Poisonous Snakebite in Central Texas
Possible Indicators for Antivenin Treatment

RALEIGH R. WHITE IV, M.D., and ROBERT A. WEBER, M.D.

Sixty-seven patients hospitalized for poisonous snakebite between 1975 and 1990 were managed by elevation, tetanus prophylaxis, intravenous fluids and antibiotics, and often by a limited excision of the bite site in the Emergency Department, with sequential laboratory studies as needed. Antivenin was used for systemic envenomation, and 23 of the 67 patients (34%) received 133 vials. Thirteen of the twenty-three patients (56%) had adverse reactions to the antivenin. Two significant observations arose. First age was an indicator. Eleven of eighteen patients 12 years or younger (61%) received antivenin, whereas 12 of 49 patients older than 12 years (24%) received antivenin (p = 0.0085, Fisher’s exact test). Second species of snake was an indicator. Sixty-two snakes were identified (93%). Of 39 rattlesnake (Crotalus and Sistrurus) bites, 20 patients received antivenin (53%), but of 23 copperhead and water moccasin (Agkistrodon) bites, only three patients (12.5%) received antivenin (p = 0.0025). Antivenin may be indicated for use in systemic rattlesnake envenomation, especially in younger patients.

The clinical management of poisonous snakebite continues to stir controversy. Advocates of antivenin (Crotalidae) polyvalent therapy (Wyeth-Ayerst Laboratories, Philadelphia, PA) record its benefits and suggest the potentially harmful result of aggressive surgical treatment.1,2 Others eschew antivenin to recommend excisional therapy,3 and some favor excision/fasciotomy therapy,4,5 sometimes using antivenin. Recently a major series report suggests that neither antivenin nor surgical excision is needed in the majority of snakebite cases.6

Stimulated by the controversy, we established a 15-year institutional review to assess our experience in treating poisonous snakebites, looking especially for possible indicators to administer antivenin.

Methods

From 1975 through January 1990, 67 patients were admitted for treatment of poisonous snakebite at Scott and White Hospital, Texas A&M University College of Medicine in Temple, Texas. Patient ages ranged from 1 to 76 years. Nine patients were aged 6 years or younger, and 18 were 12 years or younger. The average age was 32.5 years. Forty-eight patients were male, and 19 patients were female. The average time from injury to hospital presentation was 1.9 hours, with a range of 10 minutes to 12 hours.

The biting snake was identified in 93% of the cases. Either the victim or an observer at the scene made positive identification or the snake was identified using a color atlas at the Emergency Department. All snakes identified were native to Central Texas, where 11 species of poisonous snakes are indigenous, including the western diamondback (Crotalus atrox), the canebrake rattlesnake (Crotalus horridus atricaudalus), the timber rattlesnake (Crotalus horridus horridus), northern blacktailed rattlesnake (Crotalus mambus molo5'u5), and the prairie rattlesnake (Crotalus viridus viridus). A second genus of Central Texas rattlesnake includes the western massasauga (Sistrurus catenatus turgidus), the western pigmy (Sistrurus miliaris streckeri), and the desert massasauga (Sistrurus catenatus edwardsi).7

A third genus of poisonous snakes native to Central Texas includes the broad-banded copperhead (Agkistro-
don contortrix laticintus), the southern copperhead (Agkistrodon contortrix contortrix), and the western cottonmouth moccasin (Agkistrodon piscivorus leucostoma). According to type of snake, 39 victims were bitten by rattlesnake (58%), 20 by copperhead (30%), 3 by cottonmouth moccasin (4%), and 5 by an unidentified snake (7%). Medical record review also included location of bite wound, circumstances of the biting event, patients' clinical signs and symptoms, steps in early management, laboratory reports, severity of injury with attempts at retrospective grading of envenomation, use of antivenin, requirements for further surgery, and eventual outcome.

Results

Initial care began with verification of bite wound by poisonous snake. Some patients brought to the Emergency Department a dead snake in a bag, and one even brought a live one. The history of snakebite was then confirmed by documentation of one or more fang marks at the bite site. The distance between fang marks was used as a guide to size of snake and gave rough indication of severity of envenomation to be expected. Physical findings and complaints of pain confirmed envenomation, but severity of these signs varied widely at the time of initial presentation to the emergency department, depending partially on elapsed time since the biting. The sooner the patient came to the emergency department, the more unimpressive were the presenting physical findings. Several patients thought initially to have sustained no envenomation, but who had a positive history and fang marks, subsequently, in the ensuing hours developed pain, marked swelling, and ecchymosis. All patients with fang marks were admitted for close observation because initial grading was unreliable as a guide to the severity of envenomation. Clinical signs and symptoms evolved progressively in 6 to 12 hours after biting, revealing the degree of envenomation. Subsequent retrospective grading also proved imprecise.

No patients were bitten on the job, but all were bitten during what generally could be termed recreation—such as hunting, fishing, gardening, outside play, and snake round-ups. Most bites occurred during spring and summer, and the right hand (27) and left foot (21) were the most common bite sites.

Initial laboratory studies included complete blood count with platelet count and clotting studies (prothrombin time, partial thromboplastin time, fibrinogen levels, and fibrin split products.) These studies were repeated at 6-hour intervals until stable. Initial treatment often included a limited, early excision of the bite wound, especially for rattlesnake bites. Removal of a small 'plug' of skin and subcutaneous tissue, to include the fang marks, was chosen when anatomically convenient. Sometimes an incision was made connecting two fang marks. This procedure usually was carried out in the emergency department. Fascial integrity can be assessed through this wound.

The small wounds resulting from bite excision sometimes produced voluminous outpouring of serous drainage in the first several days, thus partially decompressing the extremity.

Wound sites were maximally elevated to protect distal tissue from vascular compromise associated with swelling. Upper-extremity bites were elevated by nonconstricting stockinette sling, and lower extremity bites were elevated with multiple pillows and bed positioning. Swelling was centripetal, and regional lymph nodes routinely became tender. Swelling and ecchymosis often progressed to the trunk.

Patients were administered intravenous fluids and antibiotics, tetanus toxoid, and analgesics as needed. In the early years of the review, four patients were administered systemic steroids. On review no specific benefit could be attributed to steroid therapy. Patient condition was monitored continuously. If severe systemic symptoms developed, such as marked nausea and vomiting, central nervous system signs, cardiovascular shock, or deterioration of clotting parameters, the patient was skin tested for sensitivity to antivenin (Crotalidae) polyvalent. If nonreactive to skin test, patients with severe systemic signs and symptoms were moved to a monitored bed in the surgical intensive care unit and administered intravenous antivenin. If no allergic symptoms developed, multiple vials were administered according to package insert guidelines (Table 1). Twenty-three patients received 133 vials. Mild itching

<table>
<thead>
<tr>
<th>Severity</th>
<th>Manifestations</th>
<th>Amount of Antivenin</th>
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</thead>
<tbody>
<tr>
<td>No envenomation</td>
<td>No local or systemic signs</td>
<td>0</td>
</tr>
<tr>
<td>Minimal envenomation</td>
<td>Local swelling, no systemic signs, normal lab</td>
<td>2-4 vials</td>
</tr>
<tr>
<td>Moderate envenomation</td>
<td>Extended swelling, 1 or more systemic manifestation, lab abnormalities</td>
<td>5-9 vials</td>
</tr>
<tr>
<td>Severe envenomation</td>
<td>Marked local response, severe systemic manifestations</td>
<td>10-15+ vials</td>
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From Wyeth, Antivenin (Crotalidae) Polyvalent (equine origin) package insert, 1984
or hives were treated with intravenous Benadryl® (Parke-Davis, Morris Plains, NJ). When severe allergic reactions such as anaphylactic shock developed, however, the antivenin was immediately stopped and the patient was resuscitated.

Clotting abnormalities seemed to be of two varieties. One was a consumption-type coagulopathy with very low platelet count and disseminated intravascular coagulation. The other was a hæmarhinlike syndrome with prolongation of prothrombin time and partial thromboplastin time but with normal platelet count. Mixed-coagulopathy patterns also were noted. Both types of coagulation abnormalities occasionally returned toward normal within minutes of intravenous antivenin administration, but not in all patients. Some antivenin recipients demonstrated slow recovery of clotting aberrations in a way similar to untreated patients. Relief of gastrointestinal symptoms frequently followed antivenin administration, but again, at a variable rate.

Of the 67 patients hospitalized, 23 were treated with antivenin for severe systemic symptoms of envenomation (Table 2). Twenty of these twenty-three severely injured patients (87%) were rattlesnake (Crotalus and Sistrurus) bite victims, constituting 53% of the 39 total rattlesnake bites. The remaining three patients treated with antivenin for severe systemic symptoms were bitten by copperhead (two) and cottonmouth moccasin (one) of genus Agkistrodon. They constituted 13% of the 23 Agkistrodon bites. Comparing species of biting snake as an indicator for antivenin use, 53% of Crotalus and Sistrurus bites were treated, but only 13% of Agkistrodon bites were treated (p = 0.003 Fisher’s exact test). All three of these Agkistrodon bites were treated before 1980. Our current practice is to withhold antivenin for Agkistrodon bites because the symptoms are less severe and resolve sooner than do rattlesnake bite symptoms.

Analysis of patient ages (Table 2) showed that 18 bite victims were 12 years of age or younger and that 11 of these (61%) received antivenin for signs of systemic envenomation. By contrast, 12 (24%) of 49 older patients received antivenin (p = 0.0085). Of the 12 patients developing severe coagulopathy, 9 were children, whereas only 3 were adults (p = 0.0002).

Adverse reactions to antivenin were recorded in 13 of 23 hospitalized patients treated with antivenin (56%). Nine of these patients had severe anaphylactic reactions with shock symptoms. This experience leads us to give antivenin in the intensive care setting. The mean age of hospitalized patients showing no adverse allergic reactions to antivenin was 18.2 years, whereas those with adverse allergic reactions had a mean age of 34.5 years. Although younger patients were sicker and more often received antivenin, they tolerated antivenin therapy better, having fewer adverse reactions. The frequency of serious allergic reactions, however, is a major restraint on our decision to choose antivenin therapy.

During the hospital course, 19 patients required subsequent surgical procedures (Table 3). Of these, 16 were rattlesnake bite victims (84%), 2 were moccasin bites, and 1 was a copperhead bite. Rattlesnake bites (16/39) were much more likely than copperhead bites (1/20) to require further surgery (p = 0.005). A 7-year-old patient, who was bitten by a copperhead on the left fifth toe, developed severe nausea and vomiting and a marked coagulopathy associated with dramatic swelling and impaired circulation in the left foot. Within the first 24 hours he had a pressure-releasing dorsal skin incision that was closed secondarily on day 6. No tissue was lost. This patient, treated in 1980, was also our last copperhead bite to receive antivenin. One of the two moccasin bite victims was similarly operated for severe lower-extremity swelling and distal ischemia with secondary closure and no tissue loss. The other moccasin bite requiring further surgery had a left long finger bite that led to finger-tip necrosis and distal interphalangeal amputation. The 16 rattlesnake patients requiring additional surgery included two arthrotomies for wash-out of joint penetration (one finger in an adult and one knee in a child). Fasciotomy was used whenever sus-
POISONOUS SNAKEBITE IN CENTRAL TEXAS

20 Copperhead bites
39 Rattlesnake bites
57 Days

Discussion

Although this series of 67 poisonous snakebites is not a large experience, it demonstrates several observations that may help us to understand some of the divergent recommendations in the snakebite literature.

First, our study suggests that all United States pit vipers (Crotalidae family), and pit viper bites, are not equal. Our rattlesnake (Crotalus and Sistrurus) bite patients more often manifested signs of severe envenomation, more often required additional surgery, more often received antivenin, and had a much longer average hospital stay than the copperhead (Agkistrodon) bite patients. Of course some rattlesnake bites produced minimal envenomation, but if a large rattlesnake inflicted significant envenomation, the patient would very likely be quite sick.

Snakebite series wherein rattlesnakes (Crotalus and Sistrurus) predominate, such as the comprehensive reports of Snyder et al., 4 Glass, 5 and Grace and Omer, 6 document the severe injury caused by significant rattlesnake envenomation, including tissue necrosis, amputation, and death. Our rattlesnake experience supports these reports.

Other authors report snakebite series predominantly involving bites by copperhead and water moccasin (Agkistrodon), 6, 9 or the mildly poisonous Northern Pacific rattlesnake (Crotalus viridis oreganus). 3 Burch et al. 4 report a larger series of 81 snakebites, but only 10 were rattlesnake bites. These 10 bites accounted for four of their five most severe envenomations. Their 45 copperhead bite patients had a relatively short hospital stay (2.5 days), comparing favorably with our average copperhead bite hospital stay of 2.2 days. Similarly a recent report by Wagner and Golladay 7 suggests management guidelines for (Crotalidae) envenomation in a series of 29 young snakebite patients that included only three documented rattlesnake bites. Of the 26 remaining bites (Agkistrodon or unidentified), all but one was judged to be mildly or minimally envenomated. Only three bites were graded more severe—two rattlesnake and one moccasin. In our series the 20 copperhead bites were similarly less severely envenomated than the 39 rattlesnake bites.

Based on our experience and that reported by others, we believe that identifying the biting snake is an important aspect in establishing the therapeutic mind-set for the care of a snakebite patient. In doing so, some apparent contradictions in management recommendations are resolved. Burch et al. 4 and Wagner and Golladay 7 report series from our south-central United States region. Their series include few rattlesnake bites, and their recommen-
dations for therapy are conservative, mostly advocating supportive care. Looking exclusively at our copperhead bite patients, we concur with these authors. We disagree, however, that management experience based largely on copperhead bites should be generalized to the management of all Crotalid (United States pit viper) bites.

Similarly when Snyder et al., Glass, and Grace and Omer, all dealing mainly with rattlesnake victims, advocate more aggressive medical and surgical treatment, we again concur. Our significantly envenomated rattlesnake bite patients suffered severe pain, marked coagulation defects, systemic symptoms, and tissue necrosis. We agree that aggressive medical and surgical therapy is appropriate for many rattlesnake bite victims, but we disagree that one can generalize from this experience to management recommendations for all Crotalid (US pit viper) bite patients. We also disagree with the influential report of Huang et al. from a coastal Texas experience geographically similar to that of Burch et al. Huang advocated an aggressive surgical excision approach to all poisonous snakebite patients without any genus identification of biting snake in the report. Our data cannot support the implicit assumption that all poisonous snakebites are the same and should therefore be treated similarly. In general rattlesnake bites are worse injuries than copperhead bites, and cottonmouth moccasin bites probably fall somewhere in between.

Secondly, our data show that younger patients suffered more severe envenomation syndromes than did adults. This observation is consistent with other reports. On the other hand, Wagner and Golladay suggest that poisonous snakebite in children can be managed conservatively, especially in copperhead bites. In addition, our data show that 9 of 12 severe coagulopathy reactions occurred in children, one of which was a copperhead bite. Whether this age group difference is related to weight, blood volume, surface area, or other factors is unknown.

Biochemical analyses of snakebite-related coagulation defects suggest significant species differences among poisonous snakes. Not only are differences noted between Eastern diamondback rattlesnake (Crotalus adamanteus), which can cause a hypofibrinogenemia without profound thrombocytopenia, and Western diamondback (Crotalus atrox), which can cause a consumptive-type coagulopathy with thrombocytopenia, but also differences are noted among individual snakes in the same genus. There is even variation of venom enzymatic content documented in the same rattlesnake at different times. Moreover distinct differences between Crotalus and Agkistrodon venoms are noted both in their mechanism of enzymatic initiation of anticoagulation effect and in their potency to anticoagulate the victims.

Indications for antivenin treatment remain uncertain and subject to debate. Analysis of our data shows that rattlesnake (Crotalus and Sistrurus) bites and juvenile patient age are two factors that correlate both with increased severity of envenomation and consequently with our selective decision to administer intravenous antivenin.

The answer to the question of when to give antivenin is not clarified by inspection of the antivenin (Crotalidae) polyvalent. It is developed by collecting concentrated serum globulins from horses immunized with the following venoms: Crotalus adamanteus (Eastern diamondback rattlesnake), Crotalus atrox (Western diamondback rattlesnake), Crotalus durissus terrificus (Tropical rattlesnake, Cascabel) and Bothrops atrox (Fer-de-lance). The decision to treat with antivenin not only loads the patient with additional foreign animal proteins but also administers a product derived from equine exposure to snake venoms, two of four of which snakes do not even reside in the United States. Knowing the variations among native snake venoms, one must question the wisdom of giving patients antivenin against foreign snakes. The content of antivenin complicates a therapeutic decision already facing myriad variables.

Until the double-blind study called for by Lindsey is published, the treating physician must weigh indications for antivenin therapy on an individual basis.

We recommend withholding antivenin therapy for copperhead snakebite patients in all but the most severe copperhead envenomations. Rattlesnake bites in our locale are capable of producing very severe envenomation syndromes, especially in young patients, and, therefore, we will continue to treat selected severely envenomated rattlesnake bite victims with antivenin. The species of snake and the age of patient may be possible indicators for its selected use.

Summarizing our treatment recommendations, we advocate early limited bite excision when anatomically convenient, following Snyder et al., who demonstrated removal of up to 75% of injected venom for up to 2 hours after the bite. We especially advocate excision of rattlesnake and cottonmouth moccasin bites. The injured part is then elevated to minimize swelling, seeking to avoid releasing incision/fasciotomy. Coagulation studies and clinical condition are monitored. Surgical releasing incisions are used for any signs of circulatory compromise in peripheral tissues or to release envenomated muscular compartments. No attempt is made to excise ecchymotic tissue at the time of these later operations. Secondary closure is sought as soon as decreased swelling allows. Intravenous antivenin (Crotalidae) polyvalent is given to patients who manifest systemic signs of severe envenomation, mostly for rattlesnake bites, especially in children.
Further surgery is chosen as needed in the repair of necrotic tissues. This occurs predominantly in rattlesnake bites.

References


DISCUSSIONS

Dr. Charles H. Watt, Jr. (Thomasville, Georgia): I became interested in the treatment of snakebites 37 years ago when Dr. L. M. Klauber of San Diego in his classic two-volume series of rattlesnakes stated that the Eastern diamondback rattlesnake was probably the most dangerous in America.

We have 272 poisonous snakebites treated since 1953; 94, as you see, were caused by the Eastern diamondback. Most of our bites were from this species and the Florida cottonmouth. There were no deaths. There were no deformities, except in one case in which cryotherapy was used at another institution.

Two reasons, perhaps, account for the difference in our treatment. Dr. White is faced with a 2-hour presentation time, as you noted a minute ago, compared to our 40 minutes. The difference in species, as he noted, must be taken also into account. We are using antivenin much more frequently and in larger amounts in treating our Eastern diamondback and canebrake rattlesnakes.

We are currently aware of the disadvantages of horse serum in antivenin also, but without antivenin, we would have several deaths—which happened in our hospital before 1953, but not in our series.

Even with a negative horse serum test, we administer epinephrine and antihistamine, which reduces considerably the incidence of anaphylaxis, and the frequent occurrence of serum sickness is controlled with steroids and an antihistamine.

In severe cases we may give antivenin as a 5-minute push, but we rarely continue the push after the first few vials, then switch to a more dilute solution. Due to the above routine, we almost never see coagulopathy. We average 18.7 vials of antivenin per patient who has been bitten by the Eastern diamondback and canebrake rattlesnakes. We give an average of 9.2 vials of antivenin to the victims of the adult cottonmouth.

I don't know whether that shows up very well, but this is a good example of a child bitten on the left leg three times by an Eastern diamondback snake with no excision and who received 22 vials of antivenin. She had no further surgery.

We have had to do only one fasciotomy in this series of 272 cases. This followed cryotherapy in another hospital, even though adequate antivenin had been given. Bill Larimer of Ft. Worth, Texas, and a member of this organization, feels as I do, that if adequate antivenin is given one rarely needs surgery.

Because 21% of all snakebites occur in the digits, we have done 80 digit dermotomies and think it is helpful and have described this procedure in the literature.

Dr. White, I'd like to ask you how many of your cases with antivenin had severe anaphylaxis. I agree a double-blind study would certainly be in order, as you mentioned.

Dr. Richard Baker (Lubbock, Texas): At Texas Tech we see 10 to 15 bites a year, exclusively the Western diamondback or the prairie rattler. Our current management is immediate exploration and decompression because in the past approximately one quarter of our patients required subsequent decompression after antivenin treatment, which was considered a failure. This show slide shows an 11-year-old who had received eight vials of antivenin in another institution, came in with a cold, insensate leg and required extensive debridement, which we closed a week later. And the child, again, has no significant disability.

I do not know an end point for the use of antivenin. One of our emergency room physicians regionally uses 100 to 125 vials of antivenin for significant envenomation. That's $10,000 to $12,000, which I find intriguing, to say the least.

I would ask Dr. White, if you do decide to use the antivenin, what's your end point?

Dr. Tim Pennell (Winston-Salem, North Carolina): Drs. White and Weber have undertaken another good approach in attempting to answer the very fundamental yet frustrating question of when to use antivenin. It remains an controversial issue, as we have learned in this discussion, and indeed indicators are needed. The authors make three very good points in their manuscript. (1) Antivenin is not a benign mode of treatment. (2) All poisonous snakes and snake bites, even occurring in the same genus, are not equal. Incidentally those of us who are confronted with managing such injuries should be mindful that 20% of all pit viper bites are caused by the Western diamondback rattlesnake.
bites do not result in any envenomation. (3) The use of antivenin should be based on the degree of systemic envenomation and as presented, predictors of this are age and size of the patient and snake type and size. Of course the unknown factor is the dose or amount of venom that is injected and this can be measured accurately only on the basis of clinical response. Furthermore one must take into consideration the basic health status of the victim in connection with these other factors.

If we combine and compare this series with ours reported in 1986 and now containing 119 patients, the distribution of type of snake and results remain the same. Our series is dominated by copperhead bites, whereas the Scott-White clinic experience is predominated by rattlesnakes. They are faced with the famous rattlesnake round-up in their area. Even with this variation, we both are stressing that copperhead and cottonmouth bites, even with envenomation, rarely if ever require the use of antivenin.

One final point, which is often overlooked, and then a question. The person who sustains a poisonous snake bite either because of where they live, their vocation, or hobbies and outdoor activities, usually returns to the same or similar locations. They are, therefore, at increased risk for subsequent snake bites. We should not sensitize these people with the inappropriate use of horse serum-based antivenin. I would be most interested if any of the patients in this series sustained more than one snake bite or strike on different occasions.

DR. DON BURCH (Houston, Texas): As mentioned by the authors of this paper, we do not use and have not used antivenin at the Ben Taub Hospital, although admittedly most of our patients have suffered from bites of the copperhead. However we have had some serious bites, and we have preferred to treat those with the more commonly used methods of the modern intensive care unit, including careful observation and timely intervention based on the patient's condition.

I would like to ask two questions of the authors. Were any blood products used to treat coagulopathies that occurred in patients who were treated with antivenin? Was there any evidence that patients treated with antivenin had less tissue necrosis than those who were not?

DR. WAYNE SCHWESINGER (San Antonio, Texas): Obviously some of these questions are becoming repetitive. I want to remind those of you left in the audience, however, that when controversies persist in surgery, one approach to answering those controversies is to go back to the laboratory.

That brings to mind the fact that a resident recently conducted a study in our laboratory on this very issue. Dr. Ron Stewart developed, validated, and then studied a hind-limb rabbit model of a fixed-dose diamondback rattler envenomation and noted that, in fact, the use of antivenin was associated with decreased swelling, improved survival, and retention of muscular activity when compared to either no specific treatment or the use of wide debridement.

So it appears that antivenin then would be justified in patients not only with severe systemic illness but would also be justified in those patients who had severe envenomation but no severe systemic illness. That is, a patient such as the one who has extremity injury or envenomation with massive swelling but no systemic signs. Furthermore it is suggested by this data that preservation of muscle function can be achieved by the administration of antivenin alone.

So the question would be the same, do the authors feel that the administration of antivenin may result in preservation of muscle function and, therefore, would be justified in that special circumstance?

I am also interested in the fact that the rate of anaphylaxis was so high. In point of fact, an anaphylaxis rate in excess of 40% is much higher than that reported by other authors who give rates of 1% to 10%. Is there a reason for this? Is the rate changing in the more recent time interval? I applaud the authors' use of conservative therapy and antivenin and the avoidance of massive debridements.

DR. ROBERT A. WEBER (Closing discussion): Talking about antivenin use is often like trying to answer the question whether Miller Lite beer tastes great or is less filling. With the comments we have received this afternoon, I find that this indeed holds true.

We view the treatment of snakebites as involving in two areas, local injuries and systemic involvement. We think a local treatment, surgical excision of the bite wound, is best suited for the management of local tissue damage.

While laboratory results tend to indicate that antivenin reduces local tissue injury when given soon after the snakebite, we feel the high complication rate associated with the antivenin does not justify its routine use in all circumstances. For systemic involvement, however, there is little question that antivenin seems to ameliorate the effects of envenomation. For this reason we use antivenin if and only if systemic involvement is present.

The question was raised regarding our rate of anaphylaxis. An article by Jurkovitch in the Journal of Trauma reported that 23% of his patients demonstrated an acute hypersensitivity reaction and anaphylactic shock, and 50% had serum sickness. Another paper reported an overall complication rate of 29%. Our numbers are consistent with the literature.

Dr. Pennell asked if we are seeing patients who are bitten on more than one occasion. We are. One of the first patients I treated was seen in the emergency room for anaphylactic shock. This was his third bite at a rattlesnake round-up, and this time he developed a severe hypersensitivity reaction to the snake venom. No antivenin had yet been given.

Dr. Baker asked how much antivenin we give. We recommend 5 to 10 vials at first, to be titrated to clinical response.

Dr. Burch asked if we use any blood products in the patients treated with antivenin. We used a total of 9 units of fresh frozen plasma and 6 units of packed red cells to treat envenomation associated coagulopathies and bleeding in our patients. We feel the danger of AIDS and hepatitis associated with the transfusion of blood products outweighs the morbidity associated with antivenin, therefore, decreasing or avoiding the use of blood products by using antivenin is advantageous to the patient.

Thank you for the opportunity to present our data for discussion.