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Comparison of antivenom effects between pediatric and adult patients presented to emergency department with scorpion stings

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Abstract

The aim of this study was to compare the use of antivenom, and admission to ICU, scorpionism between adult and pediatric patients. This study included 99 patients who were admitted to the emergency department with scorpion sting within 1 year. Patients' demographics including age and gender, and clinical findings such as ionized Ca values, body region of sting contact and complications were recorded from the patient files and hospital records. In addition, regarding management of patients with scorpionism the use of antivenoms, admission to intensive care unit and complications developed by the patients were also recorded. Patients were divided into two groups according to age as the pediatric group including patients aged ≤ 18 years (Group 1) old and the adult group consisting of patients aged > 18 years old (Group 2). Antivenom administration was performed in 12 patients (12.2%). Antivenom was administered in 38% (n=8) of the patients in Group 1 and 5.13% (n=4) of the patients in Group 2. The mean age of patients who received antivenom was statistically significantly lower than the patients who did not receive antivenom ($p < 0.05$). There was a statistically significant difference between the groups in terms of hospitalization in the intensive care unit. Mean age was statistically significantly higher in patients aged ≤ 18 years and hospitalized in the intensive care unit ($p < 0.05$). The management of scorpion stings shows differences between children and adults. Given potential side effects of the use of antivenom; existing classification guidelines should be followed especially in pediatric patients, and new strategies should be developed for the management of children with scorpion stings.

Keywords: Scorpion sting, scorpionism, antivenom, children

Introduction

Scorpion sting, also known as scorpionism is a serious public health problem and an acute life-threatening medical emergency in many regions of the world, and especially in rural areas of the developing countries. Scorpion envenomation is a potentially life threatening condition, leading to serious health consequences and neurological manifestations depending on severity of the scorpion sting. Signs and symptoms of envenomation are more severe especially in young children, because toxic effects of envenomation increase since the amount of toxin exposed is increased due to lower body weight of children. Severity of the sting made the treatment difficult in these cases because of the wide spectrum of clinical manifestations [1-4].

Scorpion venom is a water-soluble, heterogenous and antigenic mixture. The venom consists of various low-molecular weight neurotoxic peptides. Its heterogeneity make reactions given against the venom variable. Scorpion venom mainly exerts its toxic effects on central nervous system, neuromuscular transmission and cardiovascular system. Symptoms of scorpionism begin immediately after the sting, reach to peak within a few hours and may last 24 to 48 hours. The most common clinical effects of envenomation are neuroautonomic, neuromuscular and local tissue effects. Local effects include pain, swelling and erythema around site of the sting. Clinical manifestations include autonomic disturbances such as hypertension, hypotension, tachycardia, bradycardia, excessive salivation and lacrimation, incontinence and pulmonary edema. These disturbances are caused by release of catecholamines into the bloodstream or due to direct cardiac toxicity of the venom [5]. Mortality from scorpion stings is usually resulted from cardiogenic shock or pulmonary edema.

Scorpion antivenom therapy (SAV) is the widely accepted and single primary treatment strategy for scorpionism. However,

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SAV must be given only with appropriate local and systemic indications because of its potential serious side effects varying from mild complications such as fever, nausea / vomiting, chill, burning on face and headache to severe complications including hypotension, loss of consciousness. However, indications for the use of antivenom remain controversial.

There are numerous studies in the literature investigating management of scorpionism in adults and in pediatric patients [2,6-12]. However, the number of studies comparing management of scorpion sting envenomation between adults and childrens in emergency departments are scarce. Therefore, the objective of this study was to compare the use of antivenom, admission to ICU, ionized Ca values and complications of scorpionism between adult and pediatric patients.

Materials and Methods

This study included 99 patients who were admitted to the emergency department with scorpion sting within 1 year g were evaluated retrospectively.

A detailed medical history was received and physical examination was carried out in all patients with scorpionism. Patients' demographics including age and gender, and clinical findings such as ionized Ca values, body region of sting contact and complications were recorded from the patient files and hospital records. In addition, regarding management of patients with scorpionism the use of antivenoms, admission to intensive care unit and complications developed by the patients were also recorded. Patients found to have another diagnosis and patients with insufficient informations were excluded from the study. Patients were divided into two groups according to age as the pediatric group including patients aged ≤ 18 years (Group 1) old and the adult group consisting of patients aged > 18 years old (Group 2). Accordingly Group 1 included 21 patients and Group 2 consisted of 78 patients. Eight (38.1%) patients in Group 1 were girls and 13 (61.9%) patients were boys in Group 1, while 43 (55.1%) patients were female and 35 (44.9%) patients were male in Group 2. Routine monitorization of the patients was performed with regular measurements of heart rate, respiratory rate, blood pressure and oxygen saturation at certain intervals.

Antivenom was administered in patients with severe local and systemic indications. For this purpose, a single 5 mL equine derived antivenom (Acsera, Vetal Ltd Sti, Turkey) was injected with half administered to the wound site and the other half was given as intramuscular. Repeat dose was administered in patients hospitalized in the intensive care unit as 1 vial in pediatric patients and 0.5 vial in adult patients. Patients administered antivenom were observed for a minimum period of 24 hours before being discharged.

Statistical Methods

Data obtained from this study was analyzed using SPSS software (version 22.0, SPSS Inc., Chicago, Illinois) Descriptive statistics are expressed as mean, standard deviation, median, minimum, maximum, frequency and percentage. Normal distribution of the variables was analyzed with Kolmogorov-Smirnov test.

Mann-Whitney U test was used for the analysis of quantitative independent variables. Qualitative variables were analyzed with Chi-square test, and when conditions were not met Fischer test was used for the analysis. $p < 0.05$ values were considered statistically significant.

Results

A total of 99 patients who presented to the emergency department of due to scorpionism were included in the study. Of all patient included in the study, 51 (51.52%) were female and 48 (48.48%) were male with a mean age of 44.7 ± 27.6 years. The mean age was found as 45.73 years in female and 43.69 years in male patients. Of the patients, 21 (21.21%) were in the ≤ 18 years old (Group 1), and 78 (78.79%) in > 18 years old (Group 2) groups. Distribution of patients according to age and gender is given in Table 1.

Table 1. Distribution of patients according to age and gender

Age (year)	Femal		Male	
	n	%	n	%
0-5	2	2.02	4	4.04
6-11	3	3.03	1	1.01
12-18	3	3.03	8	8.08
19-49	21	21.21	12	12.12
50-65	8	8.08	10	10.10
> 65	14	14.14	13	13.13
Total	51	51.52	48	48.48

Contact sites were found as lower extremity in 40 (40.40%), upper extremity in 37 (37.37%), head & neck region in 14 (14.4%), and trunk in 8 (8.08%) of the patients. Distribution of contact sites is shown in Figure 1.

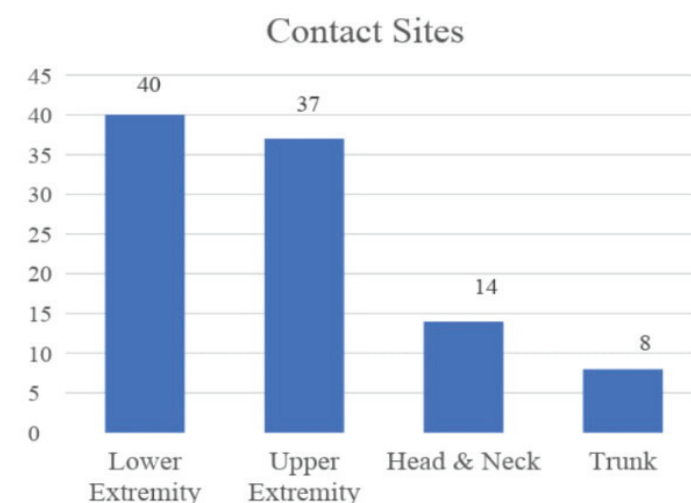


Figure 1. Numerical distribution of scorpion sting contact sites

In Group 1; contact sites were found as upper extremity by 38% (n=8), lower extremity by 33% (n=7), head & neck region by 24% (n=5), and trunk by 5% (n=1). Whereas in Group 2; contact sites were found as lower extremity by 42% (n=33), upper extremity by 37% (n=29), head & neck region by 12% (n=9), and trunk by 9% (n=7).

The mean ionized Ca value of the patients included in the study was measured as 1.2 ± 0.2 . The mean ionized Ca value was found as 1.30 in Group 1 and 1.22 in Group 2.

Antivenom administration was performed in 12 patients (12.2%). Antivenom was administered in 38% (n=8) of the patients in Group 1 and 5.13% (n=4) of the patients in Group 2. The mean age of patients who received antivenom was statistically significantly lower than the patients who did not receive antivenom ($p < 0.05$). In addition, the rate of antivenom administration was significantly higher compared to Group 2 ($p < 0.05$). Antivenom administration was used in 9 male (18.75%), and 3 female (5.88%) patients. The use of antivenom was significantly higher in male than in female patients ($p < 0.05$).

A total of 10 patients (10.10%) were admitted to the intensive care unit. The mean ages of patients with and without hospitalization in the intensive care unit were found as 45.3 ± 26.8 years and 40.0 ± 35.0 years, respectively. There was no statistically significant difference between the patient hospitalized in the intensive care unit and those not hospitalized in terms of age ($p > 0.05$). However, there was a statistically significant difference between the groups in terms of hospitalization in the intensive care unit. Mean age was statistically significantly higher in patients aged ≤ 18 years and hospitalized in the intensive care unit ($p < 0.05$). Among the patients hospitalized in the intensive care unit, 5 (50%) patients were in Group 1 and 5 (50%) patients in Group 2. The rate of hospitalization in the intensive care unit due to scorpionism was found as 4.17% (n=2) in female and 15.67% (n=8) in male patients. Total three patients developed complications with all of them being in the group administered antivenom. No mortality occurred in our any patient. Demographic data, status of antivenom administration, hospitalization in the intensive care unit and complication data are given in Table 2.

Table 2. Demographic and clinical data according to antivenom

		Antivenom (-)	Antivenom (+)	P
		N (%), (ort)	N (%), (ort)	
Iyonize Ca		1.25 ± 0.24	1.13 ± 0.31	0.018
Intensive care	(-)	86 (96.9)	3 (3.4)	0.000
	(+)	1 (10.0)	9 (90.0)	0.000
Complication	(-)	87 (90.6)	9 (9.4)	0.000
	(+)	0 (0.0)	3 (100.0)	0.000
CBA	HN	10 (71.4)	4 (28.6)	0.064
	Body	7 (87.5)	1 (12.5)	1.000
	LE	37 (92.5)	3 (7.5)	0.246
	UE	33 (89.2)	4 (10.8)	0.758
Group 1		8 (72.7)	3 (27.3)	
Group 2		74 (94.9)	4 (5.1)	

HN: Head Neck, LE: Lower Extremity, UE: Upper Extremity, CBA: Contact Body Area

Discussion

As in many areas around the world, scorpion stings are and important public health problems in our country especially in Southern and Southeastern Anatolia regions, and particularly in summer months [4,13]. This is caused by climate, geographic location, and socioeconomic structure of the region [3]. Studies in the literature have reported different results about the global incidence of scorpionism. The number of worldwide scorpion stings is estimated as 1.2 million annually, with 3,250 (0.27%) resulting in death [2,11]. However, there are studies reporting 100.000 scorpionism cases annually with 800 resulting in death globally [14-16]. In the literature screening, we could not reached to healthy data about the incidence in Turkey.

In our study, 21.21% of the patients who presented with scorpion stings were under 18 years old. On the other hand, the rate of patients aged under 19 years was reported as 26% in a study from Brazil [17], and 28.6% in a study conducted in the USA [18]. Different results reported by the studies about age groups were thought to be resulted from several factors including climate characteristics, socioeconomic and environmental conditions, number of cases etc. In a study by Yilmaz et al. performed in Diyarbakir province, which is again located in Southeastern region of Turkey; 22% of 123 patients who presented with scorpionism were under 18 years old [4]. The similarity between the results of that study and our results might be resulted from that both areas are in close proximity with similar geographic and socioeconomic characteristics.

In our study, 51.52% of the patients referred due to scorpion stings were female and 48.48% were male. Whereas 61% of the patients in ≤ 18 years group were male and 39% were female, these rates were found as 45% and 55%, respectively in > 18 years group.

When frequency of contact sites were examined in our study; the most common contact site was lower extremity with 41% followed by upper extremity by 37%, head & neck region by 14% and trunk by 8%. Similarly, in a study by Ahmed et al. from Egypt, the most common contact sites were reported as low and upper extremities [13]. Again in a study by Nejati et al. from Iran with 1522 cases of scorpion stings, the most common contact sites were reported as legs and hands [19]. This may be caused by that the lower and upper extremities are the most mobile body parts with the most frequent contact with external environment.

Local signs in scorpion sting include pain, hyperemia, itching and swelling; neurologic signs include irritability, hypothermia, hyperthermia, sweating, convulsion, coma, and myosis; cardiovascular signs include tachycardia, bradycardia, hypotension and hypertension; gastrointestinal signs include vomiting, abdominal pain, diarrhea and distension; respiratory findings include bradypnea, tachypnea, bronchial congestion, and acute pulmonary edema; and genitourinary system signs include priapism, oliguria, and hematuria [13].

Before the introduction of antivenoms, supportive care measures have been used for the treatment of scorpionism. Commonly used medical therapy has been administration of benzodiazepine and opioids to relieve agitation and pain [20]. Supportive care alone

often requires hospitalization in intensive care unit and mechanical ventilation. Whereas the use of antivenom has enabled patients to be discharged directly from emergency department [21]. Today, scorpion antivenom treatment is the only treatment strategy widely accepted for scorpion stings [22]. Efficiency of antivenom in scorpion stings has been shown in many studies [15,23,24]. When injected, antivenom binds to venom and facilitates its excretion [25]. Besides it neutralizes the unbound venom in circulation, antivenom also creates a concentration gradient between plasma and target tissue. Thus, venom bound to antivenom is excreted from the body [26,27]. In a recent randomized controlled study, it was reported that administration of scorpion venom in children significantly shortened the time for complete resolving of autonomic symptoms and duration of hospitalization [28]. However, this treatment should be limited with local and systemic symptoms together, because its potential serious side effects. Antivenom application has side effects including early allergic reactions such as skin rash, urticaria, bronchospasm, and itching [29,30]. Again, antivenom application potentially carries risk for anaphylaxis, hypotension, cyanosis and loss of consciousness [31]. In addition, overuse of antivenom without clinical indications may pose problems in the areas with limited resources [32]. In a study by Sahin et al., it was found that antivenom was used in 22.5% of patients without systemic and/or local indications, and the result was statistically significant [8]. In the present study, 87 (87.88%) patients were healed with appropriate treatment method without use of antivenom. Whereas antivenom was administered in 12 (12.12%) of patients with severe local and systemic indications. In a study by Furtado et al. in Brasil, antivenom was applied in 10.54% of the patients [17]. In a study by Sahin et al., antivenom was given in 28.2% of the patients with scorpionism [8]. We attributed the different results about the rate of antivenom use to the differences among the studies for indications of antivenom use. There is no consensus in the literature, especially on the indications and criteria for the use antivenom in pediatric patients. In addition, because scorpion stings in different regions are caused by different scorpion species, the use of antivenom shows difference among centers.

In our study, antivenom was administered by 38% in patients aged 18 years or younger, and by 5.13% in patients aged over 18 years. Antivenom administration was statistically significantly higher among the patients aged 18 years or younger ($p < 0.05$). In a study by Coorg et al. with 156 cases of scorpion sting, mean age of patients administered antivenom was significantly lower compared to patients given supportive treatment [1]. Because of the smaller body size in pediatric patients, venom spreads to the body more rapidly, and local and systemic symptoms develop more quickly. This makes the use of antivenom more important in pediatric patients compared to adults. Studies have reported that, higher doses of antivenom may be required in pediatric patients especially in cases of severe scorpion stings [10]. In our study, repeat antivenom dose was administered in pediatric patients (23.8%) who required intensive care. Again in our study, rate of hospitalization in the intensive care unit was significantly higher in patients aged 18 years or younger. Since there was no study in the literature comparing the management of scorpion stings between children and adults, we could not compared this result with other studies.

Studies in children with scorpion stings were limited and majority of them were case reports. The use of antivenom in children is primarily based on the studies conducted in adults [15,23]. Even low doses of antivenom may cause deterioration in some children because of their body size [33].

This study has certain limitations. Firstly, the relatively low number of evaluated cases may be considered as a limitation. It is necessary to undertake a further study with a higher number of cases to obtain more reliable results. Another limitation is lack of grading in scorpion stings. Finally, we could analyzed only the data existed in hospital records. However, as a strength to our knowledge our study is the first study in the literature comparing children and adults with scorpion stings.

Conclusion

The management of scorpion stings shows differences between children and adults. Local and systemic symptoms, develop earlier in children because of the same amount of venom covers a lower distance. Given potential side effects of the use of antivenom; existing classification guidelines should be followed especially in pediatric patients, and new strategies should be developed for the management of children with scorpion stings. Further studies with larger number of patients are needed to compare children and adults with scorpionism. We believe that, our results will guide further comprehensive studies to be conducted on this issue.

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Competing interests

The authors declare that they have no competing interest.

Financial Disclosure

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Ethical approval

Ethical approve of the study protocol was not applicable due to retrospective nature. The study was conducted in accordance with the principles of the Declaration of Helsinki.

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References

1. Coorg V, Levitan RD, Gerkin RD, et al. Clinical presentation and outcomes associated with different treatment modalities for pediatric bark scorpion envenomation. *J Med Toxicol.* 2017;13:66-70.
2. Chippaux JP. Emerging options for the management of scorpion stings. *Drug Des Devel Ther.* 2012;6:165-73.
3. Ozkan O, Uzun R, Adigüzel S, et al. Evaluation of scorpion sting incidence in Turkey. *J Venom Anim Toxins incl Trop Dis.* 2008;14:128-40.
4. Yılmaz F, Arslan ED, Demir A, et al. Epidemiologic and clinical characteristics and outcomes of scorpion sting in the southeastern region of Turkey. *Ulus Travma Acil Cerr Derg* 2013;19:417-22.
5. Del Brutto OH. Neurological effects of venomous bites and stings: snakes, spiders, and scorpions. *Handb Clin Neurol.* 2013;114:349-68.

6. Al-Asmari A, Manthiri RA, Abdo N, et al. Saudi medicinal plants for the treatment of scorpion sting envenomation. *Saudi J Biol Sci.* 2017;24:1204-11.
7. Nasim MJ, Asad MH, Sajjad A, et al. Combating of scorpion bite with Pakistani medicinal plants having ethno-botanical evidences as antidote. *Acta Pol Pharm.* 2013;70:387-94.
8. Sahin A, Arici MA, Hocaoglu N, et al. Antivenom use in bite and sting cases presenting to a public hospital. *Ulus Travma Acil Cerrahi Derg.* 2018;24:343-50.
9. Dudin AA, Rambaud-Cousson A, Thalji A, et al. Scorpion sting in children in the Jerusalem area: a review of 54 cases. *Ann Trop Paediatr.* 1991;11:217-23.
10. Abimannane A, Rameshkumar R, Satheesh P, et al. Second dose of scorpion antivenom in children with Indian red scorpion (*Mesobuthus tamulus*) sting envenomation. *Indian Pediatr.* 2018;55:315-8.
11. Dokur M, Dogan M, Yagmur EA. Scorpion-related cardiomyopathy and acute pulmonary edema in a child who is stung by *Leiurus abdullahbayrami*. *Turk J Emerg Med.* 2017;17:104-8.
12. Oyediji OA, Musa TL, Adebami OJ, et al. Fatal scorpion sting in a child. *Niger J Clin Pract.* 2014;17:112-4.
13. Ahmed AE, Abdel-Baseer KA, Saad K, et al. Endocrinological and biochemical changes of scorpionism in children in Upper Egypt. *Ther Adv Endocrinol Metab.* 2015;6:210-6.
14. Abourazzak S, Achour S, El Arqam L, et al. Epidemiological and clinical characteristics of scorpion stings in children in Fez, Morocco. *J Venom Anim Toxins inci Trop Dis* 2009;15:255-67.
15. Bawaskar HS, Bawaskar PH. Management of scorpion sting. *Heart.* 1999;82:253-4.
16. Gümüştekin M. Çevresel toksinler: Hayvan ısırma ve sokmaları. *T Klin J Pharmacol.* 2003;1:53-7.
17. Furtado SDS, Belmino JFB, Diniz AGQ, et al. Epidemiology of scorpion envenomation in the state of Ceará Northeastern Brazil. *Rev Inst Med Trop Sao Paulo.* 2016;58:15.
18. Kang AM, Brooks DE. Nationwide scorpion exposures reported to US poison control centers from 2005 to 2015. *J Med Toxicol.* 2017;13:158-65.
19. Nejati J, Saghafipour A, Rafinejad J, et al. Scorpion composition and scorpionism in a high-risk area, the southwest of Iran. *Electron Physician.* 2018;10:7138-45.
20. O'Connor A, Ruha AM. Clinical course of bark scorpion envenomation managed without antivenom. *J Med Toxicol.* 2012;8:258-62.
21. Boyer L, Degan J, Ruha AM, et al. Safety of intravenous equine F(ab')₂: insights following clinical trials involving 1534 recipients of scorpion antivenom. *Toxicon.* 2013;76:386-93.
22. Mishra OP, Prasad R. Myocardial dysfunction in children with scorpion sting envenomation. *Indian Pediatr.* 2015;52:291-2.
23. Pandi K, Krishnamurthy S, Srinivasaraghavan R, et al. Efficacy of scorpion antivenom plus prazosin versus prazosin alone for *Mesobuthus tamulus* scorpion sting envenomation in children: A randomised controlled trial. *Arch Dis Child.* 2014;99:575-80.
24. Natu VS, Kamerkar SB, Geeta K, et al. Efficacy of anti-scorpion venom serum over prazosin in the management of severe scorpion envenomation. *J Postgrad Med.* 2010;56:275-80.
25. Hammoudi-Triki D, Ferquel E, Robbe-Vincent A, et al. Epidemiological data, clinical admission gradation and biological quantification by ELISA of scorpion envenomations in Algeria: effect of immunotherapy. *Trans R Soc Trop Med Hyg.* 2004;98:240-50.
26. Sevcik C, D'Suze G, Díaz P, et al. Modelling *Tityus* scorpion venom and antivenom pharmacokinetics. Evidence of active immunoglobulin G's F(ab')₂ extrusion mechanism from blood to tissues. *Toxicon.* 2004;44:731-41.
27. Ghalim N, El-Hafny B, Sebti F, et al. Scorpion envenomation and serotherapy in Morocco. *Am J Trop Med Hyg.* 2000;62:277-83.
28. Krishnamurthy S, Mahadevan S. Efficacy of scorpion antivenom in children. *Indian Pediatr.* 2014;51:499-500.
29. Dehesa-Davila M, Possani LD. Scorpionism and serotherapy in Mexico. *Toxicon.* 1994;32:1015-8.
30. Ismail M. The treatment of the scorpion envenoming syndrome: the Saudi experience with serotherapy. *Toxicon.* 1994;32:1019-26.
31. de Silva HA, Ryan NM, de Silva HJ. Adverse reactions to snake antivenom, and their prevention and treatment. *Br J Clin Pharmacol* 2016;81:446-52.
32. Dissanayake V, Dalka ET, Koh C, et al. A pilot study on the management and outcomes of self-poisoning in a rural Ugandan Emergency Centre. *Afr J Emerg Med.* 2018;8:25-28.
33. Bawaskar HS, Bawaskar PH. Efficacy and safety of scorpion antivenom plus prazosin compared with prazosin alone for venomous scorpion (*Mesobuthus tamulus*) sting: randomised open label clinical trial. *BMJ.* 2011;342:7136.