Snake Envenomation: Initial Approach, Assessment and Management

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Snake envenomation

Time matters.
Venomous Snakes of Arizona

Mojave Rattlesnake
Crotalus scutulatus

Sonoran Sidewinder
Crotalus cerastes cerastes

Western Diamondback Rattlesnake
Crotalus atrox

Arizona Ridge-nosed Rattlesnake
Crotalus willardi

Blacktailed Rattlesnake
Crotalus molossus

Southwestern Speckled Rattlesnake
Crotalus mitchelli

Banded Rock Rattlesnake
Crotalus lepidus lilobi

New Mexico Ridge-nosed Rattlesnake
Crotalus willardi obscurus

Tiger Rattlesnake
Crotalus tigris

Arizona Black Rattlesnake
Crotalus cerberus

Great Basin Rattlesnake
Crotalus oreganus lutosus

Desert Massasauga
Sistrurus catenatus edwardii

Midget-Faded Rattlesnake
Crotalus oreganus concolor

Hopí Rattlesnake
Crotalus viridis mullison

Prairie Rattlesnake
Crotalus viridis

Arizona Coral Snake
Micruroides euryxanthus

Colorado Desert Sidewinder
Crotalus cerastes laterorepens

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Venomous Snakes of Florida

Eastern Coral Snake
Micruroides fulvius

Eastern Cottonmouth
Agkistrodon piscivorus

Florida Cottonmouth
Agkistrodon piscivorus conanti

Carolina Pygmy Rattlesnake
Sistrurus miliarius barbouri

Dusky Pygmy Rattlesnake
Sistrurus miliarius miliarius

Timber Rattlesnake
Crotalus horridus

Eastern Diamondback Rattlesnake
Crotalus adamanteus

Eastern Copperhead
Agkistrodon contortrix

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Initial History Taking

- Did you see the snake?
- Do you have a picture of the snake?
- What did the snake look like? (features of the snake...color, patterns, skinny, fat, approximate length, rattle present...)
- What were you doing when you encountered the suspected snake bite?
- Where on the body did the bite occur? Shoes, sandals, clothing present, wearing socks...
- Where did this occur? Near water, walking on a hike, cleaning out a barn...
- When did the bite occur? How long until you presented to health care?
- Did you pull the snake off your body or was it a quick strike?

Black tailed rattlesnake (Tucson, AZ)
Rincon Mountains, Arizona

Rock Banded Rattlesnake
Common key features of native venomous snakes in US

- Broad, flattened, (often) arrow shaped head with skinny neck
- Elliptical pupil with most venomous snakes in the US
- Heat sensing pits “pit vipers” (Viperidae) which are located near the nostrils
- A rattle at the end of the tail

Pause! Takes three steps back and assess. There are always exceptions and unique features in some species.
Exceptions to the “rules” should always be considered.
Arizona Coralsnake
*micruroides euxanthus*

- “red on yellow, kill a fellow…”
- Ring color will completely encircle the body
- Typically, the nose is black

Photo credit: NL Beatty

Eastern Coralsnake
*Micrurus fulvius*

News from the Pit, Arizona Poison and Drug Information Center, 9/5/2023
Why are people bitten?

- **Most of the time it is either:**
  - A person has grabbed or stepped on a snake on **accident**
  - They were **handling** and do not know how to handle a venomous snake
  - They were **trying to kill** it and were bitten
  - **Walking their dog** and were trying to protect their dog and were bitten
Pre-hospital clinical assessment

- Call 911!

- **Key elements in a field setting (EMS):**
  - Get a safe distance from the snake and take a quick history
  - Did the person rip the snake off?
    - Fang could have broken off and important to convey at hospital
  - Have the person describe the snake
  - Take a picture of the snake but do not try to catch it!

- **Help the person remain call**
  - This will help prevent unnecessary tachycardia
  - Lie patient in a supine position if environment allows

- **Any puncture marks from fangs?**
  - One or two puncture marks can be seen (not always)
  - Distance between fang marks can help estimate size of snake
  - Other teeth can leave a linear marks

- **Mark the “line of demarcation” with pen and put time**

Cottonmouth envenomation
8 hrs post-bite at UF Health
Pre-hospital clinical assessment

- **Children:**
  - May be difficult because they are unable to describe the snake or the encounter well
  - When in doubt, always bring to the hospital

- **En route to the hospital:**
  - Place the extremity in a heart-neutral position, lay patient flat in supine.
  - **Anticipate further swelling**...remove jewelry, rings, watches...
  - Vitals, ECG, supplemental oxygen as needed

Seifart et al. NEJM 2022
What methods are **NOT** recommended pre-hospital?

- **“Cut and Suck”** → venom extractors have not been shown to be effective and delay care

- **Arterial/venous tourniquets** → can lead to accelerated tissue damage

- **Electrotherapy at bite site** → electricity is not known to disrupt venom and its properties

- **Heat at bite site** → does not alter venom properties and only damages tissues

- **Cryotherapy at bite site** → has not been shown to be effective and may delay care

- **Pressure Immobilization Bandaging (PIB): (controversial)**
  - Broad elastic bandage to the entire bitten limb and immobilization
  - Technique that is not recommended for North American Crotaline bites
  - Utilized in regions in South-East Asia and has shown benefit
  - In North America it is likely not effective due to increasing local necrosis of tissue

Systemic symptoms

- **Local swelling, erythema, and pain:** 90 to 100 percent.
- **Thrombocytopenia and/or coagulopathy:** Up to 40 percent.
- **Vomiting:** Up to 20 percent.
- **Bleeding** (typically not life-threatening): Up to 8 percent.
- **Neurotoxicity:** Up to 8 percent (primarily after rattlesnake bites, includes myokymia [rippling muscle movement, seen in the face]).
- **Tachycardia and/or hypotension:** Up to 6 percent  
  - (primarily after rattlesnake bites).
- **Rhabdomyolysis:** <5 percent.
- **Angioedema** (allergic or anaphylactoid reaction): 1 to 2 percent.
- **Weakness, paralysis:** Rare for Crotalinae snakebites overall, but described in Mojave rattlesnake bites from southern California.

Pygmy rattlesnake, 6hrs post-bite UF Health
Crotalinae envenomation

- Monitor vital signs, continuous is needed if available (IMC or MICU)
- Remove any restrictive clothing from body; two large bore PIV placed
- Tdap should be updated; wound inspected for foreign body
- Ultrasound or Xray the region for retained fangs!
- Assess for the possibility of “dry bite” and can observe for 6-24 hours.
- CBC with diff, CMP, PT/INR, CRP, fibrinogen or fibrin split products, D-dimer, CK; Labs every 6-8 hrs
- Give antivenom!!
Figure 4. IgG and IgG Fragments Developed against Snake Venom Components.

The mammalian IgG molecule (Panel A) consists of an Fc (heavy) chain, a hinge, and two Fab (light) chains. The light chains have constant and variable regions, which allow the IgG to bind to certain antigens (Ag), such as venom components. When the IgG is treated with pepsin, the IgG molecule is cleaved below the hinge (comprising two disulfide bridges), and an F(ab')₂ fragment is produced (Panel B). When the IgG is treated with papain, the cleavage occurs above the hinge, and two Fab fragments are produced (Panel C). The Fc remnant or chain, which is more immunogenic than the Fab chains, can be removed from the remaining solution by means of various purification techniques.
Antivenom

- Should be started with confirmation or high concern for envenomation (this is often a clinical diagnosis)

- **CROFab** and **ANAVIP** are both approved by the FDA for Crotalinae snake envenomation

- Both have similar efficacy

- **Contraindications** – allergy to papain, papaya, or previous known allergy
## Antivenom

<table>
<thead>
<tr>
<th>Antivenom</th>
<th>Crotalidae immune equine F(ab')2 (Fab2AV, Anavip)</th>
<th>Polyvalent Crotalinae ovine immune Fab (FabAV, CroFab)</th>
</tr>
</thead>
</table>
| **Initial dose** | - 10 vials; repeat dose if initial control of local and systemic venom effects not achieved  
- Call physician expert if initial control not achieved after 2 loading doses  
  ④ | - 4 to 6 vials; repeat dose if initial control of local and systemic venom effects not achieved  
- 8 to 12 vials if patient in shock or with serious active bleeding  
- Call physician expert if initial control not achieved after 2 loading doses  
  ④ |
| **Maintenance doses?** | No: Patient should be observed for an additional 18 hours after control achieved | Yes: 2 vials every 6 hours for 3 doses |
| **As-needed doses for recurrent venom effects** | 4 vials | 2 vials |
| **Timeline for reassessment of platelets and fibrinogen** | - 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal  
- Reassess sooner if risks for bleeding present  
- Patients who received both FabAV and Fab2AV: 2 to 3 days and 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal  | - 2 to 3 days and 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal  
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- Patients who received both FabAV and Fab2AV: 2 to 3 days and 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal  |
Hospital Supportive care

- **Pain control is important** – usually require opioid management (morphine or dilaudid)

- **Intravenous fluids as bolus and continuous infusion** – helps with potential rhabdomyolysis

- **Fresh frozen plasma and platelets** – should only be given in life threatening bleeding and with antivenom administration; Crotalinae venom will de-activate products given

- Monitor for compression syndrome and fasciotomy; less common in Crotalinae bites but does occur and especially in eastern diamondback rattlesnake.
Snake Envenomation in the State of Florida, USA – A 20 Year Retrospective Analysis of the Epidemiology and Clinical Outcomes at a Tertiary Medical Center

Total snake envenomation encounters: **n=829**
Grace et al. Unpublished data, 2024

**Pie Chart:**
- Intentionally handling a snake in the wild (33.5%)
- Accidentally stepping on a snake (7.9%)
- Accidentally grabbing a snake (13.4%)
- Other (5.8%)
- Walking/passing by a snake (23.4%)
- Unspecified (14.3%)

**Bar Chart:**
- Pygmy Rattlesnake (*Sistrurus miliarius*)
- Cottonmouth (*Agkistrodon piscivorus*)
- Eastern Coral Snake (*Micruroides fulvius*)
- Southern Copperhead (*Agkistrodon contortrix*)
- Eastern Diamondback Rattlesnake (*Crotalus adamanteus*)
- Timber Rattlesnake (*Crotalus horridus*)

**Symptom Analysis:**
- Swelling: (100%)
- Nausea: (70%)
- Fatigue: (60%)
- Headache: (50%)
- Rash: (40%)
- Diaphoresis: (30%)
- Tachycardia: (20%)
- Hypovolemia/hypotension: (10%)
- Myotoxic: (5%)
- Respiratory distress: (5%
- Sialorrhea: (2.5%)
- Traumatic necrosis: (2.5%)

**Parts Affected:**
- Arm (1.5%)
- Leg (6.6%)
- Foot/toe (28.4%)
- Other (face, buttock, etc.) (0.8%)
- Hand/forefinger (62.7%)
Three patients who died from snake encounter or treatment:
- 2 patients bitten by Eastern diamondback despite antivenom
  - One sustained shock and cardiac arrest
  - Handling the snake in the wild
  - One developed cerebral edema and herniation
  - Moving the snake from across the road
- 1 patient died from anaphylaxis after being given antivenom; developed shock and cardiac arrest

Anaphylaxis or anaphylactoid reaction: 3.86% of participants

Grace et al. Unpublished data, 2024
Questions?

Juvenile Florida Cottonmouth (Agkistrodon conanti)