Snake Envenomation

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Venomous snakes can be found throughout most of the world. TABLE 1 identifies snake species that are common in North America. As growing human populations encroach on natural reptilian habitats, deadly encounters with venomous reptiles become more probable for humans and animals. Pets are just as likely as people to encounter a deadly snake when outdoors, so it is crucial that owners know what to do if their pet is bitten by a snake. After a snakebite, survival can depend on identifying the snake, knowing what immediate actions to take, and being prepared for on-site and clinical treatment.

Identifying the Snake

After a snakebite, identifying the snake at a safe distance is crucial for choosing antivenin for treatment. If a camera is available, a picture is the most precise and efficient way to properly identify a snake at a clinic or a wildlife facility. It is important for the person taking the picture to stand a safe distance from the snake and to use the zoom function if it is available. A picture should not be taken if a person or animal might be put at risk during the process; instead, a detailed description of the snake should be obtained from a safer distance.

It is important for pet owners to know which venomous snakes are native to areas frequented by their pets. For example, southeastern states have several venomous snakes, including the cottonmouth (Agkistrodon piscivorus), copperhead (Agkistrodon contortrix), eastern diamondback rattlesnake (Crotalus adamanteus), timber rattlesnake (Crotalus horridus), and pygmy rattlesnake (Sistrurus miliarius). Rattlesnake bites account for 65% of all venomous snakebites in human and animal patients in the United States.1 If a person is not familiar with the venomous snakes of an area, characteristics of a snake can be used to determine if it is venomous. Compared with nonvenomous snakes, venomous snakes are wider in relation to their length and have triangular heads to accommodate venom glands at the base of the lower jaw.1 Rattlesnakes can be relatively easy to identify because of the presence of “buttons” or “rattles” at the end of the tail that sound a characteristic warning.

Factors Affecting the Potency of Venom

Many factors may increase or decrease the potency of snake venom. Juvenile and hibernating snakes of the same species have different levels of venom potency. A juvenile snake’s venom is much more potent than that of its parents because the venom of juveniles is more concentrated, which compensates for their relatively small venom glands and helps to protect them from predators. In addition, dehydration and retention of venom during hibernation increase the potency of venom. Most North American venomous snake species hibernate annually, usually from winter to spring.

Immediate Actions After a Snakebite

Contrary to popular belief, lacerating the bite wound and trying to suck out the poison will not help at all; instead, this may spread venom to unaffected areas of the animal's body, possibly having detrimental effects. For snakebites on extremities only, (1) a completely dry, room-temperature compress may be applied to slow or lessen swelling2 and/or (2) a tourniquet may be used to slow systemic circulation of venom. Because snakebite wounds become progressively more painful, compresses should be applied with care. A tourniquet should not be left in place for more than 15 minutes because a lack of blood flow may result in tissue death after this amount of time. It is important to try to keep the affected animal calm and relaxed because lowering the heart rate slows systemic circulation of venom.1

Even with the best on-site field care, the affected animal must be rapidly transported for veterinary care. Reducing the time between the bite and arrival at an animal hospital is crucial. Calling ahead to inform the veterinary staff of the emergency can help ensure rapid and complete treatment.

Assessing the Patient

Animals that have been bitten by a snake should receive veterinary care as quickly as possible. The location of the bite and the dose and potency of the venom determine the patient’s morbidity and mortality. The dose of venom from a snakebite can vary greatly, and a bite may not even introduce venom (this is called a dry bite). Animals are usually bitten on the face, neck, or lower extremities. When a bite is on the face or neck, care must be taken to establish or ensure a patent airway. Swelling is the most immediate sign of a venomous bite, and severe swelling can damage organs or occlude the trachea or blood flow to the brain. Neurologic and cardiovascular signs are noticeable within 30 minutes, whereas immunologic signs (e.g., a full antibody response to the

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<table>
<thead>
<tr>
<th>Scientific and Common Names</th>
<th>Toxicity</th>
<th>Toxin</th>
<th>Geographic Range</th>
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</thead>
<tbody>
<tr>
<td>Agkistrodon contortrix mokasen; northern copperhead</td>
<td>Low</td>
<td>Hemotoxin</td>
<td>Southern Illinois to southern Pennsylvania; Tennessee; northern Georgia; northern Alabama</td>
</tr>
<tr>
<td>Agkistrodon contortrix laticinctus; broad-banded copperhead</td>
<td>Low</td>
<td>Hemotoxin</td>
<td>Middle to eastern Texas</td>
</tr>
<tr>
<td>Agkistrodon contortrix pictigaster; Trans-Pecos copperhead</td>
<td>Low</td>
<td>Hemotoxin</td>
<td>Southwestern Texas</td>
</tr>
<tr>
<td>Agkistrodon contortrix phaeogaster; Osage copperhead</td>
<td>Low</td>
<td>Hemotoxin</td>
<td>Northwest Arkansas; Missouri; far eastern Kansas</td>
</tr>
<tr>
<td>Agkistrodon contortrix contortrix; southern copperhead</td>
<td>Low</td>
<td>Hemotoxin</td>
<td>Far western Texas; southern Arkansas; Louisiana; Mississippi; Alabama south to eastern Carolina (excluding Florida)</td>
</tr>
<tr>
<td>Agkistrodon piscivorus leucostoma; Western cottonmouth</td>
<td>Moderate</td>
<td>Hemotoxin</td>
<td>Eastern Texas; Louisiana; Arkansas; Missouri; far southeastern Kansas; southern Illinois</td>
</tr>
<tr>
<td>Agkistrodon piscivorus conanti; Florida cottonmouth</td>
<td>Moderate</td>
<td>Hemotoxin</td>
<td>Southern Alabama; southern Georgia; Florida</td>
</tr>
<tr>
<td>Sistrurus catenatus catenatus; eastern Massasauga rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Northern Illinois to northern Ohio; Michigan</td>
</tr>
</tbody>
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*Only geographic ranges in the United States and northern Mexico have been included. “Extreme toxicity” is the highest toxicity level of venomous snakes in the United States; “high toxicity” is slightly less toxic. (All images were obtained from flickr.com.)
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<tr>
<td><em>Agkistrodon piscivorus piscivorus</em>; eastern cottonmouth</td>
<td>Moderate</td>
<td>Hemotoxin</td>
<td>Alabama; southern Georgia; southwestern South Carolina; eastern North Carolina</td>
</tr>
<tr>
<td><em>Sistrurus catenatus tergeminus</em>; western Massasauga rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Central Texas; central Kansas; central Oklahoma</td>
</tr>
<tr>
<td><em>Sistrurus catenatus edwardsii</em>; desert Massasauga rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Southern New Mexico; northwestern Texas; southernmost point of Texas</td>
</tr>
<tr>
<td><em>Sistrurus miliarius streckeri</em>; western pigmy rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Far eastern Texas; Missouri; southeastern Oklahoma; Louisiana; Mississippi; very small area of central Tennessee</td>
</tr>
<tr>
<td><em>Sistrurus miliarius miliarius</em>; Carolina pigmy rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Southern North Carolina; South Carolina; southern Georgia and Alabama</td>
</tr>
<tr>
<td><em>Sistrurus miliarius barbouri</em>; dusky pigmy rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Southern Alabama; southern Georgia; Florida</td>
</tr>
<tr>
<td><em>Crotalus horridus</em>; timber rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Almost all of the eastern United States except for northern Illinois and northern Ohio</td>
</tr>
<tr>
<td><em>Crotalus adamanteus</em>; eastern diamondback rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Southernmost points of Mississippi to North Carolina and Florida</td>
</tr>
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<tr>
<td><em>Crotalus atrox</em>; western diamondback rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Most of Texas, northern border of Mexico; southern Arizona and New Mexico</td>
</tr>
<tr>
<td><em>Crotalus scutulatus scutulatus</em>; Mojave rattlesnake</td>
<td>Extreme</td>
<td>Neurotoxin</td>
<td>Southernmost point of Nevada; southern New Mexico; Mexico</td>
</tr>
<tr>
<td><em>Crotalus viridis viridis</em>; prairie rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Central United States; scattered distribution of western US subspecies</td>
</tr>
<tr>
<td><em>Crotalus molossus molossus</em>; blacktail rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Edwards plateau of central Texas west to Arizona; northern Mexico</td>
</tr>
<tr>
<td><em>Crotalus lepidus lepidus</em>; mottled rock rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Small range in southern central Texas: west through Trans-Pecos region and west to San Luis Potosi</td>
</tr>
<tr>
<td><em>Crotalus lepidus klauberi</em>; banded rock rattlesnake</td>
<td>High</td>
<td>Hemotoxin</td>
<td>Southwestern Texas to western central New Mexico; far southeastern Arizona</td>
</tr>
<tr>
<td><em>Micrurus fulvius fulvius</em>; eastern coral snake</td>
<td>Extreme</td>
<td>Neurotoxin</td>
<td>Southeastern North Carolina (mainly lowlands); southern Florida, including Key Largo; west through Gulf states to central Mississippi except for delta region</td>
</tr>
</tbody>
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venom) can take 15 minutes to more than 5 hours to develop. The most common clinical signs include the following:

- Dilated pupils
- Edema
- Puncture wound(s)
- Swelling
- Pain
- Hypersalivation
- Tachycardia
- Petechiae inside the pinnae, developing into internal hemorrhage
- Obvious external hemorrhage before or while venom advances through the circulation; vascular areas and mucous membranes are affected first, resulting in epistaxis and oral or optical bleeding

The appearance of blood after epilation around the bite wound can confirm that venom was introduced. To perform this test, gently pluck a small amount of hair from around the bite wound and watch for blood to slowly seep from the hair follicles. The bleeding is due to the effect of hemotoxin (in venom) on erythrocytes and clotting factors. Venom detection kits and snakebite kits are available but are expensive and time-consuming to use. These kits can be found on the Internet and in some local stores in desert regions.

**Treatment**

As soon as envenomation is verified, a patent airway must be ensured and an intravenous (IV) catheter placed. Venom most seriously affects a patient's coagulation, neurologic system, and bite wound area. Fluid therapy, pain management, supportive care, and application of a compress are the most cost-effective treatments of envenomation. The bite wound should not be lanced or cut because this may spread venom to other tissue, resulting in increased skin sloughing and swelling. The animal's response to the venom should be monitored as soon as possible using complete blood counts (CBCs), serum chemistry profiles, and complete urinalyses.

Administration of antivenin is an excellent option if the snake has been properly identified, but the client should be informed of the cost of antivenin, which can be more than $1000 per dose, and that multiple doses may be needed. Two types of antivenin are available for use in animals. Antivenin crotalid polyvalent (ACP) can treat envenomation from all North, Central, and South American crotalid species. Crotalidae polyvalent immune Fab or Fab2 can treat envenomation from several snake species, including Mojave rattlesnakes, eastern and western diamondback rattlesnakes, and cottonmouths. Crotalidae polyvalent immune Fab is only effective at treating envenomation from a short list of species, but the action of this antivenin has been deemed five times more effective than that of ACP. The availability of antivenins varies; ACP and both Fab antivenins may be obtained through their manufacturers.

Skin sloughing may require repeated debridement, and the patient’s pain level must be controlled. Opioid therapy has been shown to effectively control most snakebite-related pain in animals.

**Monitoring the Patient**

Monitoring the patient is vital for complete recovery. Hematologic examination can reveal whether the patient is improving. Prolonged clotting time should be tested at least every 2 to 3 hours for up to 72 hours after initial presentation because it is vital to monitor the effect of hemotoxin on the patient's coagulation. Administration of antivenin greatly reduces the effects of venom on coagulation and shortens the duration of the total systemic effects of venom. The inability to coagulate may cause internal bleeding and decrease blood pressure and volume, resulting in a poor prognosis. Therefore, a CBC, serum chemistry profile, and complete urinalysis should be obtained immediately to fully assess the systemic effects of venom so that treatment may be tailored to the patient's needs. The effects of venom may include the following:

- An increase in the serum alkaline phosphatase level
- An increase in the alanine aminotransferase level
- A decrease in kidney function
- Neutrophilic leukocytosis
- Eosinopenia
- Platelet hypoaggregation without thrombocytopenia
- Hypofibrinogenemia
- An increase in the myoglobin, creatine kinase, and aspartate aminotransferase levels due to rhabdomyolysis

**Conclusion**

Many animals are innately immunoresistant to snake venom. Immunoresistance is most prevalent in equids, clownfish, king snakes, bullfrogs, and badgers. Small animals such as wood rats and prairie voles can also be fairly immunoresistant. Medium- and large-breed dogs have less immunoresistance, and small dogs are susceptible to venom because of their size in relation to average doses of venom.

Being prepared for a snakebite emergency by knowing what to do immediately can help save a patient's life. Learn what you can about snakes, and do not underestimate the danger of hatching or juvenile venomous snakes, which may be more life-threatening than adult snakes.
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References

1. To properly use antivenin, you must be able to first identify
   the
   a. bite wound.
   b. type or species of the snake.
   c. geographic area in which the animal was bitten.
   d. the age of the snake.

2. The venom of juvenile snakes or of snakes that have
   recently emerged from hibernation
   a. is more potent.
   b. is less potent.
   c. has the same potency as the venom of adult snakes.
   d. is usually not delivered in a bite.

3. Laceration or lancing of a snakebite may
   a. decrease signs of envenomation.
   b. cause more skin sloughing.
   c. spread the venom in the victim's body.
   d. b and c

4. After a snakebite, which immediate action(s) can decrease
   systemic circulation of venom in an animal?
   a. applying a cold compress
   b. keeping the animal active
   c. keeping the animal calm and using a tourniquet
   d. providing fluids

5. Which combination of variables determines the morbidity/
   mortality of an animal that has received a venomous bite?
   a. the animal's age and the amount of venom received
   b. the animal's age and the species of snake
   c. the location of the bite and the animal's attitude
   d. the location of the bite, the amount of venom received,
      and the potency of the venom

6. Which is usually the most immediate sign of envenomation?
   a. bleeding from the eyes
   b. a rapid heart rate
   c. lethargy
   d. swelling of the bite area

7. Which diagnostic tests/parameters should be performed/
   checked immediately to evaluate an animal that has been
   bitten by a snake?
   a. urinalysis, CBC, and serum chemistry profile
   b. CBC, hematocrit, and urinalysis
   c. heart rate, CBC, and urinalysis
   d. heart rate, respiratory rate, and urinalysis

8. When monitoring an animal that has been bitten by
   a snake, prolonged clotting time should be evaluated
   every___hours.
   a. 1 to 2
   b. 2 to 3
   c. 3 to 4
   d. 4 to 5

9. A method of confirming that a snakebite was venomous is
   to pull hair from around the bite wound and watch for
   a. pus.
   b. blood.
   c. tearing of the skin.
   d. clear serous fluid.

10. Immediately after diagnosis of envenomation, which of
    the following should be performed to help ensure effective
    treatment?
    a. Ensure that the patient has a patent airway, and place an
       IV catheter.
    b. Perform blood work and a urinalysis.
    c. Ensure that the patient has a patent airway, and perform
       blood work.
    d. Place an IV catheter, and perform blood work.