

# Scorpion sting syndrome in a general hospital in Saudi Arabia

Abdulrahman K. Al-Asmari, MSc, PhD, Abdulaziz A. Al-Saif, MD, PhD.

## ABSTRACT

**Objectives:** To evaluate the incidence of scorpion stings and to draw the attention of clinicians, concerning the dilemma of scorpion sting syndrome and its management in the Kingdom of Saudi Arabia (KSA).

**Methods:** In a retrospective survey, 251 cases were presented with scorpion stings to the Emergency Department of the Armed Forces Hospital, Riyadh, KSA during a period of 15 years (April 1986 to April 2000). Their ages ranged from 2 months to 101 years (male to female ratio was 2.6:1) and 70.6% of the cases were under 20 years of age.

**Results:** The mean annual incidence of the scorpion sting in the month of May was 16.7%, with the highest mean percentage of approximately 36% each year. The seasonal sting cycle showed the highest record was in the summer period (51%) as compared to the lowest winter period (10%). Local pain was the primary presenting complaint

(95%), with a total systemic toxicity of 78.3% and 35.2% of these were children. Hypertension, sweating, salivation and tachycardia were the most common signs of systemic symptoms. The majority of patients received analgesia, local anesthetics, and application of ice and a period of observation dictated by clinical findings. Eighty-two patients (32.6%) had signs of serious envenoming, requiring admission. There were no deaths. All of these cases were mainly treated symptomatically.

**Conclusion:** The beneficial effect of antivenom in protecting victims against scorpion stings is still questionable. The higher risk groups of systemic toxicity were either those with ages less than 10 years or greater than 50 years, being more susceptible due to their decreased physiologic reserves and increased debilitation.

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Scorpion envenoming is a common medical problem in many tropical and subtropical countries, and is an important cause of morbidity and mortality, especially among children.<sup>1-4</sup> Al-Medina Maternity and Children's Hospital (MMCH), Al-Medina, Kingdom of Saudi Arabia (KSA) reported an approximately 200 cases of scorpion stings each year.<sup>5,6</sup> King Fahad Hospital, Al-Baha, KSA had reported sting cases of 386 children during a 5-year period.<sup>2</sup> An epidemiological study from 11 sites of KSA showed a total of 72,168 sting cases over a 5 year period.<sup>7</sup> During a 6 month period, 820 cases were reported from Hail region of KSA alone.<sup>8</sup> More than

22 species of scorpions inhabit the Arabian peninsula, several of which are widely distributed in KSA.<sup>9</sup> A statement reporting 14 species and subspecies, classified under the 2 families, *Buthidae* and *Scorpionidae*, have been identified.<sup>9,10</sup> In a recent study, 16 species of the family *Buthidae*, 7 of *Scorpionidae*, and a single one belonging to *Diplocentridae*, were identified and classified from the different parts of KSA.<sup>11</sup> Nine of them exist in Riyadh area alone,<sup>9</sup> and severe envenoming cases occurred after stings by *Leiurus quinquestriatus*, *Androctonus crassicauda*, *A. amoreuxi*, *Parabuthus liosoma* and *Nebo hierichonticus*.<sup>6</sup>

From the Department of Research (Al-Asmari) and the Department of Medicine (Al-Saif), Armed Forces Hospital, Riyadh, Kingdom of Saudi Arabia.

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Address correspondence and reprint request to: Dr. Abdulrahman K. Al-Asmari, Consultant Toxicologist and Deputy Head of Research Center, Research Centre, Armed Forces Hospital, PO Box 7897 (775S), Riyadh 11159, Kingdom of Saudi Arabia. Tel. +966 (1) 4777714 Ext. 3811. Fax. +966 (1) 4777714 Ext. 6896. E-mail address: akasmari@medu.net.sa, drasmari@hotmail.com

Scorpion venom composition is variable, related in part to habitat and diet.<sup>12</sup> Some scorpions do possess basic polypeptides and neurotoxins.<sup>13,14</sup> The venom stimulates the neuroendocrinal-immunological axis by the ability to release catecholamines, corticosteroids, pro-inflammatory mediators, including leukotrienes, prostaglandins, platelet activity factors, kinins and nitric oxide in the pathophysiological manifestations of human and experimental animals.<sup>15-19</sup> The treatment of scorpion stings is a difficult problem.<sup>5</sup> It requires extensive knowledge of the clinical manifestations and an understanding of the mechanisms behind the clinical symptomatology.<sup>20</sup> The literature showed both clinical experience,<sup>3,21-25</sup> as well as experimental studies based on information obtained from animal experience which differs from human envenomation.<sup>26-28</sup> Hyperstimulation of the sympathetic and parasympathetic nervous system has been documented in animals injected with scorpion venom,<sup>29-31</sup> and high levels of circulating catecholamines have been reported in cases of scorpion stings.<sup>31-33</sup> Sinus tachycardia, hypertension, hyperglycemia, and leucocytosis were attributed to the direct effects of excess circulatory catecholamine, whereas priapism, hypersalivation, sweating, bronchial secretions, vomiting, sinus bradycardia, various grades of auriculoventricular block were due to excess levels of circulatory parasympathomimetics.<sup>34,35</sup> Yet, there is no unanimity on the treatment of scorpion stings. The suggested treatment regimes are 1) no antivenom, symptomatic treatment only. 2) one ml of antivenom intravenous and 3) 5 ml intravenous antivenom in all cases.<sup>36</sup> The purpose of this study was primarily to assess the risk of morbidity and mortality following scorpion envenoming in the military compounds of the Riyadh region, KSA. Secondly, it is of high importance to determine whether all scorpion stings need treatment with antivenom, supportive treatment both, or whether the cases could be categorized; hence, those asymptomatic ones are not given antivenom, in view of previous and recent works.

**Methods.** This study is a retrospective analysis of scorpion sting cases seen during a fifteen-year period (April 1986 to April 2000) in the Armed Forces Hospital, Riyadh, KSA, which is a 1000-bed tertiary care facility and receives over 100,000 emergency room visits per year. The total number of cases seen was 251 and the information collected from the hospital records was categorized according to the following criteria: 1) The mean number of patients per month as an annual cycle for the whole study period. 2) The patients' age distribution, being divided into 6 groups with 10 years interval. 3) All 251 victims (females and males) were divided into 6 groups (group 1 - group 6) with 10 years interval. Percentage distribution was carried out for each group. 4) Presence of local and systemic signs or symptoms: those ones recorded as initial observations of clinical

signs and symptoms concerning scorpion stings, shown in patient number and percentage. 5) Types of initial treatment done at the emergency room. Follow-up of treatment that was carried out for those admitted in wards.

Subgroups of patients who have been examined in detail were a) pediatric age groups with evidence of systemic toxicity - the percentage toxicity of 70 children (up to 12 years), divided into 6 groups with 2 years interval. b) Patients with evidence of systemic toxicity - this group of 199 patients was also divided into 6 groups (10 year intervals) to show frequency of toxicity according to age group.

Statistical analyses and graphs were carried out by GraphPad Prism 3 programs.

**Results. Mean annual sting incidence.** The incidence of scorpion stings was recorded as an annual mean of all the study period (**Table 1**). This annual incidence course has been categorized into 3 periods according to the number of cases. The summer period of May to August (4 months) had the highest (51%) record (29-36 cases). The next period was March, April, September and October (4 months) had a medium (39%) record (17-31 cases). In fact, this was a two-phase period; the first phase was 2 months (March and April) before the summer period and the second one was another 2 months (September and October) after the summer period. The least (9.96%) record (1-15 cases) was that of the winter period (November, December, January and February).

**Distribution of the patient's age, gender and admissions.** This is an age-wise study of the victim cases frequency. Six groups of the total 251 patients comprise group 1 (2/12-10 years) with 53 patients, group 2 (11-20 years) with 70 patients, group 3 (21-30 years) with 53 patients, group 4 (31-40 years) with 44 patients, group 5 (41-50 years) with 17 patients and

**Table 1 -** Distribution of mean number of patients per month as an annual cycle for the whole study period extending from April 1986 to April 2000.

Months	N of patients (mean month <sup>-1</sup> )
January	4
February	5
March	17
April	27
May	36
June	29
July	29
August	34
September	31
October	23
November	15
December	1

group 6 (>50 years) with 14 patients were recognized (Table 2). High frequency was observed in groups 2, 1, 3 and 4. Group 2 reflected the highest record (27.9%), followed by group 1 and group 3 (21.1% each). The third in sequence was group 4 (17.9%) and the least recorded were group 5 (6.4%) and group 6 (5.6%). Male to female ratio was 2.6:1 (72.1% and 27.9%) wherein 70.6% of the cases were under 20 years of age and 27.9% (23 females and 47 males) of these were children (Table 2). Total admissions were 82 patients (32.8%), 27 females and 55 males. Approximately half of the admitted cases were children.

**Systemic toxicity.** The incidence of systemic toxicity was detected in 199 (78.3%) cases (Table 3). The highest frequencies were detected in group 6 (25.6%), group 4 (24.6%) and group 5 (20.1%). Medium frequencies (13.1% and 12.1% were detected in groups 1 and 3, whilst the least affected was group 2 (11-20 years) with a frequency of 4.5%.

**Pediatric toxicity.** Pediatric patients with clear symptoms of toxicity (Table 4) represented 70 cases (27.9%) of all the patients. There were 23 females (9.2%) and 47 males (18.7%). Approximately half (46.3%) of the 82 (32.8% in all) admitted patients were children. The pediatric patients (2/12-12 years) who developed toxicity were divided according to age in 6 groups (2 year intervals). There was a gradual rise in the victim number (2.9% to 28.9%), reaching a peak and dropping slightly to 24.2% at the 6 groups.

**Clinical signs and symptoms.** The major clinical signs and symptoms (23) were recorded in Table 5. Local symptoms (47.4%), hypertension (37.9%), sweating and salivation (34.3%) and tachycardia (31.9%) had the highest records; whilst chills, hyperventilation, bradycardia, pulmonary edema, hemiplegia, and cerebral edema had the least score (<3%). Rest of the symptoms had an in-between frequencies. Approximately 20% of the patients were asymptomatic. Table 6 shows the medications prescribed for those patients who were seen at the hospital.

**Discussion.** The previous neglect of treating scorpion stings was mostly due to peculiar distribution of scorpions in different parts of the world. Being a common event in the tropics and subtropics, where the majority are underdeveloped and developing countries, underestimation and treatment with ineffective, old-fashioned methods led to the resultant situation.<sup>37</sup> Recent worldwide attention concerning scorpion envenoming was probably due to the works carried out on the isolation of some scorpion toxins acting selectively on certain ionic channels.<sup>38-40</sup> This has mainly helped in mapping receptors and recognition of these ionic channels.<sup>40,41-43</sup> In humans, the effects of scorpion venom are due to stimulation of hypothalamus, leading to hypothalamic discharges, and causing profound effects on the sympathetic and

**Table 2 -** Age, gender and admissions of patients with scorpion sting.

Category	Age (years)	Gender		Total	Admissions		Total admissions
		F	M		F	M	
Group 1	2/12-10	16	37	53	8	19	27
Group 2	11-20	21	49	70	11	21	32
Group 3	21-30	11	42	53	2	6	8
Group 4	31-40	13	31	44	4	5	9
Group 5	41-50	5	12	17	1	3	4
Group 6	> 50	4	10	14	1	1	2
<b>Total</b>		<b>70</b>	<b>181</b>	<b>251</b>	<b>27</b>	<b>55</b>	<b>82</b>
F - female, M - male							

**Table 3 -** A total of 199 patients with clear symptoms of systemic toxicity, divided into 6 age groups with 10 year intervals.

Age groups (year)	N of severely intoxicated patients group <sup>-1</sup>
Group 1 2.5-10	26
Group 2 11-20	9
Group 3 21-30	24
Group 4 31-40	49
Group 5 41-50	40
Group 6 >50	51

**Table 4 -** A total of 70 pediatric patients (children) with clear symptoms of systemic toxicity, divided into 6 age groups with 2 year intervals.

Age groups (year)	N of patients
0-2	2
3-4	6
5-6	10
7-8	15
9-10	20
11-12	17

parasympathetic systems.<sup>44</sup> Therefore, the therapeutic agents should be directed against the clinical manifestations of the over stimulated autonomic nervous system (ANS).<sup>20</sup> The 251 scorpion sting cases that arrived to the Armed Forces Hospital, Riyadh, KSA were studied on an annual cycle basis. No deaths were recorded. It was seen from **Table 1** that scorpions came out from their lurks, mostly in the hot season, encountering people and leading to the highest level of sting record in the 4 hot months of summer. The split period one before and another after summer, were the heating up months and the cooling down ones that gave a medium sting record. There were scarce instants of stings during the cool winter months, when scorpions go into winter dormancy (hibernation). Low scorpion sting incidence during the winter months had been reported.<sup>36</sup> The seasonal and diurnal pattern of the scorpion sting syndrome incidence is related to its behavior, as a night predator and an ectotherm (poikilotherm). **Table 2** showed 6 groups that represented all the patients, according to age category. Group 2 recorded as the highest level had a unique age range. This range is always endowed by hyperactivity and negligence, a situation that justified their vulnerability for high accident record. The younger group (group 1) that came next could be excused for their ignorance and inability to respond by retreating from danger in the appropriate time. The low frequency observed in the elderly groups (5 and 6) could be due to their awareness and limited movement within the premises of scorpion existence. Scorpion venom proved to be very potent due to the high percentage of the envenomed cases that showed clear signs of systemic toxicity. This situation was more enhanced in case of the elderly (group 6) who got the highest record, due to their debilitated physiological resistance. This weakness level was gradually lowered down towards younger ages. A sudden and prominent rise in the infant and youngest child age group 1 (**Table 4**) could refer to the tiny weight of this group and hence the pronounced effect of the body mass-venom relationship, in addition to their inability to recognize or respond to intruders. Pediatric toxicity could always pose a critical situation and demand emergency treatment due to the reduced weight effect. The gradual rise in degree of toxicity (**Table 4**) associated with age could be attributed to increased activity onset and vulnerability, which could be more effective than the expected body mass factor. A drop in percentage of victims beyond the age of 10 could be a direct consequence of child alertness and awareness. The high percentage of pediatric admissions in comparison with the other admitted groups is a pointer to the seriousness of envenomed children situation. The clinical effect of the venom is body mass sensitive, and is affected by the general health of the victim.<sup>13,20</sup> It is a powerful stimulant of the ANS, and described as a "sympathetic storm".<sup>14,22</sup> The pathophysiology is complex, but experiments on *Leiurus quinquestriatus*

**Table 5** - Clinical, signs and symptoms of the patients.

Symptoms	Patients	
	N	(%)
Asymptomatic	52	(20.7)
Local symptoms	119	(47.4)
Sweating, salivation	86	(34.3)
Vomiting, diarrhea	55	(21.9)
Abdominal pain	20	(8)
Tachycardia	80	(31.9)
Hypertension	95	(37.9)
Hypertension and tachycardia	11	(4.4)
Hypotension	46	(18.3)
Breathlessness	12	(4.8)
Dysphoria and discomfort	26	(10.4)
Dizziness/drowsiness	21	(8.4)
Chills	7	(2.80)
Hyperventilation	5	(2)
Hemiplegia	1	(0.4)
Priapism	33	(13.01)
Seizure	10	(4)
Coma	24	(9.6)
Bradycardia	3	(1.2)
Hyperkalemia	11	(4.4)
Leucocytosis	39	(15.5)
Pulmonary edema	3	(1.2)
Cerebral edema	1	(0.4)
Hyperglycemia	15	(6)

**Table 6** - List of medications used.

Class	Name of drug
Sedative	Chlorpromazine
Anti-convulsive	Diazepam, lorazepam, pentobarbital, labitalol
Anti-hypertensive	Nifedipine, hydralazine, prazosin
Diuretics	Furesamide
Vasopressors/inotropic agents	Norepinephrine, dobutamine
Analgesics	Paracetamol
Steroids	Hydrocortisone
Non-steroidal anti-inflammation	Diclofenac
Antihistamine	Chlorpheniramine
Local anesthetic	Xylocaine, marcaine
Antivenom	F(ab) <sub>2</sub> (Total) from Pasteur, Germany, Egypt, and a National Product

and *Androctonus crassicauda*, are the 2 most toxic species, suggest a mechanism in the following way:<sup>45</sup> primarily, a peripheral action through stimulation of the postganglionic elements of both components of the autonomic system and the adrenal gland with significant catecholamine release; secondarily, a central sympathetic action and a reflex mechanism through the carotid sinus or carotid body and; thirdly, a direct stimulant effect on the heart.<sup>46</sup> These toxins cause, sympathetic, parasympathetic, skeletal muscle and smooth-muscle effects.<sup>47</sup> The cardiovascular effects of venom are primarily the results of sympathetic stimulation and release of tissue catecholamine.<sup>48,49</sup> It was reported that disturbances of the central nervous system (CNS) such as confusion, agitation, seizures, cerebral edema and coma are common in children.<sup>21,29,50</sup> All cases of scorpion stings should be kept under close observation for at least 12 hours.<sup>2</sup> Clinical signs and symptoms highly associated with scorpion envenoming were local symptoms, hypertension, sweating, salivation and tachycardia. Coming next in severity to these signs were vomiting and diarrhea, hypotension, leucocytosis, priapism, dysphoria and discomfort, coma, dizziness or drowsiness, abdominal pain, hyperglycemia, breathlessness, hypertension and tachycardia, hyperkalemia and seizures. All other symptoms, chills, hyperventilation, bradycardia, pulmonary edema, hemiplegia, and cerebral edema were of low incidence. Approximately one fifth of the victims did not show any of the signs recorded in **Table 6**. This ratio of asymptomatic patients and higher had been reported.<sup>36,42</sup> Symptomatic (supportive) treatment was quite effective in alleviating these ailments. Medications that were popular and routinely prescribed to patients (**Table 6**) were issued nearly one and a half times the number of the patients, indicating the use of more than one medication in treating a single case of envenoming. The management of severe human scorpion envenoming should be directed towards neutralizing the over stimulated ANS.<sup>20</sup> The clinical picture may be dominated by respiratory difficulties in the presence or absence of cardiac involvement. It should be based on an understanding of the mechanisms behind the involvement of cardiovascular system, in particular the myocardium.<sup>3</sup> Clinical and experimental data<sup>3,51-54</sup> showed that the pathogenesis of heart failure and pulmonary edema is multifactorial, and several mechanisms are involved.<sup>20</sup> The recommended protocol for treatment of patients with severe systemic manifestations, should follow admission to the critical care unit (CCU), kept under close electro-cardiographic (ECG) monitoring, echo-cardiographic monitoring, and when necessary, invasive hemodynamic monitoring, sedation, fluid replacement and after load reduction.<sup>25,52</sup> Patients with respiratory failure or with CNS disturbances should be mechanically ventilated, and their acid-base balance corrected.<sup>20</sup> Atropine and other drugs such as digoxin,

diuretics, antihistamine, dopamine, dobutamine, calcium, phenobarbitone or steroids should be avoided.<sup>20,55</sup> It is of importance to note that the least used treatment was the application of scorpion antivenom. This situation could fairly point to suggestions of many workers prefer to avoid the use of antivenom. Gueron<sup>20</sup> stated that antivenom has no effect, whatsoever and advised to avoid the experimental protocols of Ismail et al.<sup>26</sup> Neale<sup>36</sup> reported and commented on the uncertainty debate about the use of antivenom in treating scorpion envenoming, even in serious cases.<sup>56,57</sup> Statements of the World Health Organization (WHO) concerning therapeutic value of antivenoms emphasize on the importance of testing by clinical trials.<sup>58</sup> Management of 205 cases of scorpion stings in Riyadh, KSA, concluded that symptomatic treatment without the use of antivenom was successful without any ensuing mortality.<sup>36</sup> The high mortality rate (8%) reported from Al-Baha,<sup>59</sup> KSA, is very doubtful and can not be elucidated or attributed to species inhabiting that region, which are by no means more toxic, compared to those of Riyadh, nor to the relatively milder weather of Al-Baha. Poor management of fluid therapy was responsible for the frequently unsatisfying resolution of envenoming.<sup>5</sup> It is recommended to use vasodilators such as prazosin, nifedipine or captopril, rehydration (fluid and electrolytes) and bronchodilators with O<sub>2</sub> in case of serious symptoms of hypertension, impaired left ventricular systolic function, hypotension, pulmonary edema and suppression of insulin.<sup>6,21,55</sup> Glucose, insulin and potassium drips had no proven value.<sup>55</sup> A study on 820 envenomed patients from Hail region, Saudi Arabia,<sup>8</sup> conclude that 5 ampoules (5x1 ml) of scorpion antivenom is not superior to one ampoule (1 ml), which is completely contradictory to the Ministry of Health (MOH) protocol.<sup>60</sup> According to the works of other authors, it was strongly recommended that supportive treatment should be the best therapeutic choice for severely envenomed victims.<sup>20,61</sup>

In conclusion, the result of our retrospective study is supported by several authoritative reports.<sup>5,20,36,61</sup> There is compelling argument to challenge the use of antivenom in KSA following the MOH, KSA Protocol. We strongly believe that the MOH protocol should be revised.

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