

Poisonous Snakebite Treatment in the United States

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• This is a retrospective report of 107 cases of poisonous snakebites treated in south Georgia and north Florida. Sixty-seven percent of the cases required intensive treatment. Intravenous antivenin therapy, if indicated, should be given early and over a short time. Steroids are of use primarily for allergic phenomena. Fasciotomies were not necessary unless cooling or inadequate antivenin had been administered. A grading system that matches the species of snake with the severity of the bite was used to classify the cases.

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THE TREATMENT of poisonous snakebites is a controversial issue. Fifteen deaths occur in the United States each year, but the large number of permanent deformities and amputations are also of major concern. Many of these deformities and amputations follow varying degrees of cooling of the extremities, either as a first-aid measure or as treatment directed by a physician in the emergency treatment area.

This report concerns those cases treated at the John D. Archbold Memorial Hospital in Thomasville, Ga, from 1927 to 1977. All cases were pit viper bites and have been graded retrospectively according to the method of Wood et al,¹ with additions and alterations by Parrish² and, more recently, McCullough and Gennaro.³ For the purpose of comparing cases in all series, grading is essential. The effect of the bite of various species of snakes has been described by Russell et al.⁴

The Table shows the breakdown of the 107 cases. There were eight deaths, all of which resulted from the bites of the eastern diamondback rattlesnake. The majority of these deaths occurred many years ago when antivenin was given intramuscularly (IM) in small doses, and before the development of crotaline antivenin, polyvalent (antivenin [Crotalidae] polyvalent), which met rigorous potency standards. Four bites inflicted

by small eastern cottonmouth snakes, less than 36 cm long, would have been classified as grade 1 or 2, but ice was applied before hospitalization, and, in our opinion, these cases were thereby converted to a higher grade, even with otherwise adequate emergency treatment. Altogether, there were 22 grade 4 (very severe) bites. Four of the patients who died received an average of 2.3 units of antivenin (developed before 1954) IM rather than intravenously (IV). All 14 survivors with grade 4 bites received the new crotaline antivenin, polyvalent, with ten adults averaging 16 units each, IV.

Three children younger than 13 years received an average of 7 units of the new type of antivenin IV. It is my belief and that of others that many children require more antivenin IV than do adults.

The only grade 4 case that resulted in a deformity after an eastern diamondback snakebite required 27 units of antivenin IV, but had a spontaneously contrived ice bag applied to the area for 25 minutes before coming to the hospital. This man's leg was pulseless and cyanotic (Figure). It

was the only fasciotomy performed in this series and was necessary to save the leg. Months later he still lacked 35° dorsiflexion of his ankle. Cooling apparently added to the ischemia. There were no permanent defects in any of the 99 survivors, except in those cases where cooling was used.

In my opinion, the combination of venom and even a small amount of cooling may cause conspicuous ischemia and may require fasciotomy, with the possibility of resultant deformity of the extremity or even amputation.

I recommend the prompt administration of large amounts of IV antivenin and that no form of cooling be used in any degree either in first aid or after the patient is in the care of the physician.

McCullough and Gennaro³ stated: "In an analysis of 36 cases of poisonous snakebites, it was found that cryotherapy had been used in 27 or 75% of the amputations in children." Van Mierop⁵ stated: "There were no deaths or amputations in 208 poisonous snakebite cases reported in Florida in 1969 and in none of these cases was cryotherapy used." Russell et al,⁴ in referring to the treatment of snakebites, said that "under no circumstances should an extremity be placed or packed in ice." Lorimer,⁶ in discussing Moseley's article in the *Annals of Surgery*, stated:

We do not believe in cryotherapy, because . . . it predisposes the tissues which are already jeopardized by the proteolytic enzymes to rapid and extensive necrosis during the warm-up period; and . . . repeated experimental and clinical observations have inevitably shown that cryotherapy has no beneficial effects but, rather, is detrimental to the injured tissues.

In 1965, Gennaro and I⁷ recommended no cooling of the extremities in the treatment of poisonous snakebites. In 1970, Gill⁸ wrote:

Comparison of Snake Species With Severity of Bite, 1927-1977

| | No. of Bites | Grade, No. | | | | | Deaths |
|---------------------------------|--------------|------------|-----------|-----------|-----------|-----------|----------|
| | | 0 | 1 | 2 | 3 | 4 | |
| Eastern diamondback rattlesnake | 39 | 0 | 0 | 12 | 7 | 20 | 8 |
| Other rattlesnakes | 16 | 0 | 7 | 7 | 2 | 0 | 0 |
| Eastern cottonmouth | 26 | 1 | 8 | 11 | 2, 3* | 1* | 0 |
| Southern copperhead | 4 | 0 | 2 | 2 | 0 | 0 | 0 |
| Unidentified | 22 | 4 | 13 | 4 | 0 | 1 | 0 |
| Total | 107 | 5 | 30 | 36 | 14 | 22 | 8 |

*Cases in which cooling had been used.

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Poisonous snakebite treated with ice for 25 minutes elsewhere. Patient received 27 units of antivenin intravenously. Fasciotomy was necessary because of cyanotic pulseless foot due, in my opinion, to detrimental effects of even short-term cooling.

Hemorrhagic necrosis resulting in loss of tissue from the involved leg of each dog receiving cryotherapy is strong evidence against the use of cryotherapy in treating envenomation by poisonous snakebites of the pit viper groups. Not only is the tissue destruction increased but the period of disability is lengthened.

In 1971, Clark⁹ stated: "An experimental study of 12 dogs injected with lyophilized rattlesnake venom showed that no added benefit could be demonstrated by using corticosteroids or cryotherapy as adjuvants to antivenin therapy."

In 1960, McCullough and Gennaro³ discovered that in dogs envenomated with eastern diamondback venom and then treated with antivenin tagged with iodine 131, 85% of the tagged dose, administered IV, accumulated at the site of the envenomation within two hours. This compared with a 1.43% accumulation of a comparable dose given IM and 5.6% of the dose given subcutaneously.

Our recommendations for first aid and medical treatment are based on our experience in treating the bite of what is probably the most dangerous rattlesnake in America, according to Klauber.¹⁰

FIRST AID ONLY

1. Get away from the snake. Some patients have been bitten more than once by the same snake. Quickly and carefully bring the patient and the dead snake to the physician.

2. Apply a tourniquet above the bite area and be sure that a finger can pass under the tourniquet showing that it is not too tight. Do not periodically release it before seeing a physician if 1½ hours or less from a physician. Gennaro and I³ described one patient who went into shock at the time of tourniquet release. Snyder and associates¹¹ demonstrated a 20% loss of tagged venom from enven-

omated extremities of dogs within two hours. This loss was halved (9%) by simple tourniquet compression of more proximal tissues.

3. Apply an improvised splint if it can be done within one or two minutes, and keep the limb in a horizontal position. If feasible, do absolutely no walking, thus lessening the spread of the venom.

4. If the victim is more than 1½ hours from medical help or if a large snake is the offender, immediately use incision and suction, because 22% to 50% of the venom can be removed with this method, if done within three minutes, and a lesser quantity can be removed up to 30 minutes, according to McCullough and Gennaro.³ The incision need not be more than 3 cm long and need only be carried through the skin. Cruciate incisions are not recommended. Use mouth suction only if no other method is available.

5. Transport the patient as quickly as possible to a physician. A set of car keys is the best first-aid item.¹² If feasible, call ahead to a patrolman and report an extreme emergency.

6. If the victim stops breathing or has no pulse, perform cardiopulmonary resuscitation.

7. Use absolutely no form of cooling.

CORAL SNAKEBITE FIRST AID

It is important that the snake be brought to the physician for identification. Frequently, there is no sign of envenomation at first, according to Pitts.¹² The following is recommended by Van Mierop⁵: (1) wash the bitten area promptly and simply, (2) transport the person to the emergency room as soon as possible, (3) do not apply a tourniquet or perform an incision or suction, and (4) do not give the victim solid foods en route to the hospital.

EARLY HOSPITAL TREATMENT

1. The physician should make every effort to be in the emergency room when the patient arrives and should seek immediate consultation from experts, if indicated.

2. Identify the offending snake. Some snakebites do not manifest the seriousness of the bite in the first few minutes; therefore, the patient should be observed closely for at least 60 minutes. Some bites require even longer periods of close observation. Look for pain, swelling, ecchymosis, or blebs. In some cases there may be weakness, dizziness, numbness, cold and clammy skin, tachycardia, nausea, vomiting, and diarrhea. Hypotension and a shock-like state may ensue. Muscular fasciculations are frequently prominent if the offending snake is the eastern diamondback rattlesnake. All patients suspected of being bitten by a poisonous snake should be admitted to the hospital for at least 24 hours. Do not release the tourniquet if it is a dangerous snakebite until an 18-gauge plastic line has been placed in a vein and until administration of IV antivenin has been started.

3. I excise one block of skin and subcutaneous tissue going only approximately 1 cm around each fang mark if a dangerous snake is involved and if the patient is brought to the hospital within 1½ hours of the bite. Pressure may have to be applied over the wound to control bleeding. Adequate early antivenin administration usually prevents bleeding.

4. Once the decision has been made to give antivenin, do not delay. Check for history of allergy and have aqueous epinephrine (1:1,000 dilution) readily available in a syringe in case of severe allergic reaction. Have a 5% glucose and lactated Ringer's solution running IV. Before injection of antivenin, give a skin test or eye test for hypersensitivity to horse serum. If the test reaction is negative, cautiously administer antivenin IV. If the allergic test reaction is positive, one may have to slowly desensitize as outlined in the directions accompanying the antivenin package. This delay may be too long in a serious bite. Pitts¹² suggests that aqueous epinephrine (1:1,000 dilution) may be given as a premedication (0.01 ml/kg

of body weight to total of 0.3 ml in a small child; 0.5 ml in a larger child or adult). The intradermal test is then repeated and, if the results are negative, antivenin is offered IV slowly, drop by drop. With no adverse reaction, a few milliliters are offered and with no reaction, the full necessary dose is infused. If difficulties develop during the infusion, administration of antivenin is stopped (usually temporarily) and anaphylaxis is controlled by further doses of epinephrine or by levarterenol bitartrate 0.2% (in 500 ml of saline solution) infusion.¹²

Each hospital pharmacy should keep a minimum of 15 to 25 units of crotaline antivenin, polyvalent, on hand at all times, especially in areas where the more deadly rattlesnakes exist. One of the most difficult problems is knowing how much antivenin to give and when to discontinue giving it. Insufficient neutralization has been more common than overneutralization. As complete neutralization approaches, the patient feels better and the swelling dramatically slows down. If muscular fasciculations exist and antivenin is given IV in large doses, the symptoms will decrease rapidly and vital signs will improve. Other signs of neutralization are cessation or decrease in local pain along with return to normal of the blood pressure, pulse rate, respiration rate, and urine output.

Pitts¹² gave a range of venoms extracted from various snakes by many authorities. It is difficult to know the exact amount of venom injected, but it is helpful to estimate, by using his venom dose estimate of neutralization potency. In this way, one can roughly calculate how much antivenin should be injected. Bites on digits generally require more antivenin than those on other parts of the body, and bites in children also may require 50% more antivenin. If persistent hypotension from anaphylaxis occurred, one may require the use of crystalloids, colloids, or vasopressors. Corticosteroids and antihistamines may be necessary in addition to epinephrine in the treatment of anaphylaxis. Using corticosteroids without antivenin in the primary treatment of poisonous snakebites is usually totally inadequate. If antivenin has been used, most of the patients will require steroids to allay

the ensuing serum sickness, which can be dangerous.

The patient must be warned of this with a description of the possible symptoms. Our practice has been to give all adult patients 80 mg of prednisone daily in divided dosages, increasing the dosage if symptoms worsen, from the fourth day after the bite to the 12th day, then tapering to discontinuance. This dosage should be adjusted for children.

5. Immobilize the involved extremity.

6. Tetanus immunization should be given, if indicated, and antibiotics are frequently used. In severe bites we order a complete blood cell count, cross matching of blood, coagulation profile, electrolyte package, urinalysis, and other tests as indicated. We do not recommend fasciotomy unless the arterial blood supply is impaired. One can easily be deceived by a bite that looks innocuous at first. It is most important to follow up these bites over several hours and to admit the patient to the hospital for at least 24 hours. In the geographic area of the eastern diamondback rattlesnake and if muscular fasciculations are present, more than 15 units of antivenin IV will probably be needed. Sometimes up to 30 units is required if the patient has been bitten by this extremely dangerous snake.

7. After 24 to 48 hours, if there is much swelling in the lower extremity and if no coagulopathy exists, consider use of heparinization for several days. Heretofore, we have seen a few postphlebotic syndromes after severe snakebites.

EARLY HOSPITAL TREATMENT OF CORAL SNAKE ENVENOMATION

A most difficult problem is a person brought to the hospital with a suspected coral snakebite. The person should be admitted to the hospital for 48 hours of observation if it is impossible to recover the snake. With an abnormal diagnosis and no symptoms, treatment with antivenin (*Micrurus fulvius*) should be started IV. Parrish and Khan¹³ recommend 2 units of antivenin to bind with circulating neurotoxins before they become fixed to neural tissues. Further doses of antivenin are reserved for the appearance of symptoms. Each

hospital in coral snake areas should keep vials of coral snake antivenin on hand.

Wyeth Laboratories reported that a 1-ml ampul of antivenin will neutralize 2 mg of this venom; however, this preparation is not effective in the case of the Arizona coral snake. Fix and Minton¹⁴ showed that venom yields in excess of 6 mg in one study, 12 mg in another study, and 20 mg in a third study. We may have to aim at a 20-mg venom capacity in the more severe cases. If neurologic symptoms develop, intubation and ventilatory support are necessary; even a tracheostomy may be required.

For information regarding bites by exotic snakes in the United States, contact the following: Mr William Haast, Serpentarium, Miami; Communicable Disease Center, Atlanta; or Wyeth Laboratories, Division of American Home Products, Radnor, Pa. Large zoos frequently carry appropriate antivenin, and a National Antivenin Index is maintained by the Oklahoma City Zoo.

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