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Management of pediatric snake bites: Are we doing too much?

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ABSTRACT

Background: The optimal management of children with snake bite injuries is not well defined. The purpose of this study was to review the use of antivenom, diagnostic tests, and antibiotics in children bitten by venomous snakes in a specific geographic region (Southeast Texas).
Methods: This is a retrospective single-center review of all patients with snake bite injury from 1/2006 to 6/2012. An envenomated bite was defined as causing edema, discoloration of the skin, necrosis, or systemic effects. The severity of injury was scored using a novel 4-point scale based on initial physical examination alone.
Results: One hundred fifty-one children (mean age 8.4 ± 4.3 years) were treated for a snake bite. There were no mortalities. Lower extremity injuries were most common (60%). Most bites were from copperheads (43%). Envenomation was evident in 82% (average wound score: 2.61 ± 0.81). The median hospital stay for admitted patients (79%) was 2 days (range 1–7). Four patients required surgery for complications of the snake bite. Fifty-two children (34%) received CroFab, with one allergic reaction. 22/135 (16%) had evidence of coagulopathy. Seventy-two children (48%) received IV antibiotics.
Conclusion: Despite a high rate of envenomated bites in Southeast Texas, significant morbidity is rare. Children with an envenomation score of 1 or 2 are unlikely to be coagulopathic, suggesting that laboratory investigation should be reserved for patients with higher scores. The indications for the administration of CroFab deserve further prospective study.

1. Background

Snake bites are relatively uncommon in most regions of the United States, but represent an injury that may have significant associated potential morbidity or even mortality. Globally, it is estimated that over 2 million snakebites cause 20,000 to 94,000 deaths every year [1]. In the United States, approximately 3000–6000 snake bite envenomations occur every year, with an incidence of 0.79 to 1.14 per 100,000 people, resulting in only 5 deaths [1–3]. Geographic regions have different species of snakes, resulting in significant variability in the risk of morbidity and mortality. Serpents in the Crotalidae (pit viper) family cause 99% of snakebites in the United States. There are five subspecies of copperheads which are found from New England to Florida, west to Texas, and in the southern Midwest. The three subspecies of cottonmouths are most common in the southeastern US and along the Gulf Coast. There are over 60 subspecies of rattlesnakes, with a wide distribution from the Atlantic to the Pacific coasts at lower latitudes [4].

Snake venom from pit vipers contains zinc-dependent metalloproteinases that cause direct damage to capillaries by disrupting the basement membrane-endothelial cell connections, causing hemorrhage and fluid extravasation [5]. Significant envenomation can lead to hypoperfusion of soft tissue and skeletal muscle which results in tissue necrosis. The venom of the Crotalidae subfamily, which includes rattlesnakes, copperheads, and cottonmouths/water moccasins, is hemotoxic [6–8]. The consumptive coagulopathy resulting from rattlesnake envenomation is presumably unresponsive to heparin and to fresh frozen plasma while the venom is still circulating, resulting in disseminated intravascular coagulation. The venom of the Elapid family snakes (coral snakes), works by a different mechanism as it contains alpha neurotoxins which cause direct neurotoxicity [5].

The majority of patients with envenomated snake bites present with painful swelling at the injury site and can be managed conservatively [9]. A smaller percentage of patients suffer more significant morbidity including consumptive coagulopathy, acute renal failure, hypovolemic shock, and anaphylaxis [7]. Children are at a higher risk of developing more serious injuries due to their smaller size and the higher relative concentrations of venom compared to adults.

A paucity of prospective data has led to variation in management of pediatric snakebites. The use of antivenin (CroFab) and screening

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labs to detect abnormalities in coagulation has been recommended in patients with evidence of envenomation. However, there is no clear definition of envenomation in the literature, making it difficult to determine the efficacy of these proposed guidelines [4,10]. The purpose of this study was to review a high-volume tertiary care experience with snakebites in a pediatric population, in order to examine current practice patterns and outcomes.

2. Methods

After obtaining IRB approval, the medical records of all patients < 18 years of age presenting to Texas Children's Hospital (TCH) with a snake bite injury from 1/2006 to 6/2012 were reviewed. Texas Children's Hospital is a tertiary care, level 1 trauma center in Houston, Texas with over 80,000 emergency department visits annually. Patients coded with an injury mechanism of snake bite were identified through a prospectively collected trauma database. Data collected included the age at presentation, the setting of the injury, the type of snake involved, physical exam findings, and the hospital course. Snake bites were defined as "envenomated" if there was evidence of edema, discoloration of the site, necrosis, or systemic symptoms. The severity of injury was scored using a novel scale based only on the initial physical examination (Table 1). Patients with systemic symptoms such as neuralgia, paresthesias, paralysis, altered mental status and/or hypotension received automatic scores of 4, independent of local findings.

Demographic characteristics and clinical and laboratory findings were calculated as percentages or means/medians for continuous variables. *A priori* analyses compared clinical and laboratory findings and outcomes of patients stratified by wound scale score and CroFab administration to assess management practices and resource utilization. Coagulopathy was defined as a PT > 15, INR > 1.5, or a PTT > 40. Creatine kinase (CK) was considered elevated if > 240 IU/L. Analyses were conducted using SPSS Version 20 (IBM; Chicago, IL).

3. Results

3.1. Patient population

During the study period, 151 children (66% male, mean age 8.4 ± 4.3 years) were evaluated for snakebite in our institution (Table 2). Lower extremity injuries were most common (60%, n = 91), followed by upper extremity (38%, n = 58), groin (1%, n = 1), and face (1%, n = 1). The majority of our patients were transferred from referring facilities (n = 121, 80%). Pediatric general surgery was consulted for assistance in management in 82 (54%) patients, and plastic surgery was consulted for wound management in 36 (24%); a small number of children received both general and plastic surgery consultation. The snake was identified by photo, description, or by examination of the snake (n = 27) in 86 (57%) cases. Copperheads (n = 65, 43%) were the most frequent, followed by water moccasins (n = 6, 4%), rattlesnakes (n = 6, 4%), coral snakes (n = 3, 2%), pit vipers (n =3, 2%), pygmy rattlesnake (n = 1, 1%), timber rattle snake (n = 1, 1%), and fer-de-lance (n = 1, 1%). The snakebite occurred near the home in the majority (53%) of patients. 11 patients (7%) were bitten in a wilderness setting, and the setting of the bite was not documented in 60 (40%).

Table 1
Texas Children's Hospital novel classification system for the severity of snake bite wounds.

Wound Class	Description
1	Minor injury Puncture marks only
2	Moderate injury Puncture marks Cellulitis or ecchymosis localized to puncture marks
3	Level 2 Findings +Spreading erythema, induration, or purulent material −Necrosis
4	Level 3 Findings +Tissue necrosis *Systemic symptoms (neurologic, cardiovascular, gastrointestinal) irrespective of local findings.

3.2. Patient outcomes

Four patients required surgery: two fasciotomies for compartment syndrome, one full-thickness skin graft, and one operative wound debridement. No patients presented with or developed hypotension, neurologic deficits, significant gastrointestinal symptoms, or altered mentation. There were no deaths.

3.3. Resource utilization

We evaluated the management strategies and overall resource utilization with respect to laboratory investigation, antibiotic treatment, and antivenom administration based on wound score (Table 3). Thirty-four percent (n = 52/154) received antivenom. Laboratory studies, including coagulation profile (89%), complete blood count (85%), creatinine kinase (23%), and urinalysis (2%) with microscopy (evaluating for myoglobinuria) were ordered in a significant number of patients. Of the 109 patients who had envenomated snake bites and were admitted, 81 patients were treated with intravenous antibiotic therapy. Patients with a wound score of 1 were treated with the full complement of IV antibiotics, laboratory evaluation, and antivenom 7% of the time, compared to 10%, 22%, and 21% for wound scores of 2, 3, and 4, respectively.

3.4. Laboratory evaluation

We analyzed the specific laboratory findings to determine the rates of anomalous values. Coagulation parameters are commonly ordered to assess for envenomation. Of the 135 patients with a coagulation panel obtained, 18% of patients had an abnormality. The highest values for PT, INR, and PTT were 20.2, 1.6, and 40.6, respectively. No patients had platelet levels less than 100,000 U/L. Myoglobinuria was detected in 3% (n = 3), and elevation of CK was evident in 3% (n = 1) of patients (Table 3).

3.5. Antibiotic utilization

In total, 44% (52/109) of admitted patients received IV antibiotics. 39% of all patients (59/151) were treated with oral antibiotics. Some patients received IV antibiotics as an inpatient, and were discharged with oral therapy. The specific antibiotic used for treatment varied. The most common drugs included clindamycin (14%), piperacillin/tazobactam (11%), and ticeracillin/sulbactam (7%) on an inpatient basis, and amoxicillin/clavulanate (25%), clindamycin (14%) and trimethoprim-sulfamethoxazole (4%) as an outpatient. There were no readmissions related to inadequately treated or recurrent skin infections.

3.6. Antivenom administration

Fifty-two patients (34%) received antivenom (generic name FabAV, trade name CroFab). There were no significant differences in patients who were treated with CroFab compared to those who were not (Table 2). The median dose was 6 vials (range = 1–16) for an estimated cost (based on the cost of one vial of CroFab in 2012) of