

Freshwater stingray injuries in Belém, State of Pará, Brazil

Lesiones por rayas de agua dulce en Belém, Estado de Pará, Brasil

Lesões por arraias de água doce em Belém, Estado do Pará, Brasil

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ABSTRACT

Objective: to describe clinical and epidemiological aspects of freshwater stingray injuries in the city of Belém, Pará, Brazilian Amazon. **Method:** descriptive, epidemiological and observational study, carried out between 1999 and 2008, using medical records from hospitals in the districts of Mosqueiro,

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Outeiro and Cotijuba, in Belém. Results: the majority of injuries occurred in males (67.9%) being 84.8% during leisure, mainly in the dry season (July to December) (88.6%), during the day (92.9%) affecting the feet (88.4%) primarily. Participants received medical assistance in the first hour after the accident (84.4%), with local pain (99.2%) being the main complaint. 11.3% of patients had systemic manifestations. Among the complications during evolution, local infection and infection with necrosis were the most frequent (1.7%). Wound debridement was performed in 89.2% of patients. Conclusion: stingray injuries represent an important health problem for the population of the Brazilian Amazon. Understanding its epidemiological and clinical characteristics may improve patient care in the region.

Descriptors: Clinical Study; Wounds and Injuries; Fresh Water.

RESUMEN

Objetivo: describir los aspectos clínicos y epidemiológicos de las lesiones por rayas de agua dulce en la ciudad de Belém, Pará, Amazonia brasileña. Método: Estudio descriptivo, epidemiológico y observacional, realizado entre 1999 y 2008, utilizando registros médicos de hospitales de los distritos de Mosqueiro, Outeiro y Cotijuba, en Belém. Resultados: la mayoría de las lesiones ocurrieron en hombres (67.9%) y 84.8% durante el tiempo libre, principalmente en la estación seca (julio a diciembre) (88.6%), durante el día (92.9%) y llegando a los pies (88,4%). Recibieron asistencia médica en la primera hora después del accidente (84,4%), con dolor local (99,2%) como queja principal. La proporción del 11,3% de los pacientes tenía manifestaciones sistémicas. Entre las complicaciones durante la evolución, la infección local y la infección por necrosis fueron las más frecuentes (1,7%) respectivamente. El desbridamiento de la herida se realizó en el 89,2% de los pacientes. Conclusión: las lesiones de por rayas de agua dulce representan un importante problema de salud para la población de la Amazonía brasileña. Comprender sus características epidemiológicas y clínicas puede mejorar la atención al paciente en la región.

Descriptor: Estudio Clínico; Heridas y Traumatismos; Agua Dulce.

RESUMO

Objetivo: descrever aspectos clínicos e epidemiológicos das lesões por arraias de água doce na cidade de Belém, Pará, Amazônia brasileira. Método: estudo descritivo, epidemiológico e observacional, realizado no período de 1999 e 2008, a partir de prontuários de hospitais dos distritos de Mosqueiro, Outeiro e Cotijuba, em Belém. Resultados: a maioria das lesões ocorreu no sexo masculino (67,9%) e sendo 84,8% durante o lazer, principalmente na estação seca (julho a dezembro) (88,6%), durante o dia (92,9%) e atingindo os pés (88,4%). Receberam a assistência médica na primeira hora após o acidente (84,4%), com dor local (99,2%) a queixa principal. A proporção de 11,3% dos pacientes apresentou manifestações sistêmicas. Entre as complicações durante a evolução, a infecção local e a infecção com necrose foram as mais frequentes (1,7%) respectivamente. O desbridamento da ferida foi realizado em 89,2% dos pacientes. Conclusão: as lesões por arraias representam um importante problema de saúde para a

população da Amazônia brasileira. A compreensão de suas características epidemiológicas e clínicas pode melhorar o atendimento ao paciente na região.

Descritores: Estudo clínico; Ferimentos e Lesões; Água Doce.

INTRODUCTION

Stingray injuries are a neglected health problem in Brazil¹. Stingrays are found both in fresh and seawater. South American freshwater stingrays belong to the Myliobatiforms order and Potamotrygonidae family, with a diameter when fully grown which ranges from 30 cm to 1 meter. They have 1-3 dentine stingers located in the tail base and used for defense². Stingrays attack with their tail by striking mostly the lower limbs of the human victim when stepped on, while hidden in shallow graves carved in sandy or muddy places in the river bed².

The mechanisms of stingray injuries are both mechanical and toxic. Firstly, mechanical damage occurs from the cuspidate stingers and, secondly, the stinger base inserts venomous glandular cells, which deposit venom in the tissues of the victim. The venomous glandular cells are sparsely located

*in two lower, lateral grooves of the barbed spine and are covered by a very thin layer of tissue that easily stands out during the injury, while penetrating the victim's tissue, and release the venom^{2,3}. The venom extracted from the tissue glands on the sting of freshwater rays has hyaluronidase in *P. motoro*⁴ and peptides with vasoconstrictor activity in *P. orbignyi*⁵. In a comparative study between the venoms of the freshwater stingray *P. falkneri* and the marine stingray *Dasyatis guttata*, Barbaro et al⁶ found that both venoms have edematogenic, nociceptive, gelatinolytic, caseinolytic and fibrinogenolytic activities.*

*However, the same authors showed that hyaluronidasic, necrotizing and lethal activities were in mice detected only for the venom from *P. falkneri*. Rodrigues⁷ demonstrated that the *P. motoro* venom has an active component with cholinergic activity in guinea pig ileum and hypotensive activity when*

intravenously administered in rats. Magalhães et al⁸ showed that extracts of P. scobina and P. orbignyi stingers were able to induce pain, edema and necrosis in mice. Monteiro-Dos-Santos et al⁹ reported that extracts of the mucus collected from dorsal region and stingers of P. cf. henlei possess proteolytic activity and are able to induce pain and edema, while Haddad Jr. et al¹⁰ found that the P. falkneri venom has caseinolytic, gelatinolytic and hyaluronidasic activities. Antoniazzi et al¹¹ observed the ability of P. falkneri venom to induce histopathological changes and necrosis in animal models.

More recently, studies have demonstrated that P. motoro venom quickly induces paw edema in mice, with a large number of inflammatory cells detected at the injury site¹². Furthermore, histamine released by mast cells contributes to the edema and cell influx induced by P. motoro venom in the mice model¹³.

Stingray stings produce a sharp piercing injury and local bleeding. The injury causes severe pain, which is disproportionate in

relation to the wound size^{14,15}. Surrounding areas of the wound become ischemic and cyanotic, with erythema and edema of varying intensity appearing¹⁶.

During the following days after the sting, lymphangitis, lymph node reaction, abscesses and local necrosis may arise¹⁵. Systemic symptoms may also arise, such as salivation, nausea, vomiting, diarrhea, syncope, muscle cramps, twitching, dyspnoea, cardiac arrhythmias, hypotension, seizures and, though rarely, death².

This aim of this study was to present the clinical and epidemiological characteristics of stingrays injuries recorded in the Mosqueiro, Outeiro and Cotijuba districts, in the city of Belém, state of Pará, Brazil.

METHOD

Descriptive epidemiological and observational study was conducted in the city of Belém, Pará state, in the Brazilian Amazon. Belém is located on the banks of the Guajará Bay and the Guamá River

(latitude 1°27'21''S; longitude 48°30'16''W). The Climate type is hot, super-humid equatorial, with an average monthly temperature ranging from 22° to 32° C and with

relative air humidity around 80% throughout the year (Fig. 1).

Mosqueiro, Outeiro and Cotijuba are part of the Amazon River estuary and are influenced by the Atlantic Ocean tides.



Figure 1 - Map of South America, showing location of Brazil, Pará State and the city of Belém, where the Mosqueiro and Outeiro districts are located.

A Study of 168 cases of injuries caused by fresh water stingrays attended at public health centers in the city of Belém, Pará state, in the districts of Mosqueiro, Outeiro and Outeiro, from January 1999 to December 2018. All information was obtained from the patient records, after obtained Ethics Review Board approval, which

was applied for by researchers residing in the region where the accidents occurred.

In the study, only the medical records of patients who received medical care within 24 hours after the injury were included. The following parameters were investigated: district of occurrence, gender, age group, activity in

progress when the injury occurred, surface on which the patient was walking at the time, date, season, time until medical care, anatomical site of the injury, clinical signs and symptoms upon admission, treatment, and evolution of the cases.

This manuscript was approved by the Research Ethics Committee of the João de Barros Barreto University Hospital of the Federal University of Pará (UFPA), approval number CAAE: 09435819.6.0000.0017.

RESULTS

A total of 168 stingray injuries were recorded in the period, with 93 (55.4%) cases in the Mosqueiro district, 52 (30.9%) in the Cotijuba district, and 23 (13.7%) in Outeiro district. Most of the injuries occurred to males (67.9%). The most affected age group were Adolescents (44.7%) and adults (32.7%).

A proportion of 84.8% of the injuries were classified as recreational accidents. Regarding the surface on which the patient was walking on at the time of the accident, sandy ground was the most frequent (54.4%).

Injuries were recorded mostly in the dry season (88.6%), during the day (92.9%) and during the incoming tide (36.1%). Injuries occurred mostly to the feet (88.4%). The majority of the cases received medical assistance within the first hour after the injury (84.4%) (Table 1).

On admission, patients presented mostly pain (98.2%), edema (41.6%), peripheral cyanosis (29.1%), and erythema (26.2%). A proportion of 11.3% of the patients presented systemic manifestations, namely dizziness (5.3%) and diaphoresis (3.5%). Heart rate was higher than 90 bpm in 6.5% of the patients.

Table 1 - Epidemiological characteristics of the stingray injuries in the Mosqueiro, Outeiro and Cotijuba districts Belém, Pará, Brazil. January 1999 to December 2008.

Variable	n	%
District of occurrence (n=168)		
Mosqueiro	93	55.4
Cotijuba	52	30.9
Outeiro	23	13.7
Gender (n=168)		
Male	114	67.9
Female	54	32.1
Age group (n=168)		
Child	30	17,8
Teenager	75	44,7
Adult	55	32,7
Seniors	8	4,8
Recreation (n=139)		
Recreation	139	84.8
Work (n=25)		
Work	25	15.2
Substrate where patient walked (n=125)		
Sandy ground	68	54.4
Rocky ground	31	24.8
Mud ground	26	20.8
Tide pattern (n=111)		
Flooding	40	36.1
Falling	34	30.6
Low	32	28.8
High	5	4.5
Season (n=166)		
Dry (July to December)	147	88.6
Rainy (January to June)	19	11.4
Day period (n=113)		
Day time	105	92.9
Night time	8	7.1
Time until medical assistance (hours) (n=109)		
0-1	92	84.4
2-3	14	12.8
≥4	3	2.8
Anatomical site (n=147)		
Foot	130	88.4
Ankle	10	6.8
Knee	2	1.4
Thigh	1	0.7
Hand	4	2.7

Table 2 - Clinical manifestations of stingray injuries in the Mosqueiro, Outeiro and Cotijuba districts, Belém, Pará, Brazil. January 1999 to December 2008.

<i>Clinical manifestation</i>	<i>n</i>	<i>%</i>
Local manifestations	168	100
<i>Pain</i>	165	98.2
<i>Peripheral cyanosis</i>	49	29.1
<i>Edema</i>	70	41.6
<i>Erythema</i>	44	26.2
<i>Bleeding</i>	15	8.9
<i>Paresthesia</i>	23	13.7
Systemic manifestations	19	11.3
<i>Dizziness</i>	9	5.3
<i>Diaphoresis</i>	6	3.5
<i>Nausea</i>	3	1.7
<i>Abdominal pain</i>	3	1.7
<i>Vomiting</i>	2	1.2
<i>Headache</i>	2	1.2
<i>Fainting</i>	1	0.5
<i>Dark vision</i>	1	0.5
<i>Fever</i>	1	0.5
Heart rate (bpm)*	58	34.5
<i>60-89</i>	47	27.9
<i>90-140</i>	11	6.5
Injury evolution	21	12.5
<i>Local infection</i>	3	1.7
<i>Local infection + necrosis</i>	3	1.7
<i>Necrosis</i>	2	1.2
<i>Necrosis + abscess</i>	1	0.5
<i>Necrosis + blister</i>	1	0.5
<i>No complication</i>	11	6.5
Treatment	168	100
<i>Analgesics</i>	152	90.4
<i>Debridement</i>	150	89.2
<i>Wound drain</i>	33	19.6
<i>Tetanus prophylaxis</i>	40	23.8
<i>Antiinflammatories</i>	47	27.9
<i>Antibiotics</i>	28	41.1

A follow-up of 21 (12,5%) patients showed that the most frequent complications were local infection and necrosis with infection (Fig. 2). In relation to treatment, analgesic drugs were given to 99.4%

of the injured patients. Debridement and wound draining were performed on 89.2% and 19.6% of the patients, respectively. Tetanus prophylaxis was performed on 23.8% of the patients (Table 2).



Figure 2 - Aspects of stingray injuries in a 57-year-old white man: exulcerated lesion with secondary infection and necrosis in the right foot.

DISCUSSION

This study shows the clinical, epidemiological and therapeutic findings resulting from injuries caused by freshwater stingrays. The Brazilian Amazon, mainly the states of Pará, Amazonas and Tocantins, is the region which has the highest incidence of freshwater stingrays¹. Sachett et al¹⁷, Abati et al¹⁶ and Haddad Jr et al¹⁰ cite freshwater stingray injuries as being an important health problem in the Amazon region. However, there are

also reports of envenomations in the basins of the Paraná, Paraguay and Araguaia rivers¹.

The research areas are bordered by rivers and located near the state capital Belém, which explains the higher frequency of injuries in bathers during recreational activities. Haddad Jr. et al¹⁰ also found an association between stingray injuries and recreational activities in southeastern Brazil, while, in the state of Amapá, in the Brazilian Amazon, reported that the

freshwater stingrays injuries are more often related to fishing. None of the victims were able to identify the perpetrating species of stingray, which coincides with other records from the Brazilian Amazon¹⁸.

Freshwater stingray injuries affected mostly adults and teenagers of the male population, which coincides with studies performed in other Brazilian regions^{1,15,17} as well as in other countries, such as, Venezuela¹⁹ and the United States²⁰. In the present study, injuries occurred more frequently during the day, and from July to December, which is the dry season. This pattern is due to a more intense exposure of the bathers during recreational activities in the summer period. A higher incidence of stingray injuries over the second half of the year was also observed in the other regions of Brazil¹⁶⁻¹⁸.

Stingrays prefer shallow sandy or muddy water for their resting, and stay partially hidden in the river bed. The study shows that injuries occurred mostly when the victims were walking on sandy ground, as reported previously¹⁰.

Similar to our findings, Reckziegel et al¹, Cermeño et al¹⁹ and Clark et al²⁰ observed stingray injuries mostly in lower limbs, namely to the foot. Though unusual injury locations have been reported, such as to the victim's chest^{21,22}, which includes a severe case where the stinger penetrated the right ventricle of the patient's heart and caused death²². Another unusual injury location was recorded as being the abdomen of a diver, and included intestinal perforation²³. Medical assistance of the victims occurred mostly in the first hour, probably due to easy access to the emergency health units located near the beaches in the three districts.

All the victims reported local clinical manifestations, and pain was the most commonly-reported symptom. Several authors report pain as being the predominant symptom after stingray injuries^{1,15-17}, in general, it is disproportionate to the wound size¹⁴. Halstead² states that intense pain arises immediately after stingray injuries, lasting intensely for around 90 minutes, though in some cases it can last for

up to 2 days. The great variability found in the symptoms can also be due to the perpetrating stingray species. It is speculated that the venom of the freshwater stingray *P. falkneri* is more toxic when compared to the marine stingray *D. guttata*⁶.

Dizziness and diaphoresis were the most frequently reported systemic symptoms in this study. In previous case series studies of stingray injuries, authors reported dizziness, nausea, vomiting, diarrhea, tachycardia, fever, cold sweats, diaphoresis, agitation, arrhythmia and muscular paralysis in patients^{2,17}. However, 6,5% of the patients presented tachycardia. Halstead²⁴ showed that the venom acts directly on the cardiovascular system and causes irreversible cardiac arrest. In humans, presence of supraventricular arrhythmia, confirmed by electrocardiogram, was found 40 minutes after the stingray accident²⁵.

Early medical assistance is recommended for stingray injuries in order to relieve the pain and prevent secondary infection^{14,26}. In

this study, analgesics were employed for the relief of pain in all victims presenting this symptom. Since the stingray venom is heat-labile, warm water immersion of the injury site is recommended^{2,26}. However, this measure was not observed as being performed on patients in our consultations of the medical records in this study.

Debridement after anesthesia is a procedure recommended for wound cleaning and further healing²¹, and was the second most frequent medical intervention used in this study. Other surgical procedures may be necessary, especially when the stinger or parts of it are retained in the tissue of the victim or when there is abdominal perforation, which requires the use of exploratory laparotomy²³.

Wound drainage and tetanus prophylaxis for the management of stingray injuries were infrequently used in this study, contradicting the Brazilian Ministry of Health's recommendations²⁶. Evolution to local necrosis is commonly found after stingray injuries, which leads

to an anaerobic environment and favors the multiplication of *Clostridium tetani*; thus, tetanus prophylaxis is an essential measure against this severe complication²⁷. In the presence of signs of secondary infection, prescription of antibiotics is recommended.

Domingos et al²⁸ observed mainly gram-negative bacteria in the mucus from stingers of freshwater stingrays, which can cause local infection and necrosis, and may delay wound healing. Infections resulting from perforating or lacerating freshwater stingray injuries are usually caused by gram-negative bacteria of the genus *Aeromonas* sp., particularly *A. hydrophila*, which is an agent that is usually sensitive to aminoglycosides, third-generation cephalosporins, ciprofloxacin, imipenem and sulfamethoxazole-trimethoprim²⁹.

In this study, necrosis was the most common complication followed by secondary local infection, which coincides with previous observations in other studies¹⁵.

Despite the severity of this type of injury, studies continue to place greater emphasis on other types of accidents involving venomous animals³⁰. And one of the limitations of this study refers to the small number of studies available in the literature and the incompleteness of records or the absence of notification of cases, making it difficult to understand the real picture of this disease.

CONCLUSION

Stingray injuries represent an important health problem for the population of the Brazilian Amazon. A seasonality profile of stingray accidents can be observed, with a strong predominance in the dry season. Intense pain is the hallmark of this type of injury and complications, such as secondary infections are very commonly observed. Description of this condition enables a greater understanding of its epidemiological characteristics, clinical manifestations, and provides support in order to improve knowledge

regarding the pathophysiology and treatment of this neglected problem.

Stingray injuries are a public health problem in the Amazon region, however, neglected by health professionals, who are unaware of good practices in the medical management of injuries, which can be improved with training and research on this health problem in Amazon region.

It is hoped that this manuscript will increase the interest of health professionals in the Amazon region regarding stingray injuries, however, most of them are unaware of the good practices in the medical management of injuries and, we believe that these can be improved by training and research on this subject.

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