Treatment of Snakebites at a Regional Burn Center: Report of a Case Series

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Abstract

Background. Although uncommon, snakebites can cause significant morbidity and mortality. The objective of this study was to review the characteristics, treatment, and outcome of patients with a suspected or known snakebite who were treated at a regional verified burn center.

Methods. A retrospective chart review of all snakebite victims was conducted for the time frame between January 1991 and June 2009.

Results. During the study period, 12 patients were identified. One of the twelve patients was excluded because he had been admitted as an outpatient for wound debridement after being initially treated at another facility. Ten of the remaining 11 patients were male (90.9%). Rattlesnakes were responsible for the majority of bites. One of the eleven patients needed a fasciotomy. The majority of patients received antivenin (ACP/fabAV). No anaphylactoid reactions to either antivenin were recorded. There were no deaths.

Conclusion. With burn centers evolving into centers for the care of complex wounds, patients with snakebite injuries can be managed safely in a burn center.

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Introduction

Snakebites, although rare, can be life-threatening. Between 5,000 to 7,000 venomous snakebites occur annually in the United States.[1,2] From one to six deaths occur per year in the United States from envenomation.[3-5] Snake venom can cause local tissue damage, neurotoxicity, and non-specific systemic effects. Systemic reactions can lead to disorders in coagulation, acute renal failure, hypovolemic shock, and death.

The purpose of the current study was to review the characteristics and outcomes of all snakebite victims admitted to a regional medical center. The standard practice is to admit these patients to the American Burn Association verified regional burn center with care provided by designated burn and wound care surgeons.

Methods

Study design, setting, and selection of participants. A retrospective chart review was conducted of all patients admitted to a regional health center for the treatment of a snakebite between January 1991 and June 2009.

Data collection and analyses. Patient medical records were reviewed for demographics, location and number of snakebites, type of snakebite, mode of arrival, patient presentation, antivenin treatment, antibiotic treatment, tetanus history, wound care treatment and surgical interventions, complications, and outcomes. Data summaries were calculated using SPSS release 16.0 (IBM Corp., Somers, New York).

This study was approved for implementation by the Institutional Review Board of Via Christi Hospitals Wichita, Inc. and the Human Subjects Committee of the University of Kansas School of Medicine-Wichita.

Results

During the study period, 12 patients meeting stated criteria were identified. However, one of these patients had been admitted as an outpatient for wound debridement and split thickness skin graft after initial treatment at another facility and was excluded from the study outcome measurements. Of the remaining 11 subjects, the majority was male, Caucasian, and their average age was 33.5 years (Table 1). One patient (9.1%) under the age of 18 was identified. Nearly one-half of the patients were transported by air to the facility (45.5%).

Of the 11 patients with snakebites, five were the result of rattlesnake bites (Table 2). Type of snake was unknown in three patients (27.3%), however, in two, rattlesnakes were suspected. If true, then rattlesnakes were responsible for 7 of the 11 envenomations (63.6%). The majority of patients sustained one snakebite (81.8%). Of the 14 bites sustained, the majority were located on the hand (64.3%). Of the two patients that sustained multiple bites, one sustained two bites to the hand and one sustained two bites to the hand and one to the forearm. Therefore, of the 14 bites, 78.6% were located on upper extremities and 21.4% on lower extremities.

Ten patients (90.9%) were bitten between the months of April and September. Two of the patients (18.2%) were owners of the snakes that bit them. Four envenomations (28.6%) involved intentional interaction with the snake, and nine envenomations (81.8%) occurred while the patient was outside. The action was uncertain in one patient's case, but the bite was from a pet copperhead snake. Three patients (27.3%) had consumed alcohol prior to being bitten.

Pre-hospital treatment was documented for four patients (36.4%). Two were self-treatments and the remaining treatments by EMS. Of the two self-treated cases, one patient used his belt as a tourniquet and another attempted to "suck" the venom from her thumb. Of the two cases treated by EMS, both had some form of a tourniquet applied, and one had ice packs placed over the wound.

Nine patients (81.8%) received antivenin (Table 3), of which six received ovine polyvalent Crotalidae antivenom (FabAV) and two received equine antivenin Crotalidae polyvalent (ACP). In one patient, the type of antivenin administered was not documented clearly. Of the patients receiving FabAV, an average of 10 ± 6 vials was given. For patients receiving ACP, one was administered 6 vials, and the other 20 vials. Of the two patients who did not receive antivenin treatment, one case was at the request of the patient's family. The other patient who did not receive antivenin had a local reaction to a test dose of equine ACP and was not given the antivenin. No anaphylactic reactions to the antivenins were recorded.

All patients had their tetanus status checked and were updated as indicated by standard guidelines. Five of the 11 patients (45.5%) were given prophylactic antibiotics during their treatment course (Table 3). Of the six patients who did not receive antibiotics, one returned for an incision and drainage for an abscess, and subsequently was prescribed antibiotics.

A teen male bitten just above the Achilles tendon required a fasciotomy for clinically diagnosed compartment syndrome. Three complications were noted including one patient with compartment syndrome and another with a bite infection. The final patient was readmitted, after leaving against medical advice, with a gastrointestinal (GI) bleed, secondary to suspected disseminated intravascular coagulation several days after the snakebite injury.

Table 1. Patient demographics and transport mechanism.

Parameter	Number	Percent
Number of subjects	11	100%
Mean age, years	11	33.5 ± 10.9 (12 – 45)*
Male sex	10	90.9%
Race		
Caucasian	8	72.7%
Hispanic	2	18.2%
Unknown	1	9.1%
Transport method		
Air	5	45.5%
Private vehicle	3	27.3%
Ground Emergency Medical Services (EMS)	3	27.3%

*Mean ± standard deviation (range)

Table 2. Snake bite characteristics.

Parameter	Number	Percent
Type of snake involved		
Rattlesnake	5	45.5%
Copperhead	3	27.3%
Unknown	3	27.3%
Number of snake bites		
1	9	81.8%
2	1	9.1%
3	1	9.1%
Location of snake bites		
Hand	9	64.3%
Forearm	2	14.3%
Lower leg	2	14.3%
Foot	1	7.1%

Table 3. Treatments administered hospitalization characteristics and mortality.

Parameter	Number	Percent
Antivenin administered	9	81.8%
Antibiotics administered	5	45.5%
Infection	1	9.1%
Surgical intervention	2	18.2%
Burn center admission	10	90.9%
Required mechanical ventilation	1	9.1%
Burn Center length of stay, days	10	3.5 ± 2.7
Hospital length of stay, days	11	4.2 ± 2.7
Mortality	0	0.0%

Ten of the 11 patients (90.9%) were admitted to the burn center with an average length of stay of 3.5 days (Table 3). Average hospital stay was 4.2 days. There were no deaths and all patients were discharged to home.

Discussion

General. The findings in this case series are similar to those in other studies. The majority of the snakebite victims in prior reports were also male (66.6-100%).[6-10] One study found most bites (67%) resulted from intentional exposure and 40% of snakebite victims had consumed some amount of alcohol prior to the bite.[11] Mortality from snakebites has been reported between 0-0.21%.[1,2,8,9] The average hospital length of stay for patients in various studies ranged from 2.8 to 5.6 days.[9,12,13] Tokish et al.[12] reported that 36% of patients were transported by air.

The majority of snakebites (84-94%) occurred between the months of April and September.[1,2,12,14] Most injuries, 95-100% of bites, occurred on the extremities.[10,14] Parish[1] reported the majority of bites in the lower extremities (58%).

All of the snakes identified in our study were types of viperids (rattlesnakes and copperheads). No coral snakes (elapids) were identified as the culprit in this study. This finding is most likely geographically related. Crotalidae snakes, the subfamily of viperids that includes the rattlesnakes, copperheads, and cottonmouths, also were found as the most common cause of snakebites from the database of the American Association of Poison Control Centers (98% viperid; 2% elapids).[2]

Prehospital care. Tokish et al.[12] found that 18% of snakebite patients received some sort of first aid prior to presenting to their facility. The methods included "cut and suck", cryotherapy, tourniquet, and superficial constriction band. Cryotherapy lead to extensive soft-tissue necrosis when compared to no treatment.[15] No improvement in survival or outcome with incision and suction has been shown in humans[16] and there is no evidence that lymphatic constriction bands (flat, wide bands applied only to block superficial venous and lymphatic flow, but loose enough to admit 1-2 fingers) provide any treatment benefit. In our series, none of the patients that employed cryotherapy, tourniquet/superficial constriction band, or local wound suction required surgical intervention or had complications, although all of these therapies were discontinued in the emergency department.

Antibiotics. Antibiotic usage in our study (46%) was slightly higher than that reported by Nazim (36%).[10] In our series of patients, antibiotics were administered as prophylaxis, however, wound infections after crotalid envenomation have been reported to occur in approximately 3% of cases, therefore, it is recommended that antibiotics only be given when clinical and microbiologic evidence of wound infection is present.[14,17]

Surgical interventions. Approximately 8 to 28% of snakebite patients require surgical intervention, with the majority requiring fasciotomy (4 to 15.6% of all snakebite patients).[9,10,12,13] Only one of our patients (9%) required a fasciotomy, for elevated compartment pressures. For patients with elevated compartment pressures, Gold et al.[18] recommended an additional 4-6 vials of FabAV over an hour should be administered.

Antivenin. Antivenin Crotalidae Polyvalent (ACP) was introduced in 1954. It is comprised of immunoglobulins isolated from horse serum after exposure to *Crotalus atrox* (Western diamond rattlesnake), *Crotalus adamanteus* (Eastern diamond rattlesnake), *Crotalus durissus terrificus* (Tropical rattlesnake, Cascabel), and

Bothrops atrox ("Fer-de-lance"). It has not been distributed since 2002 and all United States stocks were to have expired as of March 2007.[14,19] Rates for acute allergic reactions (including hypotension and anaphylaxis) ranged from 23-56% for ACP.[17]

FabAV was introduced in 2000.[14] It is purified Fab fragments of sheep immunoglobulin after exposure to *Crotalus atrox* (Western diamondback rattlesnake), *Crotalus adamanteus* (Eastern diamondback rattlesnake), *Crotalus scutulatus* (Mojave rattlesnake), and *Agkistrodon piscivorus* (cottonmouth or water moccasin).[19] The incidence of acute reaction with FabAV have been reported at 14.3%, and nearly all events were mild to moderate.[17] Contraindications to FabAV include a known hypersensitivity to papaya or papin.

Beside the differences in acute allergic reactions, fewer fasciotomies with FabAV (9%) than with ACP (24%) have been documented.[9] Recommended dosing for FabAV are 4-6 vials to achieve initial control, with an additional 4-6 vials until control of symptoms is reached. After initial control is reached, two vials at 6, 12, and 18 hours are recommended to prevent recurrent toxicity.[20] In a review of our patients, the indication and timing of the doses were similar to the previously mentioned strategy. The ovine FabAV has a relatively short half-life of 12-30 hours.

Treatment recommendations. Prehospital treatment should include avoiding excessive activity, immobilizing the bitten extremity, and quickly transporting the victim to the nearest hospital.[17] Initial hospital management includes managing the airway, evaluation of breathing and circulation, providing supportive care, cleaning of the wound, consultation with a medical toxicologist if needed prior to antivenin administration, and providing tetanus toxoid or tetanus immunoglobulin if indicated.[17] Patients with moderate to severe toxicity after Crotalinae bites, or confirmed rattlesnake or water moccasin (cottonmouth) bites and minimal toxicity should receive FabAV.[19]

Patients with confirmed copperhead bites and minimal toxicity should not receive FabAV. Copperhead bites are not considered to be as toxic as cottonmouth or rattlesnake bites.[13,14] A report of 60 patients with copperhead bites treated without antivenin or surgery did not lead to any death, infection, tissue loss, or compartment syndromes.[21]

Patients should be monitored for any acute reactions. Epinephrine, diphenhydramine, cimetidine, inhaled albuterol, and intravenous corticosteroids should be readily available.[17] Patients should be monitored for compartment syndrome and should be confirmed with compartment pressure measurements. Antibiotics are generally not recommended. Patient's laboratory values should be monitored for coagulopathy and rhabdomyolysis.

In some hospitals, all snakebite patients are admitted to an intensive care unit (ICU) for monitoring, regardless of treatment with antivenin, although one case review suggested that the ICU is overused for the treatment of snakebite patients.[12] It is standard policy in this institution for all snakebite patients to be admitted to the burn center, in which all beds are ICU capable. With many burn centers evolving into complex wound centers, patients with snakebite injuries may represent another group that can be provided appropriate care in that setting.[22]

Limitations. This study is subject to the limitations inherent to all retrospective studies: reliance upon data as recorded at the time of patient care, lack of specific details, and possible recording inaccuracies. Another limitation of this study was no standard grading scale for assessment of

envenomation. Additionally, this investigation suffered from a relatively small sample size, limiting the validity of any conclusions drawn from the data.

Conclusions

Guidelines for snakebites, such as used in our institution, may be beneficial as they represent an uncommon injury. The guidelines should include a grading scale for the assessment of envenomation to avoid the unnecessary use of FabAV. With many burn units across the country accepting non-burn patients, including patients with complicated wounds, those with snakebite injuries can be monitored and managed effectively in a burn unit. Furthermore, the presence of burn trauma surgeons can facilitate surgical intervention for compartment syndrome and/or the need for debridement and wound closure.

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