

There are 2 groups of venomous snakes that normally live in the United States (Figure 2, page 4).

1. Coral snakes—Small, colorful (red, yellow, and black) snakes. A simple way to remember is “Red on yellow will kill a fellow. Red on black, venom Lack.”
2. Crotaline snakes—Rattlesnakes, cottonmouth snakes, copperhead snakes. Like rattlesnakes, cottonmouth and copperhead snakes have nostrils and heat pits; however, they do not have rattles. Copperhead snakes often have a distinctive pattern, which may assist in identification. Crotaline snakes inhabit all states except Maine, Alaska, and Hawaii.

Snakebites can occur in states where snakes are not common because the practice of keeping or collecting snakes is common. Most venomous snakebites happen to people who are handling them.

For bites by exotic snakes, call the Regional Poison Control Center 1-800/222-1222

Clinical Evaluation of the Snakebite Victim

1. Assess **ABCs** and initiate appropriate resuscitation efforts.
2. **Inspect the area of the bite**, looking for fang marks, which may appear to be a small abrasion or laceration. (Note: The bite of the coral snake and some exotic snakes may leave little or no evidence of fang marks.) Special notice should be made of the size of the erythema surrounding the fang marks, if present, and the extent of associated edema. Take a history from the patient: Document the amount of pain at the site of the bite and the time of pain onset compared with time of the bite (especially important). With envenomation, the onset of pain is usually immediate. (Note: With coral snake bites, there may be little evidence of local reaction at the bite site.)
3. **Determine the extent of systemic reaction**, which already may be evident from the assessment of respiratory and circulatory parameters (hypotension, nausea, vomiting, sweating, and weakness); or neurotoxic symptoms (dizziness, perioral paresthesia, ptosis, paresis/paralysis, and/or muscle fasciculation).
4. **Identify the snake, if possible**. Most bites are nonpoisonous. (The appearance of the snake, especially the rattlesnake, may vary considerably from the illustrations, depending on season, terrain, and so on.) Use caution even when handling a dead snake.
5. **Grade the envenomation**. (Table, page 4) Snake envenomation is a dynamic process. By definition, every snakebite initially appears as a dry bite. A dry bite is defined as one that produces a skin puncture(s) but does not produce local, coagulation, or systemic effects. **Up to 25% of crotaline snake bites are dry bites**. A minimal or moderate envenomation means that the patient is likely in an early progressive phase of envenomation, while a severe bite is often a bite that has completed its course of worsening.

A crotaline snake bite shares the concept of elapsed time with other conditions, such as myocardial infarction. **“Time is Tissue.”** A delay in antivenom therapy may allow tissue injury to progress further.

Laboratory Evaluation

Routine Tests—Complete blood cell count, platelet count, prothrombin (PT) time or international normalized ratio (INR), partial thromboplastin time (PTT), electrolytes, blood urea nitrogen, serum creatinine, creatine phosphokinase (CPK), and urinalysis (if the bite is older than 60 minutes, add urine myoglobin screen)

Additional Tests (if grade 2 or greater envenomation is suspected)—Type and cross-match, fibrinogen, fibrin split products, and bleeding time

General Treatment

CAUTION: Snakes cannot always be identified as either poisonous or nonpoisonous.

The patient must be presumed to have been bitten by a snake with neurotoxic venom, and the patient should be transferred to or treated at a facility with an intensive care unit and mechanical ventilation capabilities.

1. Evidence of envenomation: Start 2 wide-bore IVs and begin infusion of a balanced salt solution.
2. All patients with evidence of crotaline envenomation should be admitted. In patients with fang marks without evidence of envenomation, observe the patient for 6–8 hours. If there is no progression of symptoms or evidence of coagulopathy, the patient can be discharged after rechecking laboratory tests to ensure that the INR is not elevated; elevated INR would indicate envenomation with a delayed coagulopathy.
3. The use of prophylactic antibiotics is controversial. The author’s current recommendation is to observe the wound and treat it empirically if an infection develops, using a broad-spectrum antibiotic.
4. Assess tetanus status and update immunization, as necessary.
5. Elevate the bitten extremity to the level of the heart.
6. If a compression band has been applied, it should be removed as soon as antivenom is available. If cryotherapy was initiated, it should be promptly discontinued. Electric shock therapy has no use for treating snakebites.
7. Vasopressors should be available and initiated as the clinical situation requires, although hypotension should be treated initially with fluid therapy and is often readily reversed with antivenom administration.
8. The local management of the snakebite site is a matter of some controversy. Most physicians agree that some form of incision and suction of the fang marks may be beneficial if performed within 15 to 30 minutes from the time of the bite. Prophylactic bite excision and fasciotomy are not indicated. Early initiation of antivenom therapy in patients with progressive local reaction may prevent further progression and tissue loss. Intraarticular envenomation may warrant arthroscopic irrigation of the joint space and possible instillation of antivenom directly in the joint space. Bites to the finger often result in significant swelling that is best relieved with medial and lateral dermatomy.

9. Compartment syndrome is a common complication of rattlesnake envenomation. Compartment pressures should be monitored carefully (depending on the local symptoms, pressures should be monitored every 30–120 minutes and fasciotomy performed promptly for pressure >30 mm Hg).
10. With evidence of increased compartment pressure, frequent monitoring of urine for myoglobin should begin, and CPK levels rechecked. If rhabdomyolysis is present, HCO₃ should be added to the IV fluids. IV fluid administration rates should also be increased to provide vigorous hydration.
11. Transfusion with blood products should be initiated only in accordance with specific indications. Coagulopathy can be reversed with antivenom therapy.

Platelet transfusion is not indicated for thrombocytopenia if that is the sole abnormality and the platelet count is greater than 20,000 cells/mL, or if the bleeding time is not prolonged longer than twice the upper limit of normal.

Fresh frozen plasma transfusion is indicated for uncontrollable bleeding when PT and PTT are prolonged. Cryoprecipitate should be administered for clinically significant hemorrhage and a fibrinogen level of <100 mg/dL.

Transfusion of packed cells should be individualized depending on the hematocrit level, comorbid conditions, and the presence of symptoms of anemia. When transfusion has been initiated for the treatment of coagulopathy, clotting studies should be repeated at 2-hour intervals until the results have returned to normal and bleeding is controlled.

Antivenom Therapy

Coral Snake Bite

Micurus antivenin (Wyeth-Ayerst Laboratories)

This antivenom is effective against bites of the coral snake (genus *Micurus*).

The snakes in that genus are the eastern coral snake and the Texas coral snake, which are the predominant coral snakes in the United States. This antivenin is not effective against bites by snakes of the genus *Micruroides*. The snakes in that genus are the Arizona coral snake and the Sonoran coral snake, which usually do not bite nor envenomate. One vial of Wyeth's *Micurus* antivenin is capable of neutralizing 2.0 mg of coral snake venom. Large North American coral snakes may have venom with yields as high as 20 mg.

Crotaline Snake Bite

Polyvalent Crotalidae Immune Fab (ovine), trade name CroFab™/CroFab™ dosing (Figure 1, page 3)

The recommended initial dose is 4–6 vials, infused over 60 minutes.

*Initial control of the envenomation syndrome is defined as cessation of progression of all components of envenomation: local effects, systemic effects, and coagulopathy.

Preparation and infusion of CroFab™

After reconstitution, the entire dose is injected into a 250 mL bag of 0.9% sodium chloride (remove 40–60 mL to make room).

CroFab™ should be infused slowly for the first 10 minutes at 25–50 mL per hour, with careful observation for any allergic reaction. If no reaction occurs, the infusion rate should be increased to the full 250 mL per hour rate until completion.

Additional CroFab™ dose

Reevaluate the patient immediately after the first 6-vial dose. Infuse an additional 4–6 vials if initial control has not been achieved.

Maintenance CroFab™ dose

After achieving initial control, 3 maintenance doses of 2 vials each should be administered to prevent the extension of local swelling and ecchymosis.

Recurrence is the return of any venom effect after that abnormality had resolved. Thus, the return of progression of swelling after its initial arrest had been documented is a local recurrence. The return of thrombocytopenia, hypofibrinogenemia, prolongation of prothrombin time, or elevation of fibrin split products is a coagulopathy recurrence. If the maintenance doses are omitted, local recurrence should be treated with 2 vials of CroFab™ intravenously.

Administration of CroFab™ is contraindicated in these circumstances:

The patient has suffered a dry bite.

History of allergic reaction to CroFab™.

History of a true allergic reaction to sheep serum. (An irritation reaction to wool is not considered an allergic reaction.)

History of hypersensitivity to papaya or papain, unless the benefits outweigh the potential risks.

Indications for Antivenom Therapy

Progression of Local Injury (Figure 3, page 4)

Progression of local injury is an indication for antivenom therapy. Pain, swelling, or ecchymosis will not reverse immediately, but the administration of antivenom can prevent or reduce further injury. Antivenom therapy may ultimately help prevent the development of a compartment syndrome and long-term disability.

Coagulopathy

A significant coagulation abnormality is an indication for antivenom therapy, particularly if it occurs within the first few hours after envenomation. Laboratory abnormalities may include an increased PT or INR, decreased platelet count, and hypofibrinogenemia. Each of these conditions typically improves with antivenom treatment.

Systemic Effects

Neurologic and cardiac effects are also reversible if treated early. The main systemic effect of concern is hypotension, which typically reverses promptly with the administration of antivenom, particularly if the patient is treated early. Other systemic manifestations include repeated nausea and vomiting as well as paresthesia and muscle fasciculation remote from the bite site. Progression is defined as worsening with direct observation of any parameter used in grading the envenomation: local injury, coagulation abnormality, or systemic symptoms or signs.

Recommended Treatment of Allergic Reaction to Antivenom

Mild Reaction

1. Stop the antivenom infusion
2. Administer H¹ and H² blockers

Diphenhydramine: 25–50 mg IV in an adult (1 mg/kg in child, up to 50 mg/dose)

Cimetidine: 300 mg IV (10 mg/kg in child, up to 300 mg)

3. Consider a beta-agonist if wheezing is present
 Albuterol: 0.15 mg/kg (maximum, 10 mg) via nebulizer every 20–30 minutes.

Moderate to Severe Reactions

1. Stop the antivenom infusion
2. Administer oxygen and intubate the patient endotracheally if needed
3. Administer H¹ and H² blockers and albuterol as for mild reactions
4. Administer epinephrine for more severe reactions

Reactions That Are Not Life-threatening.

Adult: 0.3–0.5 mg subcutaneously (SQ)

Child: 0.01 m/kg of 1:1000 SQ, up to 0.3 mL

Severe and Life-threatening Reactions (anaphylaxis or severe anaphylactoid reaction).

Adult: dilute 3–5 mL of 1:10,000 IV over several minutes.

Child: 0.01 mg/kg of 1:10,000 IV over several minutes

Consider 60–125 mg of methylprednisolone IV in adult (child: 1–2 mg/kg, up to 125 mg)

Serum Sickness

About 5% of patients who receive CroFab™ develop serum sickness. Serum sickness is manifested by diffuse maculopapular rash, fever, malaise, joint aches, and itching. Rarely, pericarditis and glomerulonephritis may complicate its course. Serum sickness typically begins 3–14 days after antivenom administration and lasts for a few days to up to a week.

Follow-up

Coagulopathy recurrence is not reported to have develop in patients without evidence of a coagulopathy during hospitalization; therefore, further coagulation tests after discharge are not recommended. If the patient had a coagulation abnormality during hospitalization, reevaluation within 4 days of discharge is recommended.

Acknowledgment: Special thanks to Richard C. Dart, MD, for his help.

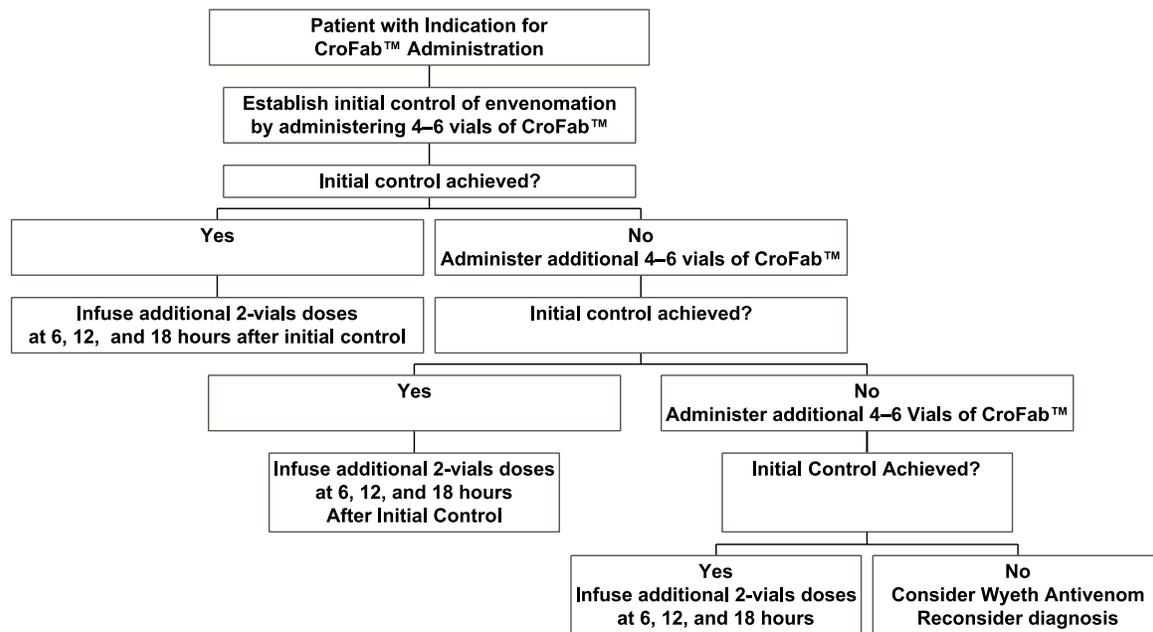


Figure 1—Algorithm for CroFab™ Administration

Table—Grades of Envenomation

Grade 0	Fang marks; swelling and erythema around the fang mark < 2.5 cm; minimal pain and tenderness; no systemic symptoms
Grade 1	Fang marks; history of immediate pain with the bite; swelling and erythema 5–15 cm; no systemic signs or symptoms
Grade 2	Fang marks; history of immediate severe pain; swelling and erythema 15–40 cm; mild systemic symptoms and/or abnormal laboratory findings
Grade 3	Fang marks; history of immediate severe pain; swelling and erythema > 40 cm; petechiae and bullae; moderate systemic symptoms; bleeding and/or disseminated intravascular coagulopathy; abnormal laboratory values
Grade 4	Fang marks; signs of multiple envenomation sites; history of immediate severe pain; severe systemic signs, possibly including coma, shock, bleeding, disseminated intravascular coagulation (DIC), and paralysis

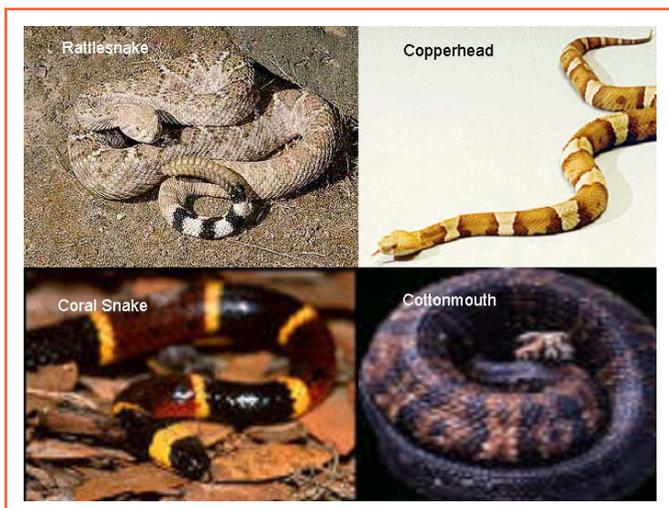


Figure 2—Venomous snakes in the United States



Figure 3—Progression of local injury

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