroid therapy, anesthetic ointment (Xylocaine, 2 percent), antihistamine lotion, systemic antihistamines or analgesics. Benzocaine topical anesthetic preparations should not be used as they may cause sensitization and later skin reactions.

Anaphylaxis may result from Jellyfish stings.

Antivenin is available to neutralize the effects of the sea wasp or box jellyfish (Chironex fleckeri, Fig. 22-9). The antivenin should be administered slowly through an IV, with an infusion technique if possible. IM injection should be administered only if the IV method is not feasible. One vial of sea wasp antivenin should be used by the IV route and three vials if injected by the IM route. Each vial of sea wasp antivenin is 20,000 units and is to be kept refrigerated, not frozen, at 36-50°F (2–10°C).

Figure 22-9.—Chironex

Sensitivity reaction to the antivenin should be treated with a subcutaneous injection of epinephrine (0.3 ml of 1:1,000 dilution), corticosteroids, and antihistamines. Treat any hypotension (severely low blood pressure) with IV volume expanders and pressor medication as necessary. The antivenin may be obtained from the Commonwealth Serum Laboratories, Melbourne, Australia. Utilize the medical chain of command to obtain.

Coral
- Coral, a porous, rock-like formation and found in tropical and subtropical waters. It is extremely sharp and the most delicate coral is often the most dangerous because of their razor-sharp edges. Coral cuts, while usually fairly superficial, take a long time to heal and can cause temporary disability.

The smallest cut, if left untreated, can develop into a skin ulcer. Secondary infections often occur and may be recognized by the presence of a red and tender area surrounding the wound. All cuts should receive medical attention.

Some varieties of coral can actually sting a diver since coral is a coelenterate like jellyfish. Some of the soft coral of the genus Palythoa have been found recently to contain the deadliest poison known to man. This poison is found within the body of the organism and not in the stinging nematocysts. The slime of this coral may cause a serious skin reaction (dermatitis) or even be fatal if exposed to an open wound. No antidote is known.

Protection against Coral - Coral should not be handled with bare hands. Feet should be protected with bootsies, coral shoes, or tennis shoes. Wet suits and protective clothing, especially gloves (neoprene or heavy work gloves), should be worn when near coral.

First Aid and Treatment
1. Control local bleeding.
2. Promptly clean with hydrogen peroxide or 10-percent povidone-iodine solution and debride the wound, removing all foreign particles.
3. Cover with a clean dressing.
4. Administer tetanus prophylaxis as appropriate.
5. Topical antibiotic ointment has been proven very effective in preventing secondary infection.
6. Stinging coral wounds may require symptomatic management such as topical steroid therapy, systemic antihistamines, and analgesics.
   a. In severe cases, restrict the patient to bed rest with elevation of the extremity, wet-to-dry dressings, and systemic antibiotics.
   b. Systemic steroids may be needed to manage the inflammatory reaction resulting from a combination of trauma and dermatitis.

Octopus
- The octopus inhabits tropical and temperate oceans. Species vary depending on region. It has a large sac surrounded by 8 to 10 tentacles (Fig. 22-10). The head sac is large with well-developed eyes and horny jaws on the mouth. Movement is made by jet action produced by expelling water from the mantle cavity through the siphon.

Figure 22-10.—Blue-Ring Octopus

The octopus will hide in caves, crevices and shells. It possesses a well-developed venom apparatus in its salivary glands and stings by biting. Most species of octopus found in the U.S. are harmless. The blue-ringed octopus common in Australian and Indo-Pacific waters may inflict fatal bites. The venom of the blue-ringed octopus is a neuromuscular blocker called tetrodotoxin and is also found in Puffer (Fugu) fish.

Envenomation from the bite of a blue-ringed octopus may lead to muscular paralysis, vomiting, respiratory difficulty, visual disturbances, and cardiovascular collapse. Octopus bites consist of two small punctures. A burning or tingling sensation results and may spread. Swelling, redness, and inflammation are common. Bleeding may be severe and the clotting ability of the blood is often retarded by the action of an anticoagulant in the venom.

First Aid and Treatment

1. Control local bleeding.
2. Clean and debride the wound and cover with a clean dressing.
3. For suspected blue-ringed octopus bites, apply direct pressure with a pressure bandage and immobilize the extremity in a position that is lower than the heart using splints and elastic bandages. Do not apply a loose constrictive band.
4. Be prepared to administer mouth-to-mouth resuscitation and cardiopulmonary resuscitation if necessary.
5. Blue-ringed octopus venom is heat stable and acts as a neurotoxin and neuromuscular blocking agent.
   a. Venom is not affected by hot water therapy.
   b. No antivenin is available.
6. Medical therapy for blue-ringed octopus bites is directed toward management of paralytic, cardiovascular, and respiratory complications.
   a. Respiratory arrest is common and intubation with mechanical ventilation may be required.
   b. Duration of paralysis is between 4 and 12 hours.
   c. Reassure the patient.
7. Administer tetanus prophylaxis as appropriate.

Segmented Worms (Annelida) (Examples: Bloodworm and Bristleworm) - This invertebrate type varies according to region and is found in warm, tropical, or temperate zones. It is usually found under rocks or coral and is especially common in the tropical Pacific, Bahamas, Florida Keys, and Gulf of Mexico.

Annelida have long, segmented bodies with stinging bristle-like structures on each segment. Some species have jaws and will also inflict a very painful bite. Venom causes swelling and pain.

First Aid and Treatment

1. Remove bristles with a very sticky tape such as adhesive tape or duct tape. Topical application of vinegar will lessen pain.
2. Treatment is directed toward relief of symptoms and may include topical steroid therapy, systemic antihistamines, and analgesics.
3. Wound infection can occur but can be easily prevented by cleaning the skin using an antiseptic solution of 10 percent povidone-iodine and topical antibiotic ointment.
4. Systemic antibiotics may be needed for established secondary infections that first need culturing, aerobically and anaerobically.
Sea Urchins - There are various species of sea urchins with widespread distribution. Each species has a radial shape and long spines. Penetration of the sea urchin spine can cause intense local pain due to venom in the spine or from another type of stinging organ called the globiferous pedicellariae. Numbness, generalized weakness, paresthesias, nausea, vomiting, and cardiac dysrhythmias have been reported.

First Aid and Treatment

1. Remove large spine fragments gently, being very careful not to break them into small fragments that remain in the wound.
2. Bathe the wound in vinegar or isopropyl alcohol. Soaking the injured extremity in hot water up to 122°F (50°C) may help. Caution should be used to prevent scalding the skin which can easily occur after a brief period in water above 122°F (50°C).
3. Clean and debride the wound. Topical antibiotic ointment should be used to prevent infection. Culture both aerobically and anaerobically before administering systemic antibiotics for established secondary infections.
4. Remove as much of the spine as possible. Some small fragments may be absorbed by the body. Surgical removal, preferably with a dissecting microscope, may be required when spines are near nerves and joints. X-rays may be required to locate these spines. Spines can form granulomas months later and may even migrate to other sites.
5. Allergic reaction and bronchospasm can be controlled with subcutaneous epinephrine (0.3 ml of 1:1,000 dilution) and by using systemic antihistamines. There are no specific antivenins available.
6. Administer tetanus prophylaxis as appropriate.
7. Get medical attention for deep wounds.

Cone Shells - The cone shell is widely distributed in all regions and is usually found under rocks and coral or crawling along sand. The shell is most often symmetrical in a spiral coil, colorful, with a distinct head, one to two pairs of tentacles, two eyes, and a large flattened foot on the body (Fig. 22-11).

A cone shell sting should be considered as severe as a poisonous snake bite. It has a highly developed venom apparatus: venom is contained in darts inside the proboscis which extrudes from the narrow end but is able to reach most of the shell. Cone shell stings are followed by a stinging or burning sensation at the site of the wound. Numbness and tingling begin at the site of the wound and may spread to the rest of the body; involvement of the mouth and lips is severe. Other symptoms may include muscular paralysis, difficulty with swallowing and speech, visual disturbances, and respiratory distress, with a 25% mortality rate.

Figure 22-11. - Cone Shells

First Aid and Treatment

1. Lay the patient down.
2. Direct pressure with a pressure bandage over the site and immobilization in a position lower than the level of the heart using splints and elastic bandages is recommended. Do not apply a loose constricting band or ligature.
3. Some authorities recommend incision of the wound and removal of the venom by suction, although this is controversial.
   a. General agreement is that if an incision is to be made, the cuts should be small (one centimeter), linear and penetrate no deeper than the subcutaneous tissue.
   b. The incision and suction should only be performed if it is possible to do so within two minutes of the sting. Otherwise, the procedure may be ineffective.
   c. Incision and suction by inexperienced personnel has resulted in inadvertent disruption of nerves, tendons, and blood vessels.
4. Transport the patient to a medical facility while ensuring that the patient is breathing adequately. Be prepared to administer mouth-to-mouth resuscitation if necessary.
5. Cone shell venom results in paralysis or paresis of skeletal muscle, with or without myalgia. Symptoms develop within minutes of the sting and effects can last up to 24 hours.
6. No antivenin is available.
7. Respiratory distress may occur due to neuromuscular block. Patient should be admitted to a treatment facility and monitored closely for respiratory or cardiovascular complications. Treat as symptoms develop.
   Local anesthetic with no epinephrine may be injected into the site of the wound if pain is severe. Analgesics which produce respiratory depression should be used with caution.
8. Management of severe stings is supportive. Respiration may need to be supported with intubation and mechanical ventilation.
9. Administer tetanus prophylaxis as appropriate.

Sea Snakes - The sea snake is an air-breathing reptile which has adapted to its aquatic environment by developing a paddle tail. Sea snakes inhabit the Indo-Pacific area and the Red Sea and have been seen 150 miles from land. The most dangerous areas in which to swim are river mouths as sea snakes are more numerous and the water more turbid. The sea snake is a true snake, usually 3 to 4 feet in length, but may reach 9 feet. It is generally banded (Figs. 22-12 and 22-13). The sea snake is curious and is often attracted by divers and usually not aggressive except during its mating season.

Figure 22-13.—Hydrophis Snake


Figure 22-12.—Yellow-Bellied Snake

Sea Snake Bite Effects - The sea snake injects a poison that has 2 to 10 times the toxicity of cobra venom. The bites usually appear as four puncture marks but may range from one to 20 punctures. Teeth may remain in the wound. The neurotoxin poison is a heat-stable nonenzymatic protein; hence, bites should not be immersed in hot water as with venomous fish stings. Due to its small jaws, bites often do not result in envenomation.

Bites characteristically produce little pain and there is usually a latent period of 10 minutes to as long as several hours before the development of generalized symptoms: muscle aching and stiffness, thick tongue sensation, progressive paralysis, nausea, vomiting, difficulty with speech and swallowing, respiratory distress and failure, plus smoky-colored urine from myoglobinuria, which may lead to kidney failure.

First Aid and Treatment

1. Keep victim still.

2. Apply direct pressure using a compression bandage and immobilize the extremity in the dependent position with splints and elastic bandages. This prevents spreading of the neurotoxin through the lymphatic circulation. Do not apply a loose constricting band or tourniquet.

3. Incise and apply suction (see cone shell stings).

4. Transport all sea snake-bite victims to a treatment facility as soon as possible, regardless of their current symptoms.

5. Watch to ensure that the patient is breathing adequately. Be prepared to administer mouth to mouth resuscitation or cardiopulmonary resuscitation if required.

6. The venom is a heat-stable protein which blocks neuromuscular transmission. Myonecrosis with resultant myoglobinuria and renal darrage are often seen. Hypotension may develop.

7. Respiratory arrest may result from generalized muscular paralysis; intubation and mechanical ventilation may be required.

8. Renal function:
   b. Peritoneal or hemodialysis may be needed.
   c. Alkalization of urine with sufficient IV fluids will promote myoglobin excretion.

9. Vital signs should be monitored closely. Cardiovascular support plus oxygen and IV fluids may be required.

10. Because of the possibility of delayed symptoms, all sea snake-bite victims should be observed for at least 12 hours.

11. If symptoms of envenomation occur within one hour, antivenin should be administered as soon as possible.
   a. In a seriously envenomated patient, antivenin therapy may be helpful even after a significant delay.
   b. Antivenin is available from the Commonwealth Serum Lab in Melbourne, Australia.
   c. If specific antivenin is not available, polyvalent land snake antivenin (with a tiger snake or krait Elapidae component) may be substituted.
   d. If antivenin is used, the directions regarding dosage and sensitivity testing on the accompanying package insert should be followed and the physician must be ready to treat for anaphylaxis.
   e. Infusion by IV method or closely monitored drip over a period of one hour is recommended.

12. Administer tetanus prophylaxis as appropriate.
Sponges - Sponges are composed of minute multicellular animals with spicules of silica or calcium carbonate embedded in a fibrous skeleton. Exposure of skin to the chemical irritants on the surface of certain sponges or exposure to the minute sharp spicules can cause a painful skin condition called dermatitis.

First Aid and Treatment
1. Adhesive or duct tape can effectively remove the sponge spicules.
2. Vinegar or a 3- to 10-percent acetic acid should be applied with saturated compresses as sponges may be secondarily inhabited by stinging coelenterates.
3. Antihistamine lotion (diphenhydramine) and later a topical steroid (hydrocortisone) may be applied to reduce the early inflammatory reaction.
4. Antibiotic ointment is effective in reducing the chance of a secondary infection.

POISONOUS MARINE ANIMALS

Ciguatera Fish Poisoning
Ciguatera poisoning is fish poisoning caused by eating the flesh of a fish that has eaten a toxin-producing microorganism; the dinoflagellate, Gambierdiscus toxicus produces ciguatoxin. The poisoning is common in reef fish between latitudes 35°N and 35°S around tropical islands or tropical and semitropical shorelines in Southern Florida, the Caribbean, the West Indies, and the Pacific and Indian Oceans. Fish and marine animals affected include barracuda, red snapper, grouper, sea bass, amberjack, parrot fish, and the moray eel. Incidence is unpredictable and dependent on environmental changes that affect the level of dinoflagellates.

The toxin is heat-stable, tasteless, and odorless, and is not destroyed by cooking or gastric acid. Symptoms may begin immediately or within several hours of ingestion and may include nausea, vomiting, diarrhea, itching and muscle weakness, aches and spasms.

Neurological symptoms may include pain, ataxia (stumbling gait), paresthesias (tingling), and circumoral parasthesias (numbness around the mouth). Sensory reversal of hot and cold sensation when touching or eating objects of extreme temperatures may occur.

In severe cases, respiratory failure and cardiovascular collapse may occur. Pruritus (itching) is characteristically made worse by alcohol ingestion. Gastrointestinal symptoms usually disappear within 24 to 72 hours. Complete recovery will occur in the majority of cases with neurological symptoms persisting for months or years. Signs and symptoms of ciguatera fish poisoning may be misdiagnosed as decompression sickness or contact dermatitis from unseen fire coral or jellyfish.

Because of rapid modern travel and refrigeration, ciguatera poisoning may occur far from endemic areas with international travelers or unsuspecting restaurant patrons. Table 22-5 lists some of toxins found in fish and shellfish and their potential sources.

<table>
<thead>
<tr>
<th>Toxin</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciguatoxin (cholinergic effects)</td>
<td>Tends to be found in fish from Coral reefs, including barracuda, grouper, red snapper, parrot fish</td>
</tr>
<tr>
<td>Scombrotoksin (histamine-like reaction)</td>
<td>Tuna, bonito, skipjack, mackerel, mahi mahi</td>
</tr>
<tr>
<td>Saxitoxin (neurologic effects)</td>
<td>Bivalve shellfish (mussels, clams, scallops) accumulate toxin from dinoflagellate during red tides causing paralytic shellfish poisoning</td>
</tr>
<tr>
<td>*Tetrodotoxin (neurotoxin)</td>
<td>Daeceria found in puffer fish, California newt, eastern salamander</td>
</tr>
<tr>
<td>*Neurotoxin</td>
<td>Moray eel</td>
</tr>
</tbody>
</table>

Table 22-5.—Examples of Toxins from Fish Known to be Poisonous
First Aid and Treatment

1. Treatment is largely supportive and symptomatic. If the time since suspected ingestion of the fish is brief and the victim is fully conscious, induce vomiting (syrup of ipecac) and administer purgatives (cathartics, laxatives) to speed the elimination of undigested fish.

2. In addition to the symptoms described above, other complications which may require treatment include hypotension and cardiac dysrhythmias.

3. Medication management:
   a. Antiemetics and anti-diarrheal agents may be required if gastrointestinal symptoms are severe.
   b. Atropine may be needed to control bradycardia.
   c. IV fluids may be needed to control hypotension.
   d. Calcium gluconate, diazepam, and methocarbamol can be given for muscle spasm.
   e. Amytriptyline has been used successfully to resolve neurological symptoms such as depression.

Scombroid Fish Poisoning

Unlike ciguatera fish poisoning where actual toxin is already concentrated in the flesh of the fish, scombroid fish poisoning occurs from different types of fish that have not been promptly cooled or prepared for immediate consumption. Typical fish causing scombroid poisoning include tuna, skipjack, mackerel, bonito, dolphin fish, mahi mahi (Pacific dolphin), and bluefish. Fish that cause scombroid poisoning are found in both tropical and temperate waters.

A rapid bacterial production of histamine and anariosine (a histamine-like compound) produce the symptoms of a histamine reaction: nausea, abdominal pain, vomiting, facial flushing, urticaria (hives), headache, pruritus (itching), bronchospasm, and a burning or itching sensation in the mouth. Symptoms may begin one hour after ingestion and last 8 to 12 hours. Death is rare.

Prevention - Immediately clean the fish and preserve by rapid chilling. Do not eat any fish that has been left in the sun or in the heat longer than two hours.

First Aid and Treatment

Oral antihistamine, (e.g., diphenhydramine, cimetidine), epinephrine (given subcutaneously), and steroids are to be given as needed. Table 22-5 lists some of toxins found in fish and shellfish and their potential sources.

Puffer (Fugu) Fish Poisoning

An extremely potent neurotoxin called tetrodotoxin is found in the viscera, gonads, liver, and skin of a variety of fish, including the puffer fish, porcupine fish, and ocean sunfish. Puffer fish also called blow fish, toad fish, and balloon fish, and called Fugu in Japanese are found primarily in the tropics but also in temperate waters of the coastal U.S., Africa, South America, Asia, and the Mediterranean. Puffer fish is considered a delicacy in Japan, where it is thinly sliced and eaten as sashimi. Licensed chefs are trained to select those puffer fish least likely to be poisonous and also to avoid contact with the visceral organs known to concentrate the poison.

The first sign of poisoning is usually tingling around the mouth, which spreads to the extremities and may lead to a body wide numbness. Neurological findings may progress to stumbling gait (ataxia), generalized weakness, and paralysis. The victim, though paralyzed, remains conscious until death occurs by respiratory arrest with a 50 to 60 % mortality rate if untreated.
First Aid and Treatment

1. Provide supportive care with airway management and monitor breathing and circulation.
3. Monitor and treat cardiac dysrhythmias.

Paralytic Shellfish Poisoning (PSP): Red Tide

Paralytic shellfish poisoning (PSP) is due to mollusks (bivalves) such as clams, oysters, and mussels ingesting dinoflagellates that produce a neurotoxin which then affects man. Proliferation of these dinoflagellates during the warmest months of the year produces a characteristic red tide. However, some dinoflagellate blooms are colorless, so that poisonous mollusks may be unknowingly consumed.

Local public health authorities must monitor both seawater and shellfish samples to detect the toxin. Poisonous shellfish cannot be detected by appearance, smell, or discoloration of either a silver object or garlic placed in the cooking water. Poisonous shellfish can be found in either low or high tidal zones. The toxic varieties of dinoflagellates are common in the following areas: Northwestern U.S. and Canada, Alaska, part of western South America, Northeastern U.S., the North Sea European countries, and in the Gulf Coast area of the U.S. One other type of dinoflagellate, though not toxic if ingested, may lead to eye and respiratory tract irritation from shoreline exposure to a dinoflagellate bloom that becomes aerosolized by wave action and wind

Symptoms - include circumoral paresthesias (tingling around the mouth) which spread to the extremities and may progress to muscle weakness, ataxia, salivation, intense thirst, and difficulty in swallowing. Gastrointestinal symptoms are not common. Death, although uncommon, can result from respiratory arrest. Symptoms begin 30 minutes after ingestion and may last for many weeks. Gastrointestinal illness occurring several hours after ingestion is most likely due to a bacterial contamination of the shellfish.

Allergic reactions such as urticaria (hives), pruritus (itching), dryness or scratching sensation in the throat, swollen tongue and bronchospasm may also be an individual hypersensitivity to a specific shellfish and not PSP.

First Aid and Treatment

1. No antidote is known.
2. If the victim is fully conscious, induce vomiting with 30 ml (two tablespoons) of syrup of Ipecac.
3. Lavaging the stomach with alkaline fluids (solution of baking soda) may be helpful since the poison is acid-stable.
4. Provide supportive treatment with close observation and advanced life support if needed until the illness resolves.

NOTE:
The poisoning is related to the quantity of poisonous shellfish consumed and the concentration of the dinoflagellate contamination.

Bacterial and Viral Diseases from Shellfish

Large outbreaks of typhoid fever and other diarrheal diseases caused by the genus Vibrio have been traced to consuming contaminated raw oysters and inadequately cooked crabs and shrimp. Diarrheal stool samples from patients suspected of having bacterial and viral diseases from shellfish should be placed on a special growth medium (thiosulfate-citrate-bile salts-sucrose agar) to specifically grow Vibrio species, with isolates being sent to reference laboratories for confirmation.

Prevention - To avoid bacterial or viral disease (e.g., Hepatitis A or Norwalk viral gastroenteritis) associated with oysters, clams, and other shellfish, an individual should eat only thoroughly cooked shellfish. It has been proven that eating raw shellfish (mollusks) presents a definite risk of contracting disease.
First Aid and Treatment

1. Provide supportive care with attention to maintaining fluid intake by mouth or IV if necessary.
2. Consult medical personnel for treatment of the various Vibrio species that may be suspected.

Sea Cucumber

Frequently eaten in some parts of the world where it is sold as Tre pang or Beche-de-mer. It is boiled and then dried in the sun or smoked. Contact with the liquid ejected from the visceral cavity of some sea cucumber species may result in a severe skin reaction (dermatitis) or even blindness. Intoxication from sea cucumber ingestion is rare.

First Aid and Treatment

1. Because no antidote is known, treatment is only symptomatic.
2. Skin irritation may be treated like jellyfish stings.

Parasitic Infestation

Parasitic infestations can be of two types: superficial and flesh. Superficial parasites burrow in the flesh of the fish and are easily seen and removed. These may include fish lice, anchor worms, and leeches. Flesh parasites can be either encysted or free in the muscle, entrails, and gills of the fish. These parasites may include roundworms, tapeworms, and flukes. If the fish is inadequately cooked, these parasites can be passed on to humans.

Prevention.- Avoid eating raw fish. Prepare all fish by thorough cooking or hot-smoking. When cleaning fish, look for mealy or encysted areas in the flesh; cut out and discard any cyst or suspicious areas. Remove all superficial parasites. Never eat the entrails or viscera of any fish.