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Clinical consequences of *Tityus bahiensis* and *Tityus serrulatus* scorpion stings in the region of Campinas, southeastern Brazil

Fábio Bucaretchi [a, b, *], Luciane C.R. Fernandes [a], Carla B. Fernandes [a], Maíra M. Branco [a], Camila C. Prado [a], Ronan J. Vieira [a, c], Eduardo M. De Capitani [a, c], Stephen Hyslop [a, d, **]

[a] Campinas Poison Control Center, Faculty of Medical Sciences, State University of Campinas (UNICAMP), Campinas, SP, Brazil
[b] Department of Pediatrics, Faculty of Medical Sciences, State University of Campinas (UNICAMP), Campinas, SP, Brazil
[c] Department of Clinical Medicine, Faculty of Medical Sciences, State University of Campinas (UNICAMP), Campinas, SP, Brazil
[d] Department of Pharmacology, Faculty of Medical Sciences, State University of Campinas (UNICAMP), Campinas, SP, Brazil

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ABSTRACT

Scorpion stings account for most envenomations by venomous animals in Brazil. A retrospective study (1994–2011) of the clinical consequences of *Tityus* scorpion stings in 1327 patients treated at a university hospital in Campinas, southeastern Brazil, is reported. The clinical classification, based on outcome, was: dry sting (no envenoming), class I (only local manifestations), class II (systemic manifestations), class III (life-threatening manifestations, such as shock and/or cardiac failure requiring inotropic/vasopressor agents, and/or respiratory failure), and fatal. The median patient age was 27 years (interquartile interval = 15–42 years). Scorpions were brought for identification in 47.2% of cases (*Tityus bahiensis* 27.7%; *Tityus serrulatus* 19.5%). Sting severity was classified and each accounted for the following percentage of cases: dry stings – 3.4%, class I – 79.6%, class II – 15.1%, class III – 1.8% and fatal – 0.1%. Pain was the primary local manifestation (95.5%). Systemic manifestations such as vomiting, agitation, sweating, dyspnea, bradycardia, tachycardia, tachypnea, somnolence/lethargy, cutaneous paleness, hypothermia and hypotension were detected in class II or class III + fatal groups, but were significantly more frequent in the latter group. Class III and fatal cases occurred only in children <15 years old, with scorpions being identified in 13/25 cases (*T. serrulatus*, $n = 12$; *T. bahiensis*, $n = 1$). Laboratory blood abnormalities (hyperglycemia, hypokalemia, leukocytosis, elevations in serum total CK, CK-MB and troponin T, bicarbonate consumption and an increase in base deficit and blood lactate), electrocardiographic changes (ST segment) and echocardiographic alterations (ventricular ejected fraction <54%) were frequently detected in class III patients. Seventeen patients developed pulmonary edema, 16 had cardiac failure and seven had cardiogenic shock. These results indicate that most scorpion stings involved only local manifestations, mainly pain; the greatest severity was associated with stings by *T. serrulatus* and in children <15 years old.

Abbreviations: CK, serum creatine kinase; CK-MB, creatine kinase isoenzyme MB; ED, Emergency Department; IQI, interquartile interval; MRC, Metropolitan Region of Campinas; PICU, Pediatric Intensive Care Unit; PCC, Poison Control Center; SAV, scorpion antivenom.

* Corresponding author. Departamento de Pediatria, Centro de Controle de Intoxicações, Faculdade de Ciências Médicas, Universidade Estadual de Campinas (UNICAMP), Rua Tessália Vieira de Camargo, 126, Cidade Universitária Zeferino Vaz, 13083-887 Campinas, SP, Brazil. Tel./fax: +55 19 3521 7573.
** Corresponding author. Departamento de Farmacologia, Centro de Controle de Intoxicações, Faculdade de Ciências Médicas, Universidade Estadual de Campinas (UNICAMP), Rua Tessália Vieira de Camargo, 126, Cidade Universitária Zeferino Vaz, 13083-887 Campinas, SP, Brazil. Tel./fax: +55 19 3521 7573.
E-mail addresses: bucaret@fcm.unicamp.br, bucaretchi@gmail.com (F. Bucaretchi), hyslop@fcm.unicamp.br (S. Hyslop).

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1. Introduction

Scorpion stings are common in tropical and sub-tropical regions, with a speculated 1.2 million stings/year and >3500 deaths, mainly in children (Chippaux and Goyffon, 2008). In Brazil, scorpion stings are the primary cause of envenomation by venomous animals. Data from the Brazilian Ministry of Health (Brasil – Ministério da Saúde, 2013) indicate that nationwide there were 114,037 cases of envenomation by venomous animals in 2012, of which 64,233 (56.3%) were scorpion stings, with 92 deaths; this corresponds to an annual rate of 32 cases/100,000 inhabitants, with a mortality of 0.14%.

Only scorpions of the genus *Tityus* cause clinically relevant envenoming in Brazil, with the most important species being *Tityus serrulatus*, which is responsible for most cases of severe envenoming (Freire-Maia and Campos, 1989; Freire-Maia et al., 1994; Bucaretchi et al., 1995; Magalhães et al., 1999; Cupo and Herling, 2002; Fukuhara et al., 2003, 2004; Cupo et al., 2007; Guerra et al., 2008). This species has a wide geographic distribution, from northeastern to southern Brazil, with greatest abundance in the southeast of the country (Brasil – Ministério da Saúde, 2009). Other clinically relevant species include *Tityus stigmurus* (northeastern region; Albuquerque et al., 2013), *Tityus bahiensis* (southeastern region; Bucaretchi et al., 1995; von Eickstedt et al., 1996) and *Tityus obscurus* (senior synonym to *Tityus paraensis* and *Tityus cambridgei*; Fet et al., 2000) in the Amazon basin (Pardal et al., 2005).

Although several studies have described envenomation by *T. serrulatus*, so far no report has compared the profiles of envenoming by *T. bahiensis* and *T. serrulatus* in a case series including children and adults from the same geographical region. In this report, we describe a large case series of patients stung by scorpions admitted to a university teaching hospital over an 18-year period and compare the envenoming caused by these two species.

2. Methods

2.1. Patients and data collection

The hospital records of 1327 patients attended in the Emergency Department (ED) and Pediatric Intensive Care Unit (PICU) of the university teaching hospital at UNICAMP from January 1994 to December 2011 and followed-up by the Poison Control Center (PCC) were analyzed retrospectively. In all cases, information on the time, day and month of envenomation, as well as the patient's age, sex and geographic location of residence [primarily within the Metropolitan Region of Campinas (MRC) that consisted of 19 municipalities with ~3.1 million inhabitants in 2013] were recorded, when available. Also noted were the anatomic site of the sting, the time elapsed between the sting and medical treatment, the local and systemic signs and symptoms, the treatment administered upon admission and in the PICU, the number of vials of antivenom given, the frequency of early adverse reactions and the outcome of the cases. Scorpions brought by the patients were identified as *T. serrulatus* (yellow scorpion) or *T. bahiensis* (brown scorpion) by medical/nursing personal trained to use the morphology-based key that allowed easy distinction of the two species (Brasil – Ministério da Saúde, 1998, 2009) (Fig. 1).

2.2. Classification of stings

The clinical classification of the scorpion stings was essentially based on the outcome, adapted from an international consensus regarding the natural history of scorpion stings (Khattabi et al., 2011). The cases were classified as dry sting when the patients presented no local or systemic manifestations; class I, when only local manifestations such as pain, edema, hyperemia or paresthesia were detected; class II (systemic manifestations) when the patients developed agitation/restlessness, diarrhea, headache, hypertension, hyperthermia, hypothermia, myosis, mydriasis, pallor, priapism, salivation, somnolence/lethargy, sweating, bradycardia, tachycardia, tachypnea, vomiting or wheezing; class III (life-threatening evolution) when the patients developed manifestations indicative of shock/cardiac failure, ventricular arrhythmia, respiratory failure (pulmonary edema), or were fatal.

The diagnosis of shock was based on the presence of clinical features such as bradycardia/tachycardia, pallor, profuse sweating, cold extremities, weak peripheral pulse, poor peripheral perfusion and/or hypotension, with the patients requiring inotropic and vasopressor agents; in most patients with cardiac failure, the diagnosis was confirmed by echocardiography that showed abnormal left ventricular systolic function (decreased ejection fraction <54%). The diagnosis of pulmonary edema was based on the presence of clinical signs of respiratory distress, such as tachypnea, inspiratory retraction of the intercostal spaces, presence of lung crepitant rales on auscultation of one or both lungs, or the identification of blood-stained froth draining from mouth or nostrils or seen during intubation, together with radiological features (signs of unilateral or bilateral interstitial and/or alveolar pulmonary edema). All of the available data was reviewed by four of the authors (CCP, EMDC, FB and LCRF) in order to classify the patient's outcome according to the clinical class of severity. Disagreements regarding class II and III classifications (systemic manifestations) were resolved by discussion among authors to reach a consensus.

2.3. Antivenom therapy

The use of scorpion antivenom (SAV; Fab'_2 polyspecific hyperimmune antivenom obtained by the immunization of horses with a 1:1 mixture of venoms from *T. serrulatus* and *T. bahiensis*; 5 mL/vial; 1 mL neutralizes 1 mg of *T. serrulatus* reference venom in mice; Butantan Institute, SP, Brazil) was based on the Brazilian Ministry of Health guidelines that recommend SAV for all children who develop systemic clinical manifestations and for severe cases in adults (Class II, 2-3 vials; Class III, 4-6 vials; Brasil – Ministério da Saúde, 1998). The SAV was administered i.v. over 5–10 min, either undiluted or diluted in 0.9% saline in a proportion of 1:1, without prior medication.