Treating venomous snakebites in the United States

A guide for nurse practitioners

Abstract: *This article discusses the current, evidence-based guidelines for managing venomous snakebites indigenous to the United States. A review of common varieties of venomous snakes, venom effects, risk factors for snakebites, and management strategies are presented to assist nurse practitioners in caring for snakebite victims.*

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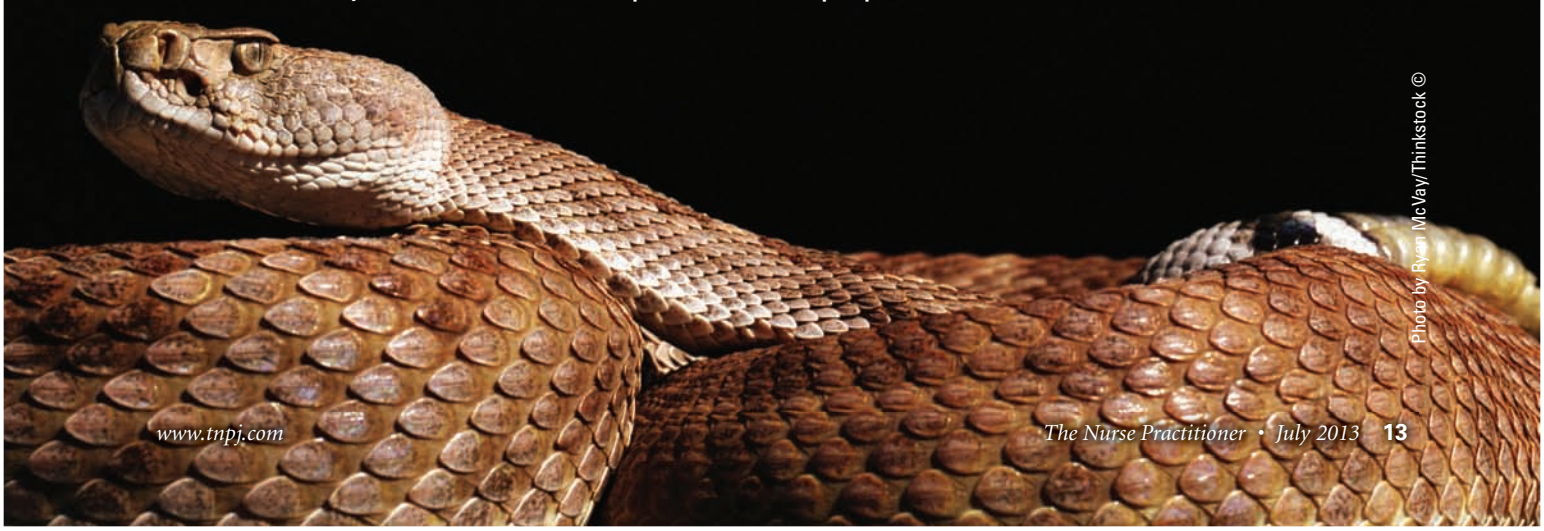
A 24-year-old White male presents to a clinic complaining of being bitten by a copperhead that he caught at an outdoor gathering 45 minutes ago. He says that he killed the snake after it bit him on the hand and adds that he brought it with him in his pickup truck if inspection is necessary. He is complaining of severe pain in his hand and arm along with some nausea. The patient has significant redness and swelling on his hand surrounding the bite mark that radiates to his elbow. He is anxious, pale, and diaphoretic. The closest hospital is 40 minutes away. What is the best course of action?

Key words: antivenom, crotalid, elapidae, envenomation, pit vipers, snake, snakebite treatment, venom



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Indigenous venomous snakes by region in the United States

Southeast
- Southern Copperhead
- Western, Eastern and Florida Cottonmouths
- Eastern Coral Snake
- Carolina Pygmy Rattlesnake
- Canebrake Rattlesnake
- Western and Eastern Diamondback Rattlesnakes

Northeast
- Northern Copperhead
- Eastern Massasauga
- Timber Rattlesnakes

Midwest
- Northern and Osage Copperheads
- Western Cottonmouth
- Eastern Massasauga
- Western Pygmy Rattlesnake
- Timber Rattlesnakes

Great Plains
- Broad Banded Copperhead
- Texas Coral Snake
- Western Diamondback
- Prairie Rattlesnake
- Western Massasauga
- Black-tailed Rattlesnakes

Southwest Desert
- Trans-Pecos Copperhead
- Western Coral Snake
- Western Diamondback
- Mojave Rattlesnake
- Desert Massasauga
- Mottled Rock Rattlesnake
- Twin-spotted Rattlesnake
- Tiger Rattlesnake
- Black-tailed Rattlesnake
- Banded Rock Rattlesnake
- Mojave Desert Sidewinder
- New Mexico Ridge-nosed Rattlesnake
- Arizona Ridge-nosed Rattlesnake
- Arizona Black Rattlesnake
- Colorado Desert Sidewinder
- Sonoran Desert Sidewinder
- Panamint Speckled Rattlesnake
- Southwestern Speckled Rattlesnake
- Grand Canyon Rattlesnake
- Prairie Rattlesnakes

Rocky Mountain
- Prairie Rattlesnake
- Midget Faded Rattlesnake
- Hopi Rattlesnakes

Great Basin
- Great Basin Rattlesnake

West coast
- Southern Pacific Rattlesnake
- Red Diamond Rattlesnake
- Southwestern Specked Rattlesnake
- Northern Pacific Rattlesnakes

Venomous snakebites are associated with significant morbidity, and in rare cases, mortality in the United States. Snakes are reclusive animals with poorly understood habits and will bite to protect themselves when threatened. An estimated 9,000 snakebite victims seek medical attention annually in the United States[1]; therefore, it is important that nurse practitioners (NPs) know how to recognize and treat patients reporting snakebites, since rapid assessment and monitoring can reduce morbidity or save a patient's life. This article provides an overview of the most common venomous snakes in the United States, signs and symptoms of envenomation, and the most current evidence-based treatment approaches for managing snakebite victims.

Epidemiology of snakebites

The World Health Organization (WHO) has identified snakebites as a neglected tropical disease in countries such as Africa, Asia, and Latin America, where envenomations pose significant occupational and environmental health risks, resulting in devastating consequences.[2,3] According to WHO, an estimated 2.5 million envenomations occur annually worldwide, leading to 100,000 deaths with three times as many victims left disabled from venom sequelae.[3]

In contrast, of the 120 species of snakes indigenous in the United States, only 25 are venomous.[4] Of the estimated 45,000 snakebites that occur annually in the United States, only 4,000 to 6,000 result from venomous snakebites, and fewer than 1% are fatal.[5,6] The reduced morbidity and mortality following envenomations in the United States is attributed to better access to expert medical care, intensive care monitoring, and use of antivenom (AV) in the majority of cases (70%).[6,7]

Categories of venomous snakes in the United States

Venomous snakes have been reported throughout the United States with the exceptions of Maine, Hawaii, and Alaska.[8] The two families of venomous snakes that inhabit the United States are the Viperidae and Elapidae.[9] (See *Indigenous venomous snakes by region in the United States.*)

The Viperidae family, also referred to as crotalids or pit vipers, includes copperheads, rattlesnakes, and cottonmouths (water moccasins), which account for the majority of venomous snakebites.[10] Crotalids inject their venom through fangs that leave very painful, visible puncture wounds, causing significant swelling within 30 minutes.[8] Approximately 25% of crotalid bites are classified as "dry bites" that occur without envenomation (see *Two common crotalid varieties from the Southeastern United States*).[4]

There are three varieties of Elapidae native to the United States, but only two are venomous: the eastern and Texas coral snakes. The western or Sonoran coral snake is not

Two common crotalid varieties from the Southeastern United States

Copperhead

Rattlesnake

Photos courtesy of Mike Cardwell. Used with permission.

Venomous coral snake

Photo courtesy of Mike Cardwell. Used with permission.

Nonvenomous king snake

Photo courtesy of Mike Cardwell. Used with permission.

venomous.[11] Coral snakes are identified by a black snout with alternating black, yellow, and red banding (see *Venomous eastern coral snake*). There are also several nonvenomous snakes that mimic the coral snake with similar but slightly different red, yellow, and black banding (see *Nonvenomous king snake*). A simple mnemonic to help with differentiating a coral snake from a nonvenomous "look alike" is "red to yellow, kill a fellow" and "red to black, venom lack."

Coral snake envenomations account for less than 2% of all venomous snakebites in the United States. This is attributed to their reclusive nature and small, short fangs that require chewing rather than stabbing to inject venom.[8,11,12] Most coral snake envenomations occur in the southeastern states with the eastern coral snake responsible for the most serious envenomations.[8,11]

Coral snakes hold on to their victims, chewing to inject venom, and victims may report pulling or shaking the snake off after being bitten.[13] Coral snakebites may also not be visible or appear only as small abrasions compared to the distinctive fang marks of a crotalid bite. The relatively "insignificant" bite of a coral snake may cause victims to underestimate its seriousness and delay treatment.[11]

Nonindigenous exotic pet snakes are responsible for 1% to 2% of snakebites reported annually in the United States. Treatment for these bites must always be made in consultation with poison control centers and local zoos.[10]

Epidemiology and risk factors associated with snakebites

Snakebites occur annually throughout the United States but are most common in southern states (78%) and during the warmer months between April and November when snakes are more active and people are outdoors (see *U.S. snakebite epidemiology from 2000 to 2007.*)[10,14] Risk factors for envenomation include being intoxicated and snake handling, and men are more than twice as likely to become envenomated

than women.[5,7,15] Children younger than six years of age are more likely to have fatal bites.[5] Most snakebites occur on extremities, and most victims are bitten around their home.[1,16] Adults are more often bitten by venomous snakes and children by nonvenomous varieties.[17]

Pathophysiology of venom effects

Snake venoms are pharmacologically complex mixtures of proteins, peptides, carbohydrates, lipids, and amines, both toxic and nontoxic, evolutionarily targeted at specific animal prey and predators.[2] Venoms can cause local, hematologic, neurologic, and other systemic effects affecting multiple organ systems. Manifestations of envenomation vary by the amount of venom injected in addition to patient factors.[2]

Crotalid envenomation causes local and hematologic symptoms from proteins that damage capillary endothelium and cause plasma membrane destruction, allowing intracellular components to leak into extracellular spaces. This can lead to edema, erythema, bullae, vesicles, compartment syndrome, and ultimately, hypovolemic shock and circulatory collapse.[4,18]

U.S. snakebite epidemiology from 2000 to 2007[10,14]

Type of venomous snake	percent of total reported snake bites
Crotalids	53.5-63.4 (Average of 57.5)
Unknown snakes	33-42.4 (Average of 38.5)
Nonindigenous snakes	1.7-2.7 (Average of 2.3)
Coral snake	1.1-2 (Average of 1.7)

Summary of local and systemic venom effects[2,4,6,8,13,18]

Type of snake	Type of effect
	Local
Crotalid and Elapidae	Pain, redness, swelling, tenderness from either elapidae or crotalid Bullae, vesicles, lymphatic spread from crotalid
	Hematologic
Crotalid	Fibrin degradation, platelet destruction, coagulopathy, intense pain, rapid pulse, oozing blood from site, ecchymosis, hypovolemia, shock
	Neurologic
Elapidae and Crotalid (Mohave rattlesnake)	Ptosis, headache, confusion, weakness, paresthesia, hyporeflexia, cranial neuropathy, salivation, vomiting, fasciculations, respiratory depression or arrest, seizures, flaccid paralysis

Hematologic symptoms result from venom components that cause fibrin degradation and platelet destruction, leading to ecchymosis, coagulopathy, and oozing from the bite wound. The most common presenting symptoms following crotalid bites are intense pain (within 5 minutes) and edema (within 30 minutes), with erythema and bullae developing over several hours.[8]

Neurotoxic effects occur with Elapidae (coral snake) and Mojave rattlesnake bites. Neurotoxic symptoms typically start with ptosis and mydriasis followed by a descending paralysis of cranial and then spinal nerves, leading to respiratory paralysis.[2] Coral snakebites are dangerous because they are often painless, and neurotoxic effects can be delayed, resulting in death when victims fail to promptly seek medical attention.[6,13] Since being bitten by any snake can lead to intense fear and autonomic nervous system hyperarousal, it is important to accurately determine whether the victim's clinical presentation is a consequence of envenomation, anxiety, or both. (See *Summary of local and systemic venom effects*.)

Prehospital treatment for snakebites

Although there are a variety of wilderness folklore practices and commercial products on the market for treating snakebites for outdoor enthusiasts, a review of the evidence indicates that most cause more harm than good. For example, snakebite suction kits have not been found to effectively remove venom from bite wounds.[19] A retrospective study found that victims were three times more likely to require surgery (incision and debridement or fasciotomy) following self-treatment with tourniquets, incision and suction, or cryotherapy (application of ice).[15] Stun guns and high-voltage, low-amplitude, direct current is also ineffective in reducing venom effects.[20]

The only definitively proven approach to reducing snakebite morbidity and mortality is rapid transport to a medical facility. Basic prehospital treatment includes removing rings and constricting bracelets and immobilizing injured extremities in a neutral position.[18] Victims should avoid use of constricting tourniquets and compression bandages for crotalid bites, as this increases the risk of local tissue damage.[18] However, applying a compression bandage to a coral snakebite may slow the progression of the neurotoxin and is recommended.[11]

Victims should be advised not to pick up a dead snake or bring it to a medical facility for identification, since the bite reflex can remain intact after the snake is dead.[16] Instead, if it can be done safely, taking a picture of the snake with a cellphone can assist in identifying the snake to improve treatment decision making (see *Snakebite first aid procedures to avoid*).

Management of crotalid bites

In 2010, an expert panel on treatment of U.S. venomous snakebites met to establish clinical guidelines for

management of crotalid bites. Their recommendations were published as the Unified Treatment Algorithm for Crotalid Bites.[18] (See *Unified treatment algorithm for the management of pit viper snakebite in the United States).* This treatment algorithm provides the most current evidence-based guidelines for assessing and managing victims of crotalid bites.

Hospital care of crotalid bites

Patients presenting to the ED need immediate, aggressive, supportive care, and maintenance of airway, breathing, and circulation. Two large bore I.V. lines and a 0.9% sodium chloride fluid bolus should be initiated.[21] Obtaining vital signs and a detailed history, including the time and location of the bite, is important because signs of envenomation generally appear within 30 to 60 minutes following crotalid bites.[16,22] A history of previous bites or treatment with antivenom (AV) must be assessed, since prior exposure can increase the risk of anaphylaxis.[18] Jewelry and tight-fitting clothing must be removed, as edema can rapidly progress. A thorough physical exam should be performed looking for evidence of coagulopathy.[21]

Bite wounds should be examined for fang or small teeth marks and retained foreign bodies. Marking the leading edge of swelling and tenderness and writing the time on the skin with reassessments every 15 to 30 minutes is required to monitor for progression of envenomation.[8,21] Immobilization and elevation of the affected extremity, while maintaining major joints in extension, reduces lymphatic obstruction, swelling, and blister formation.[18]

Pain must be treated aggressively with opioid analgesics, but never nonsteroidal anti-inflammatory drugs (NSAIDs), as they can lead to bleeding and renal damage.[8,18] Tetanus immunization should be administered according to standard recommendations, as *Clostridium tetani* infection has been reported following crotalid envenomation.[8,18] Prophylaxis with antibiotics is not needed, since infection following envenomation is uncommon.[18] Corticosteroids are also unnecessary unless patients are exhibiting allergic symptoms.[18]

Baseline labs should include a complete blood count, protime, platelets, and fibrinogen. Repeating labs every 4 to 6 hours allows for monitoring progression of envenomation. Fibrinogen is a more sensitive measurement of coagulopathy than protime. Clotting dysfunction can occur with fibrinogen levels less than 0.5 g/L.[2] Chest X-ray, ECG, blood type and cross, urinalysis, electrolytes, and creatine kinase (for suspected rhabdomyolysis) may also be considered depending on the condition of the patient and underlying medical problems.[4,16]

Indications for antivenom for crotalid bites

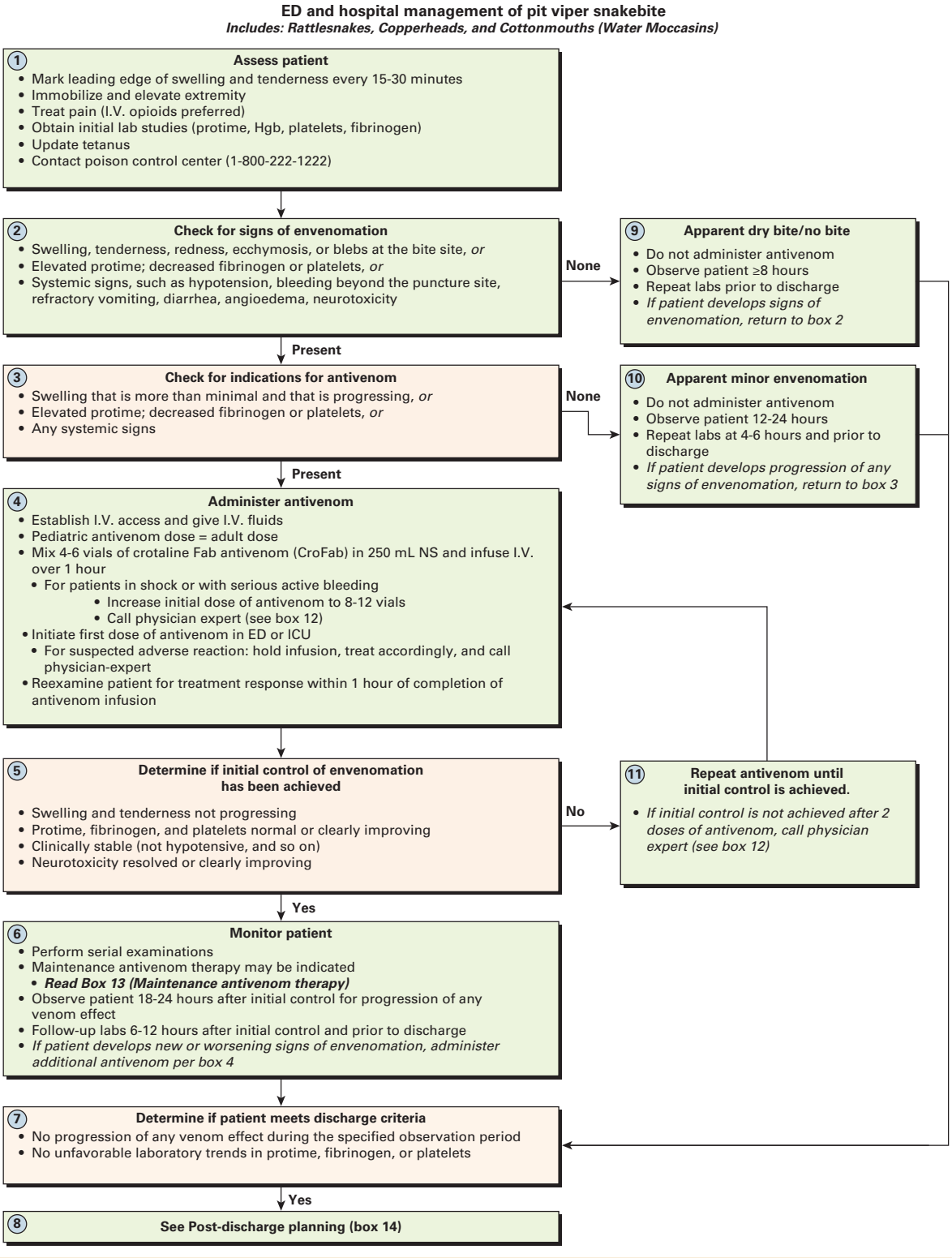
The mainstay of therapy for venomous snakebites is treatment with antivenom (AV) initiated within 4 to 6 hours. AV in adequate doses stops local effects and reduces systemic sequelae.[18] Since envenomation effects are progressive, serial examinations are necessary to determine whether to treat with AV. All patients presenting with a crotalid bite should be monitored for symptom progression for at least 8 hours prior to discharge.[16] AV can be safely withheld from patients with normal lab values or pain and swelling that does not progress after being monitored for 12 to 24 hours.[18,23] Consultation with poison control can aid in determining whether a patient is a candidate for AV therapy, since AV carries a risk for anaphylaxis and type 3 hypersensitivity reactions.[18] AV is also very costly. The U.S. wholesale cost of one vial of Crotalid AV crotalidae polyvalent immune fab (ovine), (CroFab) is $2,262.00, and one therapeutic dose consists of 4 to 6 vials.[24] Most patients require multiple doses to achieve initial control, defined as cessation of symptom spread and improvement in systemic signs and coagulation values, which must then be followed by three maintenance doses.[24]

Prior to the release of CroFab in 2000, an estimated 23% to 56% of patients experienced severe hypersensitivity reactions following antivenom treatment.[16] Unlike the earlier AV formulation, CroFab is manufactured from immunoglobulin fragments obtained from sheep serum following inoculation with one of four pit viper venoms, including either the eastern or western diamondback rattlesnake, Mojave rattlesnake, or cottonmouth (water moccasin).[25] The immunoglobulin fragments from all four venoms are then mixed to formulate the AV.[25] Fragments are an improvement over whole IgG and cause fewer hypersensitivity reactions (5% to 6%).[8] Because the risk of hypersensitivity and type 3 reactions remains possible, administration of AV is only indicated for clear evidence of envenomation.[18] The American Association of Poison Control Centers has a toll-free number that clinicians can call for immediate consultation (see *Indications for immediate consultation with Poison Control [1-800-222-1222]*).

Snakebite first aid procedures to avoid[6,15]

Procedure	Perceived goal	Adverse response
Arterial tourniquet	Contain venom locally	Tissue necrosis, gangrene
Incision and suction	Removal of venom from circulation	Increased infection
Electric shock guns	Neutralize snake venom/ stop pain	Ineffective at stopping envenomation
Cryotherapy or ice applied to site	Stop venom spread	Worsening of tissue damage

Unified treatment algorithm for the management of pit viper snakebite in the United States



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(12) When to call a physician-expert

Direct consultation with a physician-expert is recommended in certain high-risk clinical situations:

- **Life-threatening envenomation**
  - Shock
  - Serious active bleeding
  - Facial or airway swelling
- **Hard to control envenomation**
  - Envenomation that requires more than 2 doses of antivenom for initial control
- **Recurrence or delayed onset of venom effects**
  - Worsening swelling or abnormal labs (protime, fibrinogen, platelets, or Hgb) on follow-up visits
- **Allergic reactions to antivenom**
- **If transfusion is considered**
- **Uncommon clinical situations**
  - Bites to the head and neck
  - Rhabdomyolysis
  - Suspected compartment syndrome
  - Venom-induced hives and angioedema
- **Complicated wound issues**

If no local expert is available, a physician-expert can be reached through a certified poison center (1-800-222-1222) or the antivenom manufacturer's line (1-877-377-3784).

(13) Maintenance antivenom therapy

- Maintenance therapy is additional antivenom given after initial control to prevent recurrence of limb swelling
  - Maintenance therapy is 2 vials of antivenom every 6 hours x 3 (given 6, 12, and 18 hours after initial control)
- Maintenance therapy may not be indicated in certain situations, such as
  - Minor envenomations
  - Facilities where close observation by a physician-expert is available.
- Follow local protocol or contact a poison center or physician-expert for advice.

(14) Post-discharge planning

- Instruct patient to return for
  - Worsening swelling that is not relieved by elevation
  - Abnormal bleeding (gums, easy bruising, melena, and so on)
- Instruct patient where to seek care if symptoms of serum sickness (fever, rash, muscle/joint pains) develop
- Bleeding precautions (no contact sports, elective surgery or dental work, and so on) for 2 weeks in patients with
  - Rattlesnake envenomation
  - Abnormal protime, fibrinogen, or platelet count at any time
- Follow-up visits:
  - Antivenom not given:
    - P.R.N. only
  - Antivenom given:
    - Copperhead victims: P.R.N. only
    - Other snakes: Follow-up with labs (protime, fibrinogen, platelets, Hgb) twice (2-3 days and 5-7 days), then P.R.N.

(15) Treatments to avoid in pit viper snakebite

- Cutting and/or suctioning of the wound
- Ice
- NSAIDs
- Prophylactic antibiotics
- Prophylactic fasciotomy
- Routine use of blood products
- Shock therapy (electricity)
- Corticosteroids (except for allergic phenomena)
- Tourniquets

Notes:

- **All treatment recommendations in this algorithm refer to crotalidae polyvalent immune Fab (ovine) (CroFab).**
- This worksheet represents general advice from a panel of U.S. snakebite experts convened in May, 2010. No algorithm can anticipate all clinical situations. Other valid approaches exist, and deviations from this worksheet based on individual patient needs, local resources, local treatment guidelines, and patient preferences are expected. **This document is not intended to represent a standard of care.** For more information, please see the accompanying article, available at www.biomedcentral.com.

an evidence-informed consensus workshop. *BMC Emergency Medicine.* 2011. http://www.biomedcentral.com/1471-227X/11/2.

Because AV works by neutralizing venom toxins, children require the same AV dosing as adults.[4,25] Pregnant women should also be treated with AV with the additional consideration of fetal monitoring during observation periods.[26] CroFab is classified as pregnancy Category C.[25]

CroFab administration guidelines

According to the manufacturer,[25] CroFab should be stored at 2° C to 8° C, and each vial should be reconstituted in 18 mL of 0.9% sodium chloride. Vials should be inverted to mix between the hands rather than shaken to reduce foaming and increased time to administration. The initial loading dose of 4 to 6 vials, mixed in 250 mL of 0.9% sodium chloride, should be infused at 50 mL/hour for the first 10 minutes while a provider and nurse remain at the bedside to monitor for anaphylaxis. Airway equipment and an anaphylaxis kit must be available at the bedside during treatment.[8] If there is no sign of anaphylaxis after the first 10 minutes, the remaining dose should be infused over an hour followed by a one-hour observation period to determine if initial control has been achieved.[18] If initial control has not been achieved, a second loading dose (4 to 6 vials) should be administered. Fibrinogen, platelets, hemoglobin, and protime assessments should be repeated between each loading dose.[25] Once control is achieved, maintenance therapy consisting of an infusion of 2 vials of antivenom given every 6 hours for three doses is recommended.[25]

After initial control, patients should be observed for 18 to 24 hours with follow-up labs drawn at 6 and 12 hours prior to discharge. If there have been no further signs of envenomation and lab values have improved after 24 hours, patients can be discharged.

Antivenom reactions

Most reactions to AV are minor, such as fever, chills, pruritus, and urticaria.[25] AV should not be stopped for minor reactions. Only 5% to 10% of AV reactions are major, including hypersensitivity reactions, bronchospasm, angioedema, and hypotension.[2] Initial management of hypersensitivity reactions includes stopping the infusion and giving subcutaneous epinephrine, I.V. fluids, corticosteroids, and antihistamines.[18] Pretreatment skin testing wastes time and is not predictive, and prophylaxis with antihistamines or epinephrine is not beneficial.[2] To report adverse events and for 24-hour assistance with administration guidelines, contact 1-877-377-3784.

Indications for immediate consultation with Poison Control (1-800-222-1222)

- Bites to the head and neck
- Allergic reactions
- Facial or airway swelling
- Progressive limb swelling
- Compartment syndrome
- Rhabdomyolysis
- Shock or serious bleeding
- Abnormal lab values
- If 2 or more doses of AV are needed to achieve initial control of symptoms

Patient education and follow-up

Patients who receive AV require close follow-up for 3 weeks after discharge, as they can develop serum sickness any time between 7 and 21 days.[21] Patients should be instructed to return immediately if fever, rash, joint pain, malaise, or typical signs of serum sickness develop.[21] In addition, they should also return for follow-up labs, including protime, fibrinogen, platelets, and hemoglobin, between 2 and 3 days after discharge and again between 5 and 7 days.[18] Serum sickness can be managed with a tapered dose of prednisone starting at 60 mg/day.[16] Patients should also return for signs of bleeding or wound infection. NSAIDs, aspirin, contact sports, elective surgery, and dental work should be avoided for 2 weeks to prevent a risk of bleeding.[21]

Management of elapidae bites

All coral snake victims should be immediately transported to a hospital for evaluation and treatment. Recommended first aid treatment differs from crotalid bites because of the different effects of coral snake venom. Coral snake envenomation predominantly affects the nervous system by blocking postsynaptic nicotinic acetylcholine receptors at neuromuscular junctions. This produces a curare-like syndrome and places victims at risk for respiratory arrest.[13] Coral snake venom also differs in that it does not cause the same degree of local tissue destruction or coagulopathy.[13] Consequently, a circumferential pressure dressing with an ace bandage to immobilize the extremity and reduce the systemic spread of venom should be applied and not removed until antivenom therapy is initiated.[11] Apply the wrap starting distal to the site of the bite moving proximally up the extremity with enough tension to compress the wound, yet loose enough to permit a finger to be easily placed underneath the wrap.[27]

Hospital care of elapidae bites

Initial assessment and management is similar to that for crotalid bites, including tetanus vaccination, I.V. access, and narcotic analgesia.[11] Coral snake envenomation effects can be delayed for 10 to 18 hours; therefore, patients must be carefully monitored for signs of neurotoxicity in an ICU where endotracheal intubation and assisted ventilation can

be initiated for any respiratory compromise for at least 24 to 48 hours.[13] Baseline diagnostic studies are of less benefit for coral snake envenomation but may include an arterial blood gas if respiratory status is compromised.[28]

Coral snake antivenom considerations

The only FDA-approved coral snake AV, Wyeth micrurus fulvius AV, was manufactured until 2003.[12] In 2003, Wyeth, a subsidiary of Pfizer since 2009, stopped producing AV due to the rarity of coral snakebites in the United States. Since discontinuing production, the FDA has extended the shelf life/expiration date of the remaining Wyeth AV vials several times, with the existing stock now set to expire October 31, 2013.[29]

The typical dose for coral snake envenomation is 3 to 5 vials of AV diluted in 250 mL of crystalloid fluids.[11] AV is dosed relative to the amount of venom injected and the body mass of the patient; therefore, consulting with poison control is essential to managing these patients.[11]

According to S. Hon, PharmD (personal communication, October 1, 2011), the present policy for use of coral snake AV is that if the vial is expired, the patient should still be treated with AV after first administering steroids and H-1 antagonists to reduce the likelihood of anaphylaxis and type three hypersensitivity reactions. Because coral snake AV is manufactured from horse serum, the manufacturer suggests skin testing prior to administration and having resuscitation equipment, including epinephrine and an injectable pressor amine available if needed.[29]

Hospitals are urged to never throw away expired, unused coral snake AV product pending annual review by the FDA until production and release of a new micrurus fulvius AV product becomes available. Local poison control centers maintain lists of hospitals that still have the rare AV in stock and can also assist in contacting pharmacies that may have AV in stock in the area. The Southeastern Hot Herp Society and the Miami-Dade Fire Rescue Venom Response Unit (http://www.venomousreptiles.org/pages/antbnk) can also help in locating AV supplies. Another option is to consult with local zoos. Any zoo that houses a coral snake is mandated to carry the antivenom of that species. This is true for all venomous species housed within zoos and may be the best source of AV for victims bitten by exotic pets.[8]

Patient education and follow-up

Like crotalid victims, victims of coral snakebites who receive AV should be educated about the signs of serum sickness and managed as previously described.[16] Since coral snake venom does not cause coagulopathy activity, restrictions from medications that increase risk of bleeding do not apply.

Case study revisited

Since the patient in the case study is exhibiting spread of redness and edema from his hand to his elbow, it is likely that he has been envenomated by the copperhead and needs AV as soon as possible. Appropriate action for the outpatient NP includes calling emergency medical services (EMS) for transport and notifying the nearest ED and poison control center so that they can begin locating and preparing AV. If resources allow, start two large bore I.V.s while waiting for EMS, and begin a 0.9% sodium chloride bolus. While waiting for EMS, closely monitor the patient, advise them on prevention of future bites, and instruct them to leave the dead snake in the truck until it can be moved by animal control.

Moving forward

Improving snakebite outcomes requires rapid assessment, close monitoring, and use of AV when indicated. NPs should become familiar with the varieties of venomous snakes indigenous to their area to improve treatment decision making. Knowing where and how to locate AV can save precious time in caring for victims. Finally, educating patients not to handle snakes and recommending that they call animal control if snakes are found near homes may reduce this preventable health risk. NP

AVAILABLE RESOURCES

Call the Poison Center to report all snakebites and be assisted by an expert: 800-222-1222

Protherics, the manufacturer of Crofab, 24 hour hotline: 877-377-3784

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