

Snakebites

Guideline developed by Branson Bolden, MD, in collaboration with the ANGELS team, August 16, 2013. Last revised by Branson Bolden, MD, August 30, 2016.

Key Points

- Pit viper (rattlesnake, cottonmouth, and copperhead) snakebites among children and adolescents in the United States are relatively common with a substantial portion of these resulting in envenomation.
- Immediate medical evaluation is recommended for all children following a venomous or potentially venomous snakebite.
- Pit viper envenomations have variable clinical manifestations and can potentially affect almost any organ system.
- Aggressive supportive care is indicated for all pit viper envenomations.
- Crotaline Polyvalent Immune Fab (Ovine) antivenom (CroFab[®]) antivenom is available for treatment of moderate to severe pit viper envenomations.

Background

North American pit viper (family *Viperidae*, subfamily *Crotalinae*) snakes, including rattlesnake (genera *Crotalus*, *Sistrurus*), cottonmouth (genera *Agkistrodon*) and copperhead (genera *Agkistrodon*) account for the vast majority of envenomations in the United States. Approximately 4 out of 5 pit viper bites result in injection of venom. The clinical manifestations of these envenomations can be variable due to complex interactions between the victim and venom exposure. Aggressive supportive care is indicated for all snakebites. Crotaline Polyvalent Immune Fab (Ovine) antivenom (CroFab[®]) antivenom is effective and generally considered safe for the treatment of moderate-to-severe pit viper envenomations in pediatrics.

Definition, Assessment, and Diagnosis

Definition/Scope of Guideline

This snakebite guideline focuses primarily on ED/hospital evaluation and management of pit viper envenomation including rattlesnake, cottonmouth, and copperhead snakes. First aid and field treatment are discussed briefly.

Assessment and Diagnosis

History

- Presenting illness
 - Determine circumstances of the injury, snake description, time of bite, setting, provocation, first aid measures, snake's current location (if known), etc.
 - If a snake was not seen, objective signs and symptoms of envenomation become the primary focus for diagnosis.
- Past medical history
 - Coexisting medical conditions
 - Drug and food allergies (antivenom is sheep-derived)
 - Previous history of snakebite and consequent therapy

Physical Exam

- Initial assessment
 - Airway, breathing, circulation
 - Vital signs
- Full examination
 - Special attention given to the cardiovascular, pulmonary, and neurologic systems, although almost any organ system can potentially be affected
 - Determine wound type and characteristics
 - Signs/symptoms of envenomation
 - Local signs include swelling, tenderness, erythema, ecchymosis, bulla/blebs at site of snakebite.
 - Systemic signs include hypotension, bleeding beyond the puncture site, refractory vomiting, diarrhea, angioedema, neurotoxicity.
- Document several baseline circumferential measurements at, above and below the bite and re-measure same sites every 15-30 minutes until progression subsides.
- Date and time the leading edge of swelling with an indelible marker to serve as an index of progression.
- Assess perfusion distal to the bite and monitor closely for complications such as compartment syndrome. Fasciotomy should be considered cautiously as it has not consistently been shown to improve clinical outcome and may significantly worsen the amount of myonecrosis.

Laboratory Evaluation

- Initial labs
 - Hemoglobin
 - Platelet count
 - Prothrombin time
 - Fibrinogen

Lab Findings Suggestive of Envenomation

- Decreased hemoglobin (hemolysis), decreased platelet count (aggregation and destruction), elevated prothrombin time (consumptive coagulopathy), decreased fibrinogen (degradation)
- Subsequent labs: Repeat testing for hemolysis and coagulopathy may be indicated based on severity of envenomation.
- **Note:** There is not an available test to measure presence or quantity of venom within the bloodstream.

Classification of Severity

The clinical decision of primary concern involves appropriate use of antivenom therapy. [see Table, General Severity Classification of North American Pit Viper Envenomations.](#)

Management

Field Treatment

- Transport to a medical facility capable of providing monitoring and treatment of snakebites is of primary importance.
- Very few of the traditional field treatment strategies are effective.
- Recommended first aid care
 - Remove patient from the snake's striking range.
 - *First aid should focus on airway, breathing, and circulation while transport occurs.*
 - *Keep patient and affected extremity immobilized to the extent possible.*
 - If it can be done safely, take a picture of the snake to aid in identification. Do not attempt to capture the snake, even if presumed dead for concern of reflex biting.
- Venous tourniquets and pressure immobilization (PI) are generally not recommended. Venous tourniquets (goal pressure 20-30mmHg) and PI with splint application (goal pressure 55 mmHg) can possibly decrease the systemic spread of venom but with potential for increased local tissue damage. Physicians should be aware of the possibility of a venom bolus effect with release of tourniquet or PI.
 - Discouraged field treatment
 - Incision and suction or suction alone
 - Cryotherapy or ice packing
 - Electrotherapy
 - Arterial tourniquet application (unless progressive, life-threatening neurotoxic effects are observed)
 - Pretreatment with medications such as H1- and H2-histamine receptor blockers, epinephrine or corticosteroids is not recommended.

Antivenom

- **Crotaline Polyvalent Immune Fab (Ovine) antivenom (CroFab®)**
 - Derived from sheep blood immunized with venom from species of the *Viperidae* family
 - Indicated for treatment of pit viper envenomations with substantial or progressive

swelling, systemic signs/symptoms, or laboratory abnormalities consistent with moderate to severe envenomations ([see Table](#), General Severity Classification of North American Pit Viper Envenomations).

- Wholesale cost exceeds \$1000 U.S. dollars per vial

• Administration

- Pediatric and adult dosing is the same (determined by the molar dose of venom protein rather than mg/kg dosing)
- Reconstitute each vial with 10 mL sterile water and mix by continuous gentle swirling. Further dilute the contents of ALL reconstituted vials for administration in 250 mL 0.9% sodium chloride.

Note: For patients less than 10 kg in weight, consider administering CroFab[®] with approximately half of the fluid recommended for each dose⁵ and reduce infusion rate accordingly.

- Infuse at 25-50 mL/hour rate for 10 minutes and observe for any allergic reaction.
- If no allergic reaction, complete infusion at full rate of 250 mL/hr and further monitor for tolerance.
- Recommended administration within 6 hours of envenomation
- Utility of initial administration greatly diminished at greater than 24 hours following envenomation, but can be considered for prolonged/progressive symptoms or late coagulopathy
- It is important to note that initial dosing of CroFab[®] is given to arrest progression of local tissue, hematologic and systemic venom effects. Repeating initial dosing may be necessary in some cases. Re-examine patient for treatment response within 1 hour of completion of antivenom infusion.

• CroFab[®] Adverse Reactions

- Eight percent immediate hypersensitivity reaction; 7.3% reported in pediatric patients
- Reactions are typically mild and may not preclude further administration of CroFab[®].
- If an immediate hypersensitivity reaction occurs
 - Stop antivenom infusion.
 - Administer antihistamines, corticosteroids, and fluids as needed until signs of hypersensitivity are resolved; severe reactions may require epinephrine administration.
 - Consult with a physician expert in snakebite management ([See: When to call a physician-expert](#)).
- Serum sickness 13% incidence following CroFab administration.

ED/Hospital Care

- Identification of the specific snake species is not required prior to treatment.
- Regional variation in snake species may influence treatment decisions.
 - Rattlesnakes: Local edema, muscle injury, hematologic abnormality, and secondary systemic injury is common
 - Cottonmouth and copperhead
 - Local edema and soft-tissue injury is common.
 - Systemic and hematologic symptoms are typically less severe than rattlesnake envenomations.
- Notification of a certified poison control center (PCC) is recommended.
 - PCC can provide treatment recommendations based on local snake species and medical

resources available.

- PCCs provide de-identified data on snakebites for use by public health professionals and policy-makers.

Table. Assessment of Severity and Treatment

To view a larger image on your device, please click or touch the image.

General Severity Classification of North American Pit Viper Envenomations			
	Minimal/Minor	Moderate	Severe
Local symptoms	Local swelling, erythema or ecchymosis at site of snakebite	Progressive swelling, erythema or ecchymosis beyond site of snakebite	Rapid and extensive swelling, erythema or ecchymosis
Systemic symptoms	No systemic signs or symptoms	≥1 non-life threatening systemic sign or symptom (e.g. nausea, vomiting, paresthesias, muscle fasciculations)	Severe systemic signs or symptoms(e.g. hypotension for age, tachycardia, tachypnea, respiratory distress, altered mental status)
Hematologic/coagulation	No significant laboratory abnormality	Mild anemia or thrombocytopenia; mildly prolonged prothrombin time or decreased fibrinogen; no clinically significant bleeding	Severe anemia or thrombocytopenia; markedly elevated prothrombin time and decreased fibrinogen with or without clinically significant bleeding. Results of other lab tests may be markedly abnormal

([See: Physical Exam](#)).

• **Apparent Dry Bite/No Bite**

- Provide supportive care; administer fluids as needed, immobilize and elevate the affected extremity, pain control, etc. Do NOT pack affected area with ice.
- Obtain initial labs (hemoglobin, platelet count, prothrombin time, fibrinogen).
- DO NOT administer antivenom.
- Observe patient at least 8 hours; document circumferential measurements and mark edge of swelling as noted above
- Repeat labs prior to discharge.
- If signs/symptoms of envenomation or laboratory abnormality develop, reassess severity and possible need for antivenom.

• **Minimal/Minor Envenomation**

- Provide supportive care; administer fluids as needed, immobilize and elevate the affected extremity, pain control, etc. Do NOT pack affected area with ice.
- Obtain initial labs (hemoglobin, platelet count, prothrombin time, fibrinogen).
- DO NOT administer antivenom.
- Observe patient for 12-24 hours; document circumferential measurements and mark edge of swelling as noted above ([See: Physical Exam](#)).
- Repeat labs at 4-6 hours and prior to discharge (hemoglobin, platelet count, prothrombin time, fibrinogen).
- If signs/symptoms of envenomation or laboratory abnormality develop, reassess severity

and possible need for antivenom.

- **Moderate/Severe Envenomation**

- Provide supportive care; administer fluids as needed, immobilize and elevate the affected extremity, pain control, etc. Do NOT pack affected area with ice.
- Establish intravenous (IV) access.
- Obtain initial labs (hemoglobin, platelet count, prothrombin time, fibrinogen)
- Give first dose of antivenom in the Emergency Department or Intensive Care Unit
 - Pediatric antivenom dose = Adult dose
 - Mix 4-6 vials of CroFab® in 250ml Normal Saline (NS) and infuse per instructions above ([See Antivenom](#)).
 - Patients in **shock or with serious, active bleeding**:
 - Increase initial dose of antivenom to 8-12 vials.
 - Contact physician expert in snakebite management (see page 6).
 - For suspected **adverse reaction to antivenom**
 - Hold infusion.
 - Treat symptoms according to reaction.
 - Contact physician expert in snakebite management ([See: When to call a physician-expert](#)).
- **Re-examine patient for treatment response within 1 hour of completion of antivenom infusion**
 - Assess for initial control
 - Clinically stable (not hypotensive, etc.)
 - Swelling and tenderness not worsening
 - Neurotoxicity resolved or obvious improvement
 - Laboratory findings normalized or improved
 - Initial control NOT achieved
 - Repeat antivenom dosing until control achieved
 - If multiple doses of antivenom are given without effect, reconsider diagnosis
 - Initial control achieved
 - Perform serial examinations
 - Consider administering maintenance antivenom therapy ([See: Maintenance antivenom therapy](#)).
 - Observe patient for 18-24 hours following initial control and monitor for progression of any adverse venom effect
 - Repeat labs 6-12 hours after initial control and prior to discharge (hemoglobin, platelet count, prothrombin time, fibrinogen)
 - If patient develops new or worsening signs of envenomation, administer additional antivenom as instructed above

- **Maintenance Antivenom Therapy**

- Additional antivenom given after initial control of symptoms to prevent recurrence
- Give 2 vials every 6 hours for 3 doses (6, 12, 18 hours following initial control).
- Maintenance therapy may not be indicated in certain situations, such as
 - Minor envenomations
 - Facilities where observation by a physician expert is available

- **When to call a physician-expert**

- Life threatening envenomation

- Shock
- Serious, active bleeding
- Facial or airway swelling
- Difficulty in controlling symptoms: More than 2 doses of antivenom needed for initial control
- Recurrence or delayed-onset of venom effects, that is, worsening swelling or abnormal labs on follow-up visits
- Allergic reaction to antivenom
- Blood product transfusion required
- Uncommon clinical situations
 - Bites to the head and neck
 - Rhabdomyolysis
 - Suspected compartment syndrome (early fasciotomy may worsen myonecrosis)
 - Venom-induced hives and angioedema
- Complicated wound issues

Note: If a local expert is not available, a physician expert can be reached through the American Association of Poison Control Centers at 1-800-222-1222 or the antivenom manufacturer at 1-877-377-3784.

Additional Considerations

- Pain control
- Snakebites can be very painful to victims due to tissue injury, cytokine response and associated edema/swelling.
- Pain severity should be assessed in each patient and treated appropriately
 - Mild pain can typically be controlled with acetaminophen. Ibuprofen and NSAID analgesics should be avoided due to potentiation of bleeding risk associated with envenomations.
 - Moderate to severe pain often requires opioid analgesics in standard dosing. Opioid analgesics should be avoided when treating a snakebite patient with the potential for significant neurotoxin venom effects, e.g. Mojave rattlesnake
- Tetanus prophylaxis
 - Tetanus immunization should be administered for prophylaxis if
 - Patient had <3 prior tetanus immunizations received or unknown history. Also, consider giving tetanus immunoglobulin.
 - Greater than 5 years from completion of complete Tetanus primary series. Tetanus immunoglobulin not required in this situation.
 - Tetanus immunization by age
 - DTaP (Diphtheria, Tetanus, acellular Pertussis) if <7 years old
 - Td 7-10 years old (for the under-immunized child who has not previously received Tdap, then give Tdap)
 - Tdap >10 years old
- Antibiotics
 - Wound infections following pit viper bites are uncommon, occurring in 3% of snakebite patients.
 - Prophylactic antibiotic therapy is not indicated.
 - If there is clinical or microbiological evidence of a wound infection, appropriate antibiotic therapy should be instituted. Cottonmouth snakebites have the potential for both aerobic and anaerobic bacterial infection due to their aquatic habitat.
- Post-discharge planning
 - Patients should seek medical care for

- Worsening swelling not relieved by elevation
- Abnormal bleeding (easy bruising, gingival bleeding, melena, etc.)
 - Late hematologic venom effects most often occur 2-7 days following antivenom therapy.
 - Higher risk with rattlesnake envenomations and following any abnormal hematologic effect during acute phase of treatment
- Symptoms of serum sickness (fever, rash, myalgia/arthritis)
 - Thirteen percent (13%) incidence following treatment with CroFab[®]
 - Generally mild and responds well to oral antihistamines and corticosteroids
- Bleeding precautions include no contact sports, elective surgeries or dental work, etc. for 2 weeks in patients with
 - Rattlesnake envenomations
 - Elevated prothrombin time, decreased fibrinogen or decreased platelet count at any time following envenomation
- Follow-up visits
 - If antivenom not given, follow-up only as needed
 - If antivenom given
 - Copperhead victims: follow-up only as needed
 - Other pit viper envenomations (Rattlesnake, Cottonmouth): follow-up with labs (hemoglobin, platelet count, prothrombin time, fibrinogen) at 2-3 days and again at 5-7 days following antivenom administration, then as needed.

This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.

References

References

1. American Academy of Pediatrics. Redbook Online. Section 3-Summary of Infectious Diseases. Tetanus. Available at: <http://aapredbook.aappublications.org/content/1/SEC131/SEC271/T115.expansion.html>. Published 2013. Accessed Jul 19, 2013.
2. Anz AW, Schweppe M, Halvorson J, Bushnell B, et al. Management of venomous snakebite injury to the extremities. *J Am Acad Orthop Surg* 2010;18(12):749-59.
3. Behm MO, Kearns GL. Crotaline Fab antivenom for treatment of children with rattlesnake envenomation. *Pediatrics* 2003;112(6 Pt 1):1458-9.
4. Bronstein AC, Spyker DA, Cantilena LR, Jr., Rumack BH, et al. 2011 Annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 29th Annual Report. *Clin Toxicol (Phila)* 2012;50(10):911-1164.
5. Cumpston KL. Is there a role for fasciotomy in Crotalinae envenomations in North America? *Clin Toxicol (Phila)* 2011;49(5):351-5.
6. Farrar HC, Grayham T, Bolden B, Vyas D, et al. The use and tolerability of Crotalidae Polyvalent Immune FAB (Ovine) in pediatric envenomations. *Clin Pediatr (Phil)* 2012;51(10):945-9.
7. Gold BS, Dart RC, Barish RA. Bites of venomous snakes. *N Engl J Med* 2002;347(5):347-56.

8. Johnson PN, McGoodwin L, Banner W, Jr. Utilisation of Crotalidae polyvalent immune fab (ovine) for Viperidae envenomations in children. *Emerg Med* 2008;25(12):793-98.
9. Lavonas EJ, Ruha AM, Banner W, Bebarta V, et al. Unified treatment algorithm for the management of crotaline snakebite in the United States: results of an evidence-informed consensus workshop. *BMC Emerg Med* 2011;11:2.
10. O'Connor AD, Ruha AM, Levine M. Pressure immobilization bandages not indicated in the pre-hospital management of North American snakebites. *J Med Toxicol* 2011;7(3):251.
11. Schaeffer TH, Khatri V, Reifler LM, Lavonas EJ. Incidence of immediate hypersensitivity reaction and serum sickness following administration of crotalidae polyvalent immune Fab antivenom: a meta-analysis. *Acad Emerg Med* 2012;19(2):121-31.
12. Tanen DA, Danish DC, Grice GA, Riffenburgh RH, et al. Fasciotomy worsens the amount of myonecrosis in a porcine model of crotaline envenomation. *Ann Emerg Med* 2004;44(2):99-104.
13. Weant KA, Johnson PN, Bowers RC, Armitstead JA. Evidence-based, multidisciplinary approach to the development of a crotalidae polyvalent antivenin (CroFab) protocol at a university hospital. *Ann Pharmacother* 2010;44(3):447-55.