An epidemiological study of scorpion envenomation in the Zagora oases (Morocco)

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Objective: The aim of this study is to determine epidemiological features of scorpion stings in the oases of southern Morocco: Zagora province.

Methods: We performed three years prospective descriptive survey to obtain epidemiological data on scorpion stings, including information on knowledge, attitudes and practice, and gathered information on scorpion species distribution. The following information was recorded for each scorpion sting: demographics (age, gender, geographical location), circumstances of the sting (location, time, date, activity at the time), and any traditional medical attention. A questionnaire was completed for every stung patient. Concomitantly with the epidemiological survey, a systematic sampling of scorpions, based on observations and direct captures in situ was applied.

Results: Our sample contains 50 cases of death among 1053 cases studied. Most cases of death were recorded among children (under 15 years) (64%). The average age of victims was 23 ± 15.36 years. The scorpion sting occurred in 56% of cases between 18 pm and 24 pm, and it coincides with the warm period and particularly between June and September with a percentage of 70%. The stings were produced principally in hands and feet (897 cases or 85.71% of cases). The majority of victims have chosen traditional remedies (69.61%), and only 22.79% have received modern treatment while 1.33% of cases did not receive any treatment. The scorpion species involved were yellow in 179 cases and in 815 were black. In 59 cases the scorpion involved was not identified.

Conclusions: Our data constitute a preliminary descriptive study and suggest that scorpion envenomation is an important problem in the studied area.

1. Introduction

Scorpion envenomation is a real public health problem in many parts of the world, especially in North Africa, Central America, South America, the Middle East and India[1] [2] [3] [4], with over 1.2 million cases of scorpion stings and 3250 deaths each year worldwide[5]. Among the 1500 species described, venoms of at least 25 species are of medical importance for humans and the majority of those species belong to Buthus, Parabuthus, Mesobuthus, Tityus, Leiurus, Androctonus and Centruroides genera of Buthidae family[5].

Scorpion stings in Morocco is the leading cause of poisonings with a rate of 30%–50% of all the poisoning cases reported to the Poison Control Center of Morocco (PCCM) mainly in the south and central-south provinces of the country, where the highest lethality rate was reported[6]. However the works done so far have rarely addressed the Moroccan Sahara and pre-Saharan areas, such as Zagora oases. This area is known by the presence of five species of scorpions including dangerous species like Hottentota gentilli, Androctonus amoreuxi and Androctonus liouvillei[4]. The presence of this dangerous wildlife may suggest a high incidence of scorpion envenomation.

To assess the epidemiological situation in the province of Zagora we conducted this study which aims to investigate morbidity and mortality indicators using a prospective study over three years (2010–2013).

2. MATERIALS AND METHODS:
2.1. Studied Area:

The oasis of Zagora province belongs to the region southeast of Morocco (figure 1), and extends over an area of 23 000 km². These oases are involved in the maintenance of biodiversity, which is characterized by its strong specialization precisely due to the effect of isolation and its wealth. These environments are good shelters for animal communities in general and in particular species of scorpions.

The population of the province of Zagora rises, according to the 2004 census, 240,566 to 283,368 inhabitants, located in rural areas. The framework is part of overall climate in the Saharan bioclimatic stage. The average annual rainfall is very low and decreases from north to south: 108 mm Agdez, 74 mm in Zagora and high

2.2. Inventory of scorpion fauna:

A systematic sampling of scorpions, based on observations and direct captures in situ was applied. In each habitat, areas suspected of housing scorpions (under rocks, pieces of wood ...) were systematically explored. Species identification was based on an appropriate identification keys.

2.3. Epidemiological study:

We performed three years prospective descriptive survey to obtain epidemiological data on scorpion stings, including information on knowledge, attitudes and practice, and gathered information on scorpion species distribution.

The following information was recorded for each scorpion sting: demographics (age, gender, geographical location), circumstances of the sting (location, time, date, activity at the time), and any traditional medical attention. A questionnaire was completed for every stung patient.

3. Results:

3.1. The scorpion fauna inventory:

The systematic inventory, according to the identification of a set of 75 specimens, consists of five species, belonging to the Buthidae family and four genera, Androctonus (Ehrenberg, 1828), Buthus (Leach, 1915), Hottentota (Birula, 1908) and orthochirus (Karsch, 1891). These surveys revealed the presence of dangerous species such as, Hottentota gentili, Androctonus amoreuxi and Androctonus liouvillei (figures 1 and 2).

3.2. The epidemiological study:

A total of 1053 subjects were recruited during the three years period.

Figure 1: Geographic location of studied oases and scorpion distribution in the Zagora province.

Figure 2: Scorpions present in the studied area; (a) Hottentota gentili (Pallary, 1924), (b) Androctonus liouvillei (Pallary, 1924), (c) Orthochirus innesi (Simon, 1910 ), (d) Androctonus amoreuxi (Audouin, 1826), (e) Buthus draa (Lourenço & Slimani, 2004).
and of these there were 50 case of death, a fatality rate of 4.74%; children younger than 15 years old presented a high mortality rate (64% of death cases).

Table 1: Epidemiological characteristics of patients stung by a scorpion

| Epidemiological characteristics | Number of patients (n: 1053) | (%) |
|---------------------------------|-----------------------------|-----|
| Sex                             |                             |     |
| Male                            | 695                         | 66  |
| Female                          | 358                         | 44  |
| Age                             |                             |     |
| Less than 15 years              | 267                         | 25.35|
| 16 years – 30 years             | 667                         | 63.34|
| Over 46 years                   | 119                         | 11.30|
| Part of body where sting occurred|                             |     |
| Hand                            | 523                         | 49.66|
| Foot                            | 374                         | 35.51|
| Arm                             | 21                          | 2    |
| Thigh                           | 24                          | 1.27 |
| Leg                             | 18                          | 1.71 |
| Head/Neck                       | 40                          | 3.79 |
| Stomach/Back                    | 53                          | 5.03 |
| Circumstances where stings occurred|                             |     |
| Working                         | 575                         | 54.60|
| Resting/sleeping                | 338                         | 32.10|
| Others                          | 140                         | 13.29|
| Accident location               |                             |     |
| Indoors                         | 447                         | 42.45|
| Near house                      | 154                         | 14.62|
| Field                           | 412                         | 39.12|
| Others                          | 40                          | 3.80 |
| Species of scorpion             |                             |     |
| Yellow scorpions                |                             |     |
| Androctonus amoreuxi            | 179                         | 16.99|
| Bathus draa                      |                             |     |
| Black scorpions                 |                             |     |
| Androctonus liouvillei          | 815                         | 77.39|
| Orthochirus innesi              |                             |     |
| Hottentota gentili              |                             |     |
| Unknown                         | 59                          | 5.6  |
| Treatments                      |                             |     |
| Traditional                     | 733                         | 69.61|
| Traditional + Modern            | 66                          | 6.26 |
| Modern                          | 240                         | 22.79|
| None                            | 14                          | 1.33 |

Figure 2 lists species of scorpions present in the studied area. The most scorpion stings were caused by the black scorpion 77.39% of total stings (Table 1). With respect to age groups, the 16–45 age group were affected the most (63.34%) compared to other groups (25.35% for the less than 15 years group, and 11.30% for the over 45 age group) (Table 1). The average age of victims was 23 ± 15.36 years. Seventy percent of the accidents took place in hot months (reaching close to 42°C) from June to September, of which 37% of stings occurred in July (figure 3). The stings mainly occurred at night between 6 p.m. and midnight (34.37%) when the victims were asleep, and from early morning 6 a.m. to 12 a.m. (26.68%) (figure 4). The circumstances of the sting were: 54.6% doing farm work, 32.10% resting or sleeping and in 13.29% doing other activities. Forty-two (42%) stings occurred indoors and thirty-nine percent (39%) in the field (Table 1). In all, 75% of stings were at the extremities; particularly the hands. This frequency was clearly different from that in the head and the neck (3.79%) (Table 1). The lowest site of the stings was located on the thigh, with an incidence of only 1.27%.

Scorpion stings records in both sexes were almost similar and there were no significant differences between sexes across all age groups (Table 1). The majority of patients have chosen traditional remedies (69.61%), and only 22.79% have received modern treatment while 1.33% of cases did not receive treatment (Table 1).

Figure 4: Distribution of scorpion stings cases according to time of day in Zagora province oases.

4. Discussion:

This study characterizes the epidemiology effects of scorpion stings and established the relationship between the epidemiology of scorpion envenomation and the major scorpion species in the south-eastern oasis of Morocco (Province of Zagora).

During three years of study, we collected 1053 cases of scorpion envenomation with 50 deaths, a fatality rate of 4.74%. In the present study, children younger than 15 years old presented a high mortality rate. This child vulnerability to scorpion stings was also reported by Hellal et al. in Algeria[7]and Touloun et al. in southern-western Morocco[8]. According to the literature, this mortality can be explained by the immaturity of both physiological systems and body’s defenses and by the ratio between venom dose injected and body weight[9]. Men are stung by the scorpions most frequently than women. Corroborating with this finding Dubo (2011), also reported the majority (54.6%) of victims as male in the north of Mali[10]. However, other studies from Turkey have reported no preference in regard to the gender of the affected persons[11], whereas other study conducted in Texas, USA have reported higher proportion of female cases[12]. In our study, higher proportion of males can be explained by the fact that apart from which they can be attacked within the house room also increases the risk of beingitched outside the house, because the majority of the people leave to realize works in the field and directly exposed to these poisonous animals.

Scorpions are most active during the warmer months. In our survey the most cases of scorpion envenomation (70%) were recorded between June and September. Thus, our data are consistent with those in the literature, in a retrospective study carried out in the south Tunisia region.
the majority of the cases were recorded during the hot period peaking in July and August[13]. In Texas, Scorpion stings were most frequently reported in May and June[12]. Another study from Iran confirms that the greatest number of stings occurred in the summer[14].

Most epidemiological studies have shown that the afflicted body parts are mostly the extremities (hand and foot)[15]. In parallel we found that 75% of the investigated patients were stung in their extremities. This could be explained both by the probability that the feet are not covered during sleep, farming and wood gathering in the countryside especially as the population working in agriculture and more to livestock.

Most accidents with scorpions take place in houses (42.45%) when people are sleeping or in the field (39.12%) when doing farm work. It is interesting to note that most patients turn to traditional medicine (69.61%) and that few victims directly consult the nearest hospital (22.79%). This can be explained by the poorly-information on the pathology and the scarcity or even absence, of health facilities in rural areas which make the population even close to health centers, to make use of preventive or control curative methods closely related to traditional medicine. The use of traditional care for the treatment of scorpion stings was also observed in Colombia, where 42% of patients received traditional treatment before being admitted to health centers[16].

The scorpion-fauna of Zagora province is characterized by the presence of five species of scorpion belonging to the buthidae family. In terms of public health, important scorpion species are identified as A. amoreuxi, H. gentili and A. liouvillei.

In our study, identification of scorpions has shown that 815 stings (77.39%) were inflicted by black scorpions (A. liouvillei, H. gentili or O. innesi) and 179 stings (16.99%) by yellow scorpions (A. amoreuxi or Bathus draa). The toxic effects of A. amoreuxi is well known and studied, it has a subcutaneous dose lethal of (LD50) 0.75 mg/kg[16] which indicate the high toxicity of this specie. In spite of the fact that there is no data about the DL50 of A. amoreuxi, it were behind several case of deaths reported by the epidemiologic study conducted in southwestern Morocco, which makes it some of toxic species of scorpion(s).

Our data constitute a preliminary descriptive study that will help in developing interventions to prevent scorpion stings, which should take into consideration local epidemiological features. This data can also be used to determine those population groups most in need of education regarding the prevention and treatment of scorpion stings.

Conflict of interest statement

We declare that we have no conflict of interest.

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