

# Scorpion Sting Syndrome in Libya

## A Management Protocol

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### ***Abstract:***

Scorpion sting syndrome is a life threatening emergency in children and older individuals, especially, who are suffering from respiratory and/or cardiovascular diseases. Although there are mortalities from scorpion stings in Libya, but there is no management protocol for this medical emergency. The possible causes of these mortalities in Libya are late presentation of the patient, absence of a referral poison control center in Libya, and due to doctors' hesitation to use the available polyantivenom and the presence of deadly scorpion species especially in the southern part of the country. This

paper is an attempt to make a management protocol in Libya based on the latest published literature.

*Keywords:* scorpions, sting, protocol, venom, polyantivenom.

***Introduction:***

Scorpions belong to phylum Arthropoda, class Arachnida and to order scorpiones, with 18 living families; *Bothriruridae*, *Buthidae*, *Chactidae*, *Chaerilidae*, *Diplocentridae*, *Euscorpiidae*, *Hemiscorpiidae*, *Heteroscor-pionidae*, *Iuridae*, *Liochelidae*, *Microcharmidae*, *Pseudochactidae*, *Scorpionidae*, *Scorpiopidae*, *Superstitioniidae*, *Troglotayosicidae*, *Urodacidae*, *Vaejovidae*<sup>1</sup>. The most dangerous species are found in Africa, Middle East, Asia, and Latin America<sup>2</sup>, and they belong to the family *Buthidae*<sup>3</sup>. In Libya, nine different species have been recognized; most of them belong to the family *Buthidae*<sup>4,5</sup>. The recognized species in Libya are:

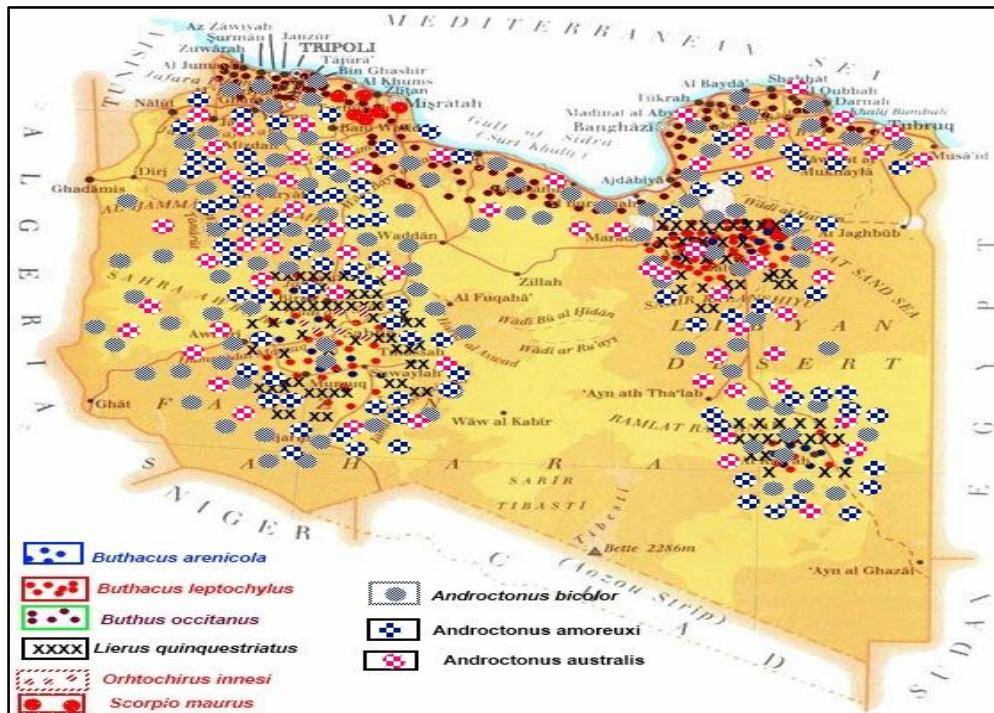
1. *Leiurus quinquestriatus*: It is yellow in color with average length 58 mm. It is also called deathstalker. This species is the most abundant and toxic scorpion in Libya and it is restricted to the southern parts e.g. Aujla, jkharra, Elkufra<sup>4,5</sup>.
2. *Androctonus amoreuxi*: the second most abundant and toxic species, they are found in the same areas with *L. quinque-striatus* forming a co-occurrence<sup>4</sup>. The term androctonus means “man killer”. The scorpions in the genus Androctonus are also called fattail (fat-tailed) scorpions.

Figure1 Androctonus bicolor



3. *Androctonus bicolor aneas*: A black colored scorpion, which is widely distributed in east, west, and south areas in Libya but at lower numbers than the previous two species<sup>4,5</sup>.
4. *Androctonus australis*: is found in the costal and southern parts of Libya, but more abundant in Sirt, Algariat, and Shwerif, as well as El-Jabal El-Akdar and Jabal Nafusa<sup>4,5</sup>.
5. *Buthus occitanus*: is found mainly in Tajoura, and some other coastal regions but not in the southern parts<sup>4,5</sup>. This scorpion is yellow in color.
6. *Buthacus arenicola*: is found in the same areas with *Buthus occitanus* but in small numbers<sup>4,5</sup>. Species of *Buthacus* are very similar to each other; they are small to moderately sized scorpions (40–75 mm). Most species are yellow, some are brownish, yellow-grayish or yellow-greenish colored
7. *Buthacus leptochelys*: mainly in Jalow, Aujla, and Jekhirrah<sup>4,5</sup>.
8. *Orthochirus innesi*: found in restricted areas mainly at Morzug, Marhaba, and Tsawah<sup>4,5</sup>.
9. *Scorpio maurus*: the least toxic species and it is restricted to

Figure2 Distribution of Scorpion Species in Libya



10. Khums and Msillata<sup>4,5</sup>. It is also called large-clawed scorpion. Scorpions are nocturnal arthropods as they can't tolerate light and temperature<sup>6</sup>. Scorpions have no sophisticated visual, auditory or olfactory senses and they utilize their mechanoreceptors on legs to interpret vibrations produced by their prey for the localization<sup>6</sup>. Although there are annual deaths from scorpion stings in Libya but there are no statistical data for the incidence of scorpion stings, or their complications in Libya. The possible causes of these annual deaths in Libya, according to the experience and observations of the author, include:

- A) The late arrival of the patient for medical help as some victims and their families wait for the effect of the traditional medicine

usually used.

- B) Hesitation of doctors to give the polyantivenom to the patient because of their fear from the risk of anaphylactic reactions that may happen.
- C) Absence of a referral poison control center in Libya.
- D) There is no management protocol for scorpion sting syndrome (SSS).
- E) No local polyantivenom has been produced for these scorpion species, and only imported polyantivenom is used which may be of limited or no value.

The aim of this work is to probe the latest literature on the subject and try to formulate the first attempt of management protocol for scorpion sting syndrome in Libya.

### **Pathophysiology of Scorpion Venom**

Scorpion venom is a water-soluble, heterogeneous mixture<sup>7</sup>. This heterogeneity of the venom may reflect the different reactions that could happen due to scorpion sting. The scorpion venom is composed of neurotoxins, cardiotoxins, nephrotoxins, hemolytic toxins, histamines, phosphodiesterases, serotonin, and cytokine releasers<sup>8,9</sup>. The venom enters the circulation very rapidly; it has high volume distribution with a peak tissue concentration in about 37 minutes after the sting<sup>9</sup>. Experimentally<sup>10</sup>, after intravenous administration of Tc-99m labeled venom, the venom was found within 5 minutes in the blood (28%), muscle (30%), bone (13%), kidney (12%), and liver (11%). The labeled venom was excreted through kidneys and hepatobiliary system<sup>9</sup>. The maximum renal uptake of 32% at 30 minutes dropped to 22% at 3 hours, indicating that

clearance of labeled venom from the kidney is slow<sup>10,11</sup>. Neurotoxin is the most potent of venom components; it has 2 classes that act by altering ion channel permeability causing cellular impairment in nerves, muscles, and the heart<sup>12</sup>. The cardiovascular effects of venom are primarily the result of sympathetic stimulation and release of tissue catecholamines<sup>13,14</sup>. In addition, the venom inhibits angiotensin converting enzyme, resulting in accumulation of bradykinin, which is involved in the development of pulmonary edema and acute reversible pancreatitis<sup>15</sup>. Alpha receptor stimulation plays a major role in the pathogenesis of pulmonary oedema<sup>16</sup>. Angiotensin II stimulates alpha adrenergic receptors in the myocardium and hypoxia results from coronary spasm as well as from the accumulation of free fatty acids and free radicals leading to cardiac arrhythmias and sudden death<sup>17</sup>. Venom-induced biochemical changes include hyperkalaemia and hyperglycaemia<sup>18</sup>. Severe scorpion toxicity causes hypertension, increased myocardial contractility and dysrhythmias and neuromuscular hyperactivity<sup>17,19</sup>. Severe envenomation usually appears within 1-3 hours following a sting and death most commonly results from left heart failure and pulmonary edema<sup>20</sup>.

***Clinical Manifestations:***

The first symptom of SSS is severe localized pain, which reflects the penetration of the venom and is a valuable warning signal, especially in children. Pain is present in more than 95% of cases of SSS and may be associated, in 20% of cases, with edema and erythema and more rarely with small blisters<sup>21</sup>. Scorpion sting syndrome has different clinical manifestations, which are more severe in children than in adults due to mainly higher dose in this age

category<sup>22</sup>.

According to the clinical manifestations, many grading scales had been described to facilitate the clinical management of cases with SSS. The last grading scale had been developed in 2011 by Khattabi et al.<sup>23</sup> (Table 1).

**Table 1: Scorpion sting syndrome grading scale described by Khattabi et al. (2011)**

<b>Class I: Local Manifestations</b>	<b>Class II: Minor manifestations (non life threatening)</b>	<b>Class III: Severe manifestations (life threatening). Presence of at least one of the following signs</b>
Bullous eruption Burning sensation Echymosis Erythema Hyperesthesia Itching Necrosis Parasthesia Pain Purpura/Petechia Swelling Tingling	Abdominal distension Nausea <i>Agitation/Restlessness/Excitement</i> Nystagmus Anisocoria Odinophagia Arthralgia Pallor Ataxia Pancreatitis <i>Confusion</i> General paraesthesia Convulsion Priapism Diarrhea Prostration Dry mouth Ptosis Dystonia Rhinorrhea <i>Encephalopathy</i> Salivation Fasciculation <i>Somnolence/Lethargy/Drowsiness</i> Gastrointestinal hemorrhage Stridor Hematuria	<b>Cardiogenic failure</b> Hypotension Ventricular arrhythmia Bradycardia Cardiovascular collapse  <b>Respiratory failure</b> Cyanosis Dyspnoea Pulmonary edema  <b>Neurological failure</b> Glasgow Score $\leq 6$ (in absence of sedation) Paralysis

	Sweating Headache Tachycardia <i>Hypertension</i> Thirst Hyperthermia Urinary retention <i>Hypothermia</i> Vomiting Lacrimation Wheezing Local muscular cramps Miosis Mydriasis Myoclonia	
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This new grading scale seems to be more reliable than the older ones although there are some signs of Class II that have been the subject of debate among experts, namely, hypertension, agitation, confusion, somnolence, encephalopathy and hypothermia. The experts agreed to include them in Class II depending on the absence of published literature showing their association with a fatal outcome<sup>23</sup>.

In comparison with the previously, commonly, used grading scale of scorpion sting, which was described in 1983 by Curry et al.<sup>24</sup> (table 2), the advantage of the new grading scale described by Khattabi et al. is that it includes both neurological and non-neurological manifestations of SSS, especially the cardiovascular manifestations. This is important because of the frequency of such manifestations as well as their clinical significance in the management and in the prognosis of the patients. Table (2) shows the old grading scale, which concentrates mainly on the neurological manifestations.



**Table 2: Scorpion sting syndrome grading scale described by Curry et al. (1983)**

Grade	Clinical Picture
I	Local pain and/or erythema and/or paresthesia at site of envenomation
II	Pain and/or paresthesia remote from the site of the sting and/or <i>tachycardia and mild hypertension</i> in addition to local findings
III	<p><b>Cranial nerve or somatic skeletal neuromuscular dysfunction:</b></p> <p><b>Cranial nerve dysfunction:</b> blurred vision, wandering eye movement, dysphagia, tongue fasciculation, problems with upper airway, slurred speech, and/or ptosis.</p> <p><b>Somatic skeletal neuromuscular dysfunction:</b> jerking extremity, restlessness, severe involuntary shaking and jerking that may be mistaken for a central seizure disorder.</p>
IV	Any combination of cranial nerve dysfunction, somatic skeletal neuromuscular dysfunction.

### The Management Protocol of Scorpion Sting Syndrome

This management protocol is applied according to a combination of the new grading scale of Khattabi et al. as well as the older scale by Curry et al.

#### A-The Pre-hospital Management

Although pre-hospital management is usually applied at the nearest medical center which, usually, has no sufficient facilities, but this management is important because it may delay the systematic absorption of the venom, and consequently decreases the morbidity. The employment of many traditional remedies may worsen the case<sup>25</sup>. The pre-hospital management includes:

- 1) Reassurance of the patient.
- 2) Stabilization of Vital functions: this step is important in all emergencies and should continue during transfer to nearest hospital where more management, if necessary, will be applied.

- 3) Use of the pressure-immobilization bandage which aims to retard venom transport via the lymphatic system. This technique can virtually stop venom movement into the circulation without any threat to limb oxygenation, which is one of major problems in using tourniquet<sup>26</sup>.
- 4) Analgesics: because pain is frequent and intense, it can be useful to administer analgesics with an anti-inflammatory action, such as salicylates. Morphine or its derivatives or analogs (tramadol) should be avoided because the opioid receptor agonists inhibit norepinephrine reuptake, which may potentiate their effects<sup>21</sup>.

## **B- Hospital Management**

Definitive treatment should take place within a critical care area of the hospital, such as intensive care unit or emergency department, where complications arising from envenomation or reactions to polyanitvenom can be best managed<sup>27</sup>.

### **1- Stabilization of Vital Functions (Supportive Care):**

ABCD of any emergency situations is done by establishing airway, breathing, and circulation. Continuous monitoring of the vital signs is important; blood pressure, heart rate, respiratory rate, pulse oximetry, and temperature.

If the patient has not developed any symptoms or signs of envenomation, close observation of the patient for a period of 6-12 hours is advised, during this period an hourly check of the patient should be done assessing the level of consciousness, pulse rate and rhythm, blood pressure, respiratory rate and any new symptoms or signs<sup>28,29</sup>.

**2-Pharmacotherapy** includes the antivenom therapy and ancillary treatment.

**a-The antivenom therapy**

- i. The indication of antivenom therapy is when the patient has signs and symptoms other than local manifestation.
- ii. Systemic envenomation is suggested if the patient has class II according to the severity scaling of Khattabi et. al. or Curry et al.
- iii. The decision of giving the antivenom is very important as it significantly decreases the level of circulating unbound venom within the first hour.
- iv. The intravenous administration of antivenom is considered to be the effective route, intramuscular or subcutaneous routes should be discouraged due to the slower rate of absorption and therefore delayed response, and the possibility of formation of large hematomas at the site of injection especially inpatients with coagulopathy. For intravenous infusion, dilution of the antivenom 1 in 5 or 1 in 10 in physiological saline helps to reduce the incidence of reactions and gives better control over the rate of administration. For the cases with history of allergy, further dilution with 1:100 or 1:1000 is required. Slow intravenous injection of undiluted antivenom at a rate not exceeding 2 ml per minute. If response to antivenom is not satisfactory, use of additional doses is advocated. However, no studies establishing an upper limit are available. Infusion may be discontinued when satisfactory clinical improvement occurs even if recommended dose has not been completed<sup>30</sup>. Children must be given the same dose of antivenom as adult or may be larger, in view of relative larger volume of venom in relation to body surface<sup>31</sup>.

- v. Perform a skin test prior to administering the antivenom. First, dilute 0.1 mL of antivenom in a 1:10 ratio with isotonic sodium chloride solution. Second, administer 0.2 ml intradermally. A positive test result is if a wheal develops within 10 minutes. The skin test has a sensitivity of 96% and a specificity of 68%<sup>32</sup>.

**b- Ancillary Treatment**

- i. Cardiovascular complications such as hypertension, arrhythmia, heart failure, and pulmonary edema. Prazosin is selective  $\alpha$ 1-adrenergic blockers. It is recommended for the treatment of scorpion envenoming<sup>33</sup>. Prazosin is more effective than nifedipine which is a calcium channel blocker<sup>34</sup>. Hydralazine is effective but it has several disadvantages, including tachycardia due to sympathetic stimulation, with a risk of myocardial infarction, and an increase in plasma renin, leading to urinary retention. Further, hydralazine administered parenterally produces a prolonged hypotensive response which is difficult to control<sup>11</sup>. Captopril, a drug that inhibits the conversion of angiotensin has also been suggested<sup>34</sup>. Although prazosin use in children is not approved yet, some studies have showed its efficacy in the treatment of both adults and children with scorpion envenomation<sup>35</sup>. In heart failure, dobutamine can be used alone or in combination with diuretics or antiarrhythmics<sup>36</sup>.
- ii. Diazepam or midazolam can be used to treat neuromuscular disorders. Benzodiazepines are beneficial in the treatment of hypertension and could be the initial drug of choice in the treatment of scorpion envenoming<sup>21</sup>.
- iii. In general, antiparasymphathetic drugs, such as atropine, are not recommended routinely in the treatment of scorpion envenoming.

These cause blockage of sweating, which is essential for temperature regulation, especially in children, and potentiate the adrenergic effects of scorpion venom, increasing hypertension and ischemic complications<sup>37</sup>. These drugs can be useful in cases of severe bradycardia or complete atrioventricular block, which are sometimes observed<sup>21</sup>.

- iv. Insulin administration in scorpion envenomation has helped in preventing multisystem failure. Some authors<sup>17,38</sup> have showed the efficacy of insulin in humans with scorpion envenomation; they found that early start of insulin-glucose infusion has resulted in the recovery of cardiac, respiratory and metabolic derangements, and in significant decrease of mortality rate.
- v. Corticosteroids do not have any role in decreasing mortalities or morbidities as well as they have effect on the ICU length of stay<sup>39</sup>.

#### ***Conclusion and Recommendations:***

Scorpion envenomation in Libya is a public health problem of the magnitude that dictates the necessity of formulating a management protocol for scorpion sting syndrome. For this protocol to be applied effectively by treating doctors, other mandatory steps have to be taken by the health sector:

- Establishing a poison control center equipped with modern facilities at least in major cities of the country.
- Producing local antivenom specifically for local scorpion species.
- Promoting people awareness of the risk of delaying scorpion sting treatment in the hospitals or other well prepared health centers.
- Establishing a more reliable statistical collection system of the

number of cases in different region of the country.

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