

Summary of WMS Practice Guidelines for the Treatment of Pit Viper Envenomations in the United States and Canada

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The Wilderness Medical Society convened an expert panel to develop a set of evidence-based guidelines for the prevention and treatment of North American pit viper envenomations. The guidelines should assist in clinical decision-making, but a “cookbook” approach is often insufficient as each patient is unique and may respond differently to therapeutics. Consultation with a poison control center is recommended to assist in patient management. These guidelines are for crotaline snakes in the United States and Canada, and should not be applied to other snake species or geographic regions.



Figure 1. Geographic range of some common pit viper snakes in the United States and Canada.
From top to bottom: Western rattlesnake - *Crotalus oreganus* & geographic range of *Crotalus* & *Sistrurus*;

Cottonmouth - *Agkistrodon piscivorus* & geographic range of *Agkistrodon piscivorus*; Copperhead - *Agkistrodon contortrix* & geographic range of *Agkistrodon contortrix*.

SECTION 1: CHARACTERISTICS

The most medically important venomous snakes in the U.S. and Canada belong to the taxonomic family Viperidae. Pit vipers have fangs that are associated with high-pressure venom glands. They also possess heat-sensing facial (loreal) pits. North American (north of Mexico) pit vipers include the rattlesnakes, cottonmouths, and copperheads. All of these pit vipers are generally heavy-bodied snakes with triangular heads, vertically elliptical pupils, keeled dorsal scales, and a single row of subcaudal scales. The rattle is unique to rattlesnakes. Some pit viper venoms are known to contain more than 100 different proteins that produce toxic effects. The toxic components of snake venom vary greatly and are known to vary considerably between species.

SECTION 2: EPIDEMIOLOGY AND PREVENTION

Snakebites are estimated to result in as many as 9,000 emergency department visits annually in the United States. Venomous species account for approximately one third of these visits, almost all of which are pit viper bites. Snakebite fatalities average from 5 to 7 annually. Nonfatal bites by venomous species are underreported by epidemiological databases, poison centers are not consulted on all bites, and many bites are never reported beyond a primary treating facility.

The majority of crotaline envenomations occur during intentional interaction with a snake. Most snakebite patients are male, with white men 25-34 years old being at greatest risk of life-threatening envenomations. Intentional interactions may be associated with alcohol or drug intoxication, and typically occur when people try to catch, kill, or interfere with a wild snake, as well as when handling or caring for captive snakes. Caution must be exhibited when handling a dead snake or detached head as they may have intact bite reflexes and result in envenomation. Studies indicate that the majority of bites occur on the upper extremities, fewer on the lower extremities, and rarely on the face, neck, or trunk. Bites from unintentional encounters are predominantly on the lower extremities, whereas those resulting from intentional interaction are mainly on the hands and arms.

SECTION 3: FIELD MANAGEMENT

A priority following snakebite is to avoid another bite, thus the patient should be moved away from the snake. Calm the patient, as fatalities are rare and serious sequelae are usually preventable. A good photograph, taken from a safe distance (more than the length of the snake), can sometimes be transmitted via cell phone to an expert and may be valuable for identification. Determining the kind of snake involved can make the difference between simple superficial wound care and a potentially hazardous and expensive evacuation. Patients should

be rapidly assessed, including airway, breathing, and circulation. After initial assessment and vital signs, a thorough history should be taken from the patient or bystanders including the time of the bite and signs or symptoms of envenomation.

Local	Systemic	Hematologic	Neurologic
Pain	Tachycardia*	Anemia	Diplopia
Localized bleeding	Dyspnea*	Thrombocytopenia	Perioral paresthesias or metallic taste
Erythema	Chest pain	Petechiae	Numbness / tingling (widespread)
Edema	Nausea or vomiting*	Gingival bleeding	Fasciculations (widespread)
Ecchymosis	Hypotension	Epistaxis	Altered mental status
Blistering	Angioedema	Retinal hemorrhage	Cranial nerve dysfunction, especially ptosis (Mohave toxin)
Joint stiffness	Myalgia / cramps	Internal bleeding	
Numbness / tingling (localized)	Rhabdomyolysis	Coagulopathies	
Cramps / fasciculations (localized)		Disseminated intravascular coagulation	

Table 1. Local, hematologic, and systemic signs and symptoms of snakebite envenomation

* Can be from envenomation or autonomic responses to pain and anxiety, thus not used as a sole indicator of systemic signs of envenomation.

Jewelry or constrictive clothing near the bite should be removed quickly before swelling begins. While en-route or waiting for evacuation, first aid and wound care can be administered, so long as it does not delay transportation. Time and date of the snakebite should be noted, either on the patient or in an incident report. The leading edge of erythema and/or swelling should be marked, and the circumference of the bitten appendage measured above and below the snakebite for later comparison. The wound can be cleaned in standard fashion (soap and running water, high-pressure irrigation, and/or an antiseptic solution) and a sterile dressing applied.

Immobilization of the affected area by splinting (without compression) may benefit the patient. Depending on evacuation needs, the affected area should be maintained at the level of the heart. Furthermore, the limb and joints should be kept in a functional position in case they swell and become immobile.

Non-sedating analgesia is preferred for pain control; however, opioids are appropriate as long

as the patient remains alert with a patent airway. Severe intractable pain in an affected extremity can sometimes be temporarily relieved by regional nerve block. Aspirin and non-steroidal anti-inflammatory drugs are relatively contraindicated due to risks of increased bleeding, platelet dysfunction, and in patients with rhabdomyolysis.

Many myths associated with snakebite first aid have permeated popular culture, despite lack of supporting evidence, some of which can be harmful to the patient. The following techniques are of no benefit and are potentially harmful to the patient: oral suction, mechanical suction, laceration or bleeding of the bite, electricity or electrotherapy, cryotherapy or cooling, tourniquets, and pressure bandaging.

SECTION 4: HOSPITAL MANAGEMENT

Envenomation	Observation	Laboratory Studies	Treatment
Dry / No Bite	≥ 8 hours	Initial labs*	No antivenom
Minor: <i>non-progressive symptoms without systemic signs</i>	12-24 hours	Initial labs. Repeat labs** every 4-6 hours and prior to discharge	Consider antivenom only if high risk areas affected (eg. hand or face)
Moderate: <i>progressive symptoms, and/or systemic signs</i>	Admit	Initial labs. Repeat every 1 hour after antivenom until initial control	Antivenom administration, supportive care
Severe: <i>progressive symptoms with systemic signs, and/or end-organ damage</i>	Admit	Initial labs. Repeat every 1 hour after antivenom until initial control	Antivenom administration, supportive care

Table 2: Emergency Medicine Care of Crotaline Envenomations

*Initial labs include CBC, BMP, LFT, PT/INR, PTT, TCK, fibrinogen, urinalysis.

**Repeat labs include CBC, PT/INR, and fibrinogen.

Hospital management of pit viper envenomations includes observation and monitoring, antivenom and supportive care, and debridement if necessary. The ovine-derived Crotalidae Polyvalent Immune Fab antivenom (FabAV) works by binding to and neutralizing crotaline venom. It is recommended to administer antivenom in any patient with progressive signs or symptoms following a crotaline snakebite.

Pregnant women

Pregnant women with crotaline envenomations should be managed in close collaboration with an obstetrician. Snakebite envenomations may lead to increased morbidity to the fetus, and up to 20 percent of documented envenomations in pregnancy have associated fetal death (with or without antivenom treatment). Snakebite patients who are pregnant should receive antivenom as indicated, and fetal assessment or monitoring.

Pediatric patients

Pediatric snakebite patients should receive the same dose of antivenom as an adult. Antivenom

has been shown to be safe in pediatric and infant populations.

Reference: [Kanaan NC, Ray J, Stewart M, Russell KW, Fuller M, Bush SP, Caravati EM, Cardwell MD, Norris RL6, Weinstein SA](#). Wilderness Medical Society Practice Guidelines for the Treatment of Pitviper Envenomations in the United States and Canada. Wilderness Environ Med. 2015 Dec;26(4):472-87.