

Forefoot infection by *Staphylococcus lugdunensis* following a stonefish sting: A case report

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Abstract

Several orthopedic injuries caused by marine creatures envenomation have been reported in recent years all around the world, occurring mainly during water sports practice.

We reported a case of an Italian tourist who developed an acute forefoot infection by *Staphylococcus lugdunensis* following a penetrating wound at the plantar region of the fourth toe, caused by a Stonefish, during a session of snorkeling in Indonesia.

Diagnosis by microbiological methods, soft tissue and bone biopsy, surgical debridement and administration of antimicrobials led to a successful treatment of this potentially severe infection in this case. From this experience, we suggest to consider this bacterium in the differential diagnosis of bone infection following stonefish envenomation in tropical areas.

Background

Water sports practice such as diving, or snorkeling is rapidly growing in popularity and there are now estimated to be up to 6 million recreational divers globally [1].

It is estimated that greater than 1200 species of fish may be venomous or poisonous to humans [2]. As more people dive and snorkel for leisure, the incidence of envenomation injuries presenting to emergency departments has increased. Each year occur between 40,000 and 50,000 marine envenomation, the most serious in the temperate or tropical waters of the Indo-Pacific region [3,4]. However, in scientific literature few series of venomous fish stings have been reported with a low incidence of consequent morbidity [5,6]. Puncture wounds by Stonefish and other venomous fish raise concerns for envenomation, foreign-body deposition, and infection by atypical pathogens especially vibrio species [7]. Local presentation ranging from mild to rapidly progressive, including necrotizing fasciitis or gangrene and result in amputation or death [7-9].

We report the first and only case of Stonefish poisoning with a secondary infection by *Staphylococcus lugdunensis* present in Literature at now referred and treated in our hospital.

Case presentation

A 35-years-old female was admitted, in September 2019, in our hospital, one of the national reference centers for Infectious Diseases, after a holiday in Indonesia, in which she procured an injury of right foot's fourth toe, due to the attack of stonefish, while she was practicing snorkeling, wearing special equipment. The envenomation occurs 1 month earlier in August 2019, the identification of the offending fish was made by direct viewing of local fishermen who witnessed the injury and subsequently confirmed diagnosis in local hospital.

She received a puncture on the plantar region of fourth toe, with a penetrating wound while diving a few meters from the shore, despite wearing special socks for the practice of water sport. The victim was carried out from the water and transported to the local hospital. She

referred uncontrolled pain with an extremely swollen foot associated to a progressive extended area of paresthesia in the leg. At local hospital first clinical assessment showed a pulse rate of 110 beats/min, a blood pressure equal to 100/65 mmHg with a tympanic membrane temperature of 37.2°C. Furthermore, the patient was reported to be fully conscious but in an evident state of agitation because an uncontrolled pain with a progressive worsening of swelling and redness despite preserved peripheral pulses. A persistent paresthesia area was involving both the foot and leg with a poor ankle range of motion (ROM). The patient was already covered by antitetanic vaccination. No antivenom was available in this hospital upon the patient arrival but luckily no systemic symptoms were reported on physical examination such as abdominal tenderness, respiratory distress, nausea, vomiting, headache, chest pain. At the local emergency department, after clinical exam, the wound was immediately explored and copiously irrigated using sterile techniques. According to standard procedures, as reported by Ongkili et al. [10] she was treated with hot water immersion, and Ciprofloxacin 500 mg twice a day plus oral steroid therapy twice a day were immediately prescribed for seven days. Seven days after, the patient was still painful with a persistent lymphedema involving both ankle and foot in association with hyperaemia and a constant tympanic membrane temperature higher than 37,2° C. Furthermore pain, redness and swelling were particularly evident at the 4th toe. Sequestered blood tests showed a modest rise in inflammatory markers and the patient (CRP 12 mg/L and white cells count 10.3 x 10⁹/L), still without any systemic manifestation, was prescribed to continue with oral antibiotics for further 15 days. Furthermore Metronidazole 500 mg 3 times a day

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intravenously for 15 days and Prednisone 25 mg 1 time a day orally for 15 days were added to the therapy with a recommendation of an immediate return to home.

Upon her arrival she was referred to our infectious disease department, and she underwent to a tropical infectious medical evaluation confirming the above reported clinical scenario still showing no general symptoms and no local drainage. White cells count and CRP returned to normal range (CRP 0.8 mg/L and white cells count $5.82 \times 10^9/L$). A radiologic assessment of the foot didn't show any foreign body but a clear interphalangeal cortical irregularity of fourth toe located to the proximal phalanx. A consequent MRI revealed clear signs of acute osteomyelitis process in proximal phalanx associated to a marked edema located both to the adjacent soft tissues and to the head of the fifth metatarsal [11]. Clinical appearance still did not show any systemic sign possibly related to the toxin after one month and in agreement with Infectious disease specialist she suspended all therapy implementing a wash-out. Twenty days later she had worsening of the swelling of the forefoot and painful symptoms with higher CRP 5.8 mg/L and white blood cell count of $6.77 \times 10^9/L$ and pain during walking. Therefore, she was referred to the out-patient orthopedic department for biopsy (4th metatarsal and 4th proximal phalanx).

The open biopsy associated to a local debridement was performed under local anesthesia using a dedicated sampler commonly used for breast cancer biopsies, allowing to obtain multiple specimens (two sample collected from bone and soft tissue) for microbiological and histological assessments. Intraoperative macroscopical appearance shows dense sclerotic bone tissue with necrotic soft tissues. The results of all culture tests revealed the presence of *Staphylococcus lugdunensis*, a coagulase-negative staphylococci species (CNS), an uncommon bacterium in bone and joint infections [12].

The histological examination was not significant but confirmed the local presence of inflammatory aspecific cells.

Consequently, the patient underwent to an antibiotic therapy specifically addressed on the pathogen for 6 weeks: the first two with intravenous Daptomycin 500 mg one administration 1 time a day and oral Trimethoprim 160 mg and Sulfamethoxazole 800 mg one administration 3 times a day, the others with oral Doxycycline 100 mg one administration 1 time a day alone.

The patient after 1 week referred a progressive reduction of both forefoot pain and swelling with a progressive improvement in foot and ankle functionality with a complete regression of any local signs after 45 days associated to a normal weight bearing. At 6 months and 12 months of follow-up the patient was totally asymptomatic with the absence of any radiological and clinical signs of acute osteomyelitis or soft tissue infection.

Discussion

Despite few cases of orthopedic complications following venous fish puncture are reported in Literature [3-5], this is the first documented case of secondary acute infection by *Staphylococcus lugdunensis*, resulting from Stonefish sting, with forefoot soft and bone tissue involvement.

The Stonefish (Genus *Synanceia*) is a member of the family Scorpaenidae, that includes the most venomous fishes in the Ocean [7]. Due to climate change some species of stonefish have also been spotted in Florida's waters as well and the Gulf of Mexico or the Mediterranean with an increase in cases of poisoning [13].

All Scorpaenids have a hard bony plate and they has 13 dorsal spines, capable of piercing a shoe with a soft sole equal to 0,5 cm,

erected involuntarily when seabed is disturbed [7]. This venom is heat-labile, non-dialyzable and has high molecular weight proteins, with antigenic properties and enzymes, with cytolytic, neurotoxic, myotoxic and hypotensive activity [14-16].

The acute systemic manifestations of Scorpaenidae injuries might include nausea, diaphoresis, dyspnoea, weakness, cardiac arrhythmias, myocardial ischemia, chest or abdominal pain, marked hypotension, and syncope even with a potential life threatening [17]. Chronic local manifestations in all Scorpaenidae envenomation injuries may include slowly healing necrotic ulcers at the puncture sites, persistent pain and joint swelling [17,18]. Late complications may include foreign body granulomas, peripheral neuropathies and secondary infections with variable presentation such as local abscesses, suppurative tenosynovitis, osteomyelitis, necrotizing fasciitis, compartment syndrome and gangrene with consequent different therapeutic protocols as described by several authors in literature [14,18]. These approaches range from first simple aid measures with hot water immersion therapy, administration of antibiotics, analgesics and antivenom, indicated for systemic manifestations, until wide surgical debridement's associated to Vacuum-assisted closure (VAC) therapy and/or hyperbaric oxygenation for management of large soft tissue necrosis [19].

S. lugdunensis is a rare coagulase-negative, gram-positive, anaerobic coccus organism [20]. Osteomyelitis can be rare complication but can occur as well as soft tissue infection after a history of trauma [21-23]. Following its identification, this particular organism should never be considered as a contaminant but more frequently as an aggressive pathogen often related to a general health status of immunosuppression and comorbidity.

Seng et al. in 21 cases of osteomyelitis from *S. lugdunensis* found a high rate of severe complication such amputation (29%), demonstrating the potential aggressiveness of this pathogen and recommending an early correct treatment as mandatory to prevent devastating damages. On this purpose we believe that an appropriate management of these aquatic injuries ranging from an early traumatic mechanism identification and venom neutralization to any early conservative or surgical treatment can make a difference in the final results.

Conclusion

Globalization has made it easier to become in contact with rare species of animals in every part of the world, making a case like this of possible observation even in western countries. Every specialist should be aware of this possibility, to undertake the most correct diagnostic path, to adopt, in the shortest possible time, the appropriate therapies to reduce potential devastating compliances and any further surgical procedures.

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