



Pediatric snakebites: lessons learned from 114 cases

Brendan T. Campbell*, John M. Corsi, Cristiano Boneti,
Richard J. Jackson, Samuel D. Smith, Evan R. Kokoska

Department of Surgery, Arkansas Children's Hospital and the University of Arkansas for Medical Sciences,
Little Rock, AR 72202, USA

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Abstract

Purpose: Evidence-based guidelines for the treatment of pediatric snakebite injuries are lacking because they occur infrequently in most centers.

Methods: We reviewed our experience treating snakebites from January 1995 through December 2005. Demographic (eg, age, sex, geographic location) and clinical information (eg, location of bite, species of snake, vital signs, laboratories, treatment, hospital length of stay) were obtained.

Results: Over the last decade, we have treated 114 children with confirmed snakebites. Mean age was 7.3 ± 4.2 years (range, 1–17 years), and snakebites were more common in males ($n = 68$, 60%). All bites occurred on the extremities, and lower extremity bites were more common ($n = 71$, 62%). Copperheads inflicted the most bite injuries ($n = 65$, 57%), followed by rattlesnakes ($n = 9$, 8%) and cottonmouths ($n = 7$, 6%). The snake was not identified in 33 (29%) cases. Seven (6%) children were treated with *Crotalidae* antivenin. Of the children treated with antivenin, only 4 met criteria for treatment, and 1 had an anaphylactic reaction. If compartment syndrome was suspected based on neurovascular examination, compartment pressures were measured. Only 2 (1.8%) patients required fasciotomies. Over the last 2 years, we have stopped empiric treatment with antibiotics and have not observed any infectious complications. Average hospital length of stay was 30 ± 25 hours.

Conclusions: Most children bitten by pit vipers can be managed conservatively with analgesics and elevation of the affected extremity. Treatment with *Crotalidae* antivenin, antibiotics, and fasciotomy is rarely indicated.

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An estimated 8000 bites by venomous snakes occur in the United States annually, resulting in 5 or 6 deaths [1]. There are an estimated 120 species of snakes indigenous to the United States, and approximately 20 species are venomous. Venomous snakes are found in every state except Alaska, Hawaii, and Maine [2]. Venomous snakebites in children are

uncommon but have the potential to produce significant morbidity and occasional mortality. Clinicians must be able to rapidly identify and treat children who develop the sequelae of severe envenomation.

1. Methods

We reviewed our experience treating snakebites from January 1995 through December 2005. Demographic (eg,

* Corresponding author. Connecticut Children's Medical Center, 282 Washington St, Hartford CT 06106, USA. Tel.: +1 860 545 9545; fax: +1 860 545 9520.

E-mail address: bcampbell@ccmckids.org (B.T. Campbell).

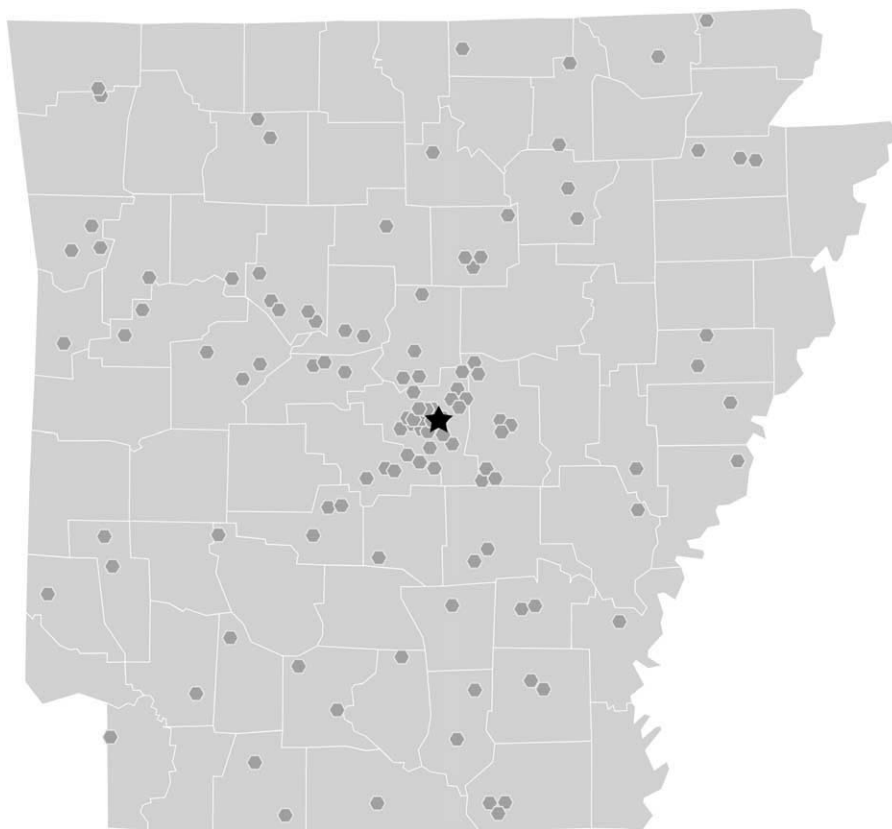


Fig. 1 Geographic distribution of pediatric snakebites in Arkansas.

age, sex, geographic location) and clinical information (eg, location of bite, species of snake, vital signs, laboratory tests, treatment, hospital length of stay, surgical fasciotomies treatments, and follow-up information) were obtained from surgical inpatient records. Summary statistics were performed using STATA statistical software (College Station, TX).

The Institution Review Board Human Research Advisory Committee at the University of Arkansas for Medical Sciences has approved this study (IRB record number 48114).

2. Results

Over the last decade, we have treated 114 children with confirmed snakebites. The overwhelming majority (99%) of bites occurred between April and October and were evenly distributed throughout the state (Fig. 1). Mean age was 7.3 ± 4.2 years (range, 1-17 years), and envenomations were more common in males ($n = 68$, 60%).

All bites occurred on the extremities, and lower extremity bites were more prevalent ($n = 71$, 62%). All of the snakebites in this series were inflicted by pit vipers (family *Crotalidae*): Copperheads (*Agkistrodon contortrix*), western diamondback rattlesnakes (*Crotalus atrox*), and cottonmouths (*Agkistrodon piscivorus*). Copperheads inflicted the most bite injuries ($n = 65$, 57%), followed by rattlesnakes

($n = 9$, 8%) and cottonmouths ($n = 7$, 6%). The species of snake was not clearly identified in 33 cases (29%) (Fig. 2).

Seven (6%) children were treated with *Crotalidae* antivenin. Of the children treated with antivenin, only 4 met criteria for treatment, and one had an anaphylactic reaction. Of the 4 patients that met criteria for antivenin administration, 2 were bitten by rattlesnakes.

Two (1.8%) patients required fasciotomies for compartment syndrome, and both were 2 years old. The first patient was bitten by a cottonmouth on the left hand and received 2 doses of antivenin. Before the fasciotomy, the patient's compartment pressures were greater than 60 mm Hg. Surgery was performed 20 hours after the bite and required release of the flexor and extensor compartments in the forearm, the palmar compartment, and the flexor compartment of the proximal arm (biceps). The second patient was bitten by a

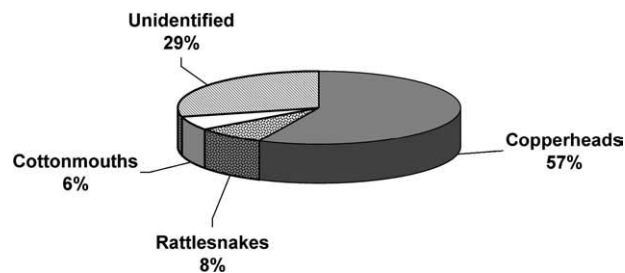


Fig. 2 Species of culprit snake.

Treatment Algorithm for Pediatric Snakebites (*Crotalidae*)

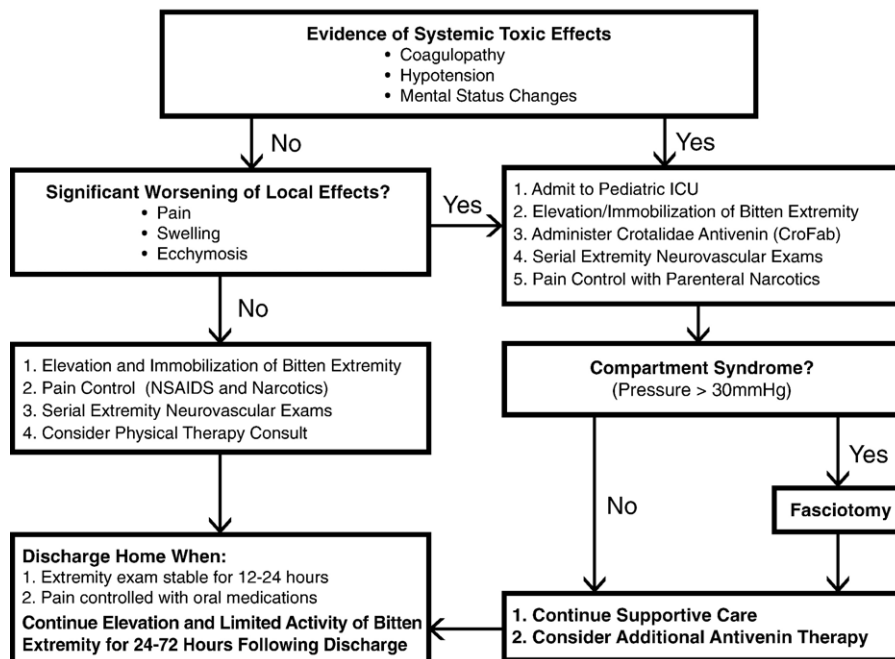


Fig. 3 Treatment algorithm for pediatric snakebites.

copperhead on the foot and did not receive antivenin. The patient's compartment pressures measured 35 mm Hg in the leg and 40 mm Hg in the foot. Fasciotomies were required in all 4 compartments in the lower extremity and in the dorsum of the foot. The surgery was performed 92 hours after the snakebite injury.

Patients who received antivenin and those that developed compartment syndrome were admitted to the Pediatric intensive care unit (PICU) for hemodynamic monitoring and serial neurovascular examinations. The remaining patients were admitted to the floor on the surgical service for close observation.

Over the last 2 years, we have stopped empiric treatment with antibiotics and have not observed any infectious complications. Average hospital length of stay was 30 ± 25 hours. There were no amputations or fatalities.

3. Discussion

This is the largest series of pediatric snakebites of which we are aware. Most of the children in this case series were treated conservatively once the clinical effects of severe envenomation were excluded. Our recommendations are based upon our experience treating children with confirmed pit viper (family *Crotalidae*) bites, most commonly copperheads.

Snakebite victims and their parents are frequently alarmed by the swelling and bruising that usually occurs in the affected extremity. These symptoms are caused by the injection of snake venom, which is composed of a chemically

complex mixture of (mostly) enzymatically active proteins [3]. The observed edema and ecchymosis result from a venom-induced capillary leak, which causes extravasation of plasma and erythrocytes [3].

The distribution of culprit snake species in our series is similar to other large series from the southwestern United States [4,5]. All identified snakebites in this series were inflicted by pit vipers, and all but one bite occurred between April and October, when snakes are active and many young Arkansans are barefoot outdoors. The epidemiology of pediatric snakebites is different from that of adults. Most pediatric snakebites occur on the lower extremities, and they are not associated with alcohol intoxication or deliberate attempts to handle snakes [3].

The dose of venom delivered is a function of the size of the snake, the location of the bite, and the size of the patient. Because of children's smaller relative size, they receive a higher dose of venom. Some authors advise this could increase their morbidity and mortality risks [6,7]. Our study suggests this is not true. Very few of our patients required treatment with antivenin or surgical fasciotomy, and there were no deaths.

Several authors have recommended that prophylactic antibiotic treatment be abandoned because the risk of wound infection after *Crotalidae* envenomation is low [3,8,9]. Our study corroborates this recommendation because for the last 2 years, we have discontinued empiric antibiotic use without any observed increase in infectious complications.

Recently, sheep-derived *Crotalidae* polyvalent immune Fab (ovine; FabAV) has become available for the treatment of severe envenomation. It is significantly more potent

and less allergenic than antivenin (*Crotalidae*) polyvalent (equine; ACP), which has been the standard of care since the 1950s [3]. FabAV is made by immunizing sheep with pit viper venom. Several studies have shown that FabAV is highly efficacious in treating the local and systemic toxic effects of *Crotalidae* envenomation in adults and children [10,11]. The cost of FabAV, however, is substantial: \$25,000 per patient for FabAV alone [12]. Some centers are treating the most (75%) of their patients bitten by pit vipers with FabAV, although many patients do not meet the accepted criteria for treatment [11].

Several authors argue that FabAV is unnecessary after most pit viper envenomations [4,13,14]. Our data suggest that FabAV can be used judiciously and reserved for only those children that develop systemic toxic effects of pit viper envenomation or compartment syndrome.

Our study is a retrospective case series that has several limitations inherent to this type of observational study [15]. For example, our recommendation to discontinue prophylactic antibiotics in pediatric snakebite victims is based solely on our observation that children who did not receive antibiotics did not develop infectious complications, not on a randomized controlled trial.

Our study is also limited by the fact that most snakebites in our study were inflicted by copperheads. Rattlesnake venom is 10 times more toxic than copperhead venom, and children bitten by rattlesnakes may need to be treated more aggressively with FabAV [16]. Finally, this study does not include follow-up data with respect to long-term functional disability.

Future studies are needed to better define the population of children who will benefit from FabAV administration. Identifying the population of patients in whom FabAV treatment is unnecessary will allow clinicians to avoid its associated risks and substantial cost [17].

Children with suspected snakebites require prompt evaluation, and an effort should be made to identify the species of culprit snake. Two peripheral IVs should be started: one for antivenin and a second for blood products and other medications [7]. Baseline laboratory tests should include a complete blood count with platelet count, electrolytes, blood urea nitrogen, fibrinogen levels, and prothrombin time. Although these tests do not quantify the degree of envenomation, they can screen for coagulopathy, identify metabolic derangement, and monitor renal function [7]. In addition, typing and crossmatching should be done upon admission because the systemic effects of the envenomation may make this impossible later [7]. Serial neurovascular examinations in the affected extremity should be performed to identify patients who are developing compartment syndrome. If neurovascular examinations are abnormal, compartment pressures should be measured immediately so fasciotomies can be performed expeditiously. Tetanus toxoid should be administered to patients who have

not received it within 5 years or in patients whose immunization history is in question.

Those children who exhibit signs and symptoms of life-threatening systemic reaction (ie, shock, coagulopathy, compartment syndrome) should be admitted to the pediatric intensive care unit, treated with FabAV, and have compartment pressures measured if compartment syndrome is suspected.

In our experience, a conservative approach to the treatment of pediatric pit viper envenomations is best (Fig. 3). Most children can be admitted to the floor and managed conservatively with analgesics, elevation and immobilization of the affected extremity, and close observation for 24 hours. Treatment with *Crotalidae* antivenin, antibiotics, and fasciotomy are rarely indicated.

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