

CATFISH STINGS AND THE VENOM APPARATUS OF THE AFRICAN CATFISH *CLARIAS GARIEPINUS* (BURCHELL, 1822), AND STINGING CATFISH *HETEROPNEUSTES FOSSILIS* (BLOCH, 1794)

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Abstract: The ability of catfish to inflict extremely painful wounds with their pectoral and dorsal stings has been well known for many decades. The venom apparatus of the African catfish *Clarias gariepinus* (Burchell, 1822), and stinging catfish *Heteropneustes fossilis* (Bloch, 1794) is constituted by a single, sharp and stout sting immediately in front of the soft-rayed portion of the pectoral fins. The sting has well developed articulations, making it possible for it to become erect and locked. The toxicological centres in Poland have recorded 17 cases of envenomations caused by stinging catfish and African catfish; the injury was accompanied by intense pain, numbness of the site, dizziness, local oedema and erythema. In addition, systemic symptoms such as tachycardia, weakness and arterial hypotension were observed. The treatment of these injuries should include cleansing of the wound and surrounding area. Immersion of the wounded extremity in hot water (45°C) was used for the pain control. An attempt to remove any spinal sheath or remnant must be undertaken. Antibiotic management depends on several factors: the age and immune status of the victim, the interval between injury and presentation, or the presence of a foreign body. The most serious long-term complications of sting envenomation involve infections.

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INTRODUCTION

Venomous catfish have a sharp and stout sting immediately in front of the soft-rayed portion of the pectoral and dorsal fins. Stings are derived from fin rays, and are covered by a thin integumentary sheath. There is no external sign of the venom glands, which are located in a series of sharp, recurving teeth capable of cutting into a victim's flesh, helping the venom to be absorbed and often seeding serious infections. The stings of the catfish are very dangerous once they have been erect. In catfish, the pectoral fins aid the fish in its defence mechanism against predators [5, 7]. The ability of catfish to inflict extremely painful

wounds with their pectoral and dorsal stings has been well known for many decades. Catfish sting envenomation is a frequent cause of morbidity among anglers, fishermen, food processors and aquarists [1, 2, 4, 6, 7, 10, 11]. Catfish have two toxicity mechanisms: the first is linked to sting penetration and rupture of the venom glandular tissue surrounding the sting, whereas the second, called crinotoxicity, is associated with the production of toxins in the entire fish skin [3]. The venom of catfish is a complex composition of haemolytic, dermonecrotic, oedema-producing and vasospastic factors whose potency is largely inversely proportional to the fish size, and is a defensive mechanism [1, 2]. In some fish, single-cell glands may be grouped in

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larger aggregates of cells called venom glands that may form organs resembling multicellular glands of terrestrial animals. They are usually located around the spines or hard rays, of the fin. Even if covered with a connective tissue sheath, the aggregates of the venom cells do not have any common outlet; they are not therefore proper multicellular glands. The venom glands of catfish are covered with a thin sheath and release their contents when the sting is pressed. When the sting penetrates the body of its prey, pressure and rupture of the glandular tissue cause venom penetration of the wound. [1, 2, 10]. The African catfish is a fish with an elongated body that is smooth and very flexible. It has a long dorsal fin without a sting. Stings occur in the pectoral fins. This species has venom glands organized similarly to stinging catfish (masses of single-cell glands, mainly serous, in the proximity of the stings located near the spine of the pectoral spine [3]. This family is widely distributed throughout Africa, India, Indonesia and Indochina. It has an organ for breathing with air, which is a gill chamber, broader in its upper part, filled with bush-like upward-directed protrusions of the second and fourth gill arcs. *Clarias gariepinus*, which is generally considered to be one of the most important tropical catfish species for aquaculture, has an almost Pan-African distribution, ranging from the Nile to West Africa and from Algeria to South Africa. They also occur in Asia Minor (Israel, Syria and southern Turkey). In general, *C. gariepinus* lives in most river basins sympatrically with *C. anguillaris* (L). *Heteropneustes fossilis* commonly known as stinging catfish, the only species belonging to the family Heteropneustidae found in Asia. In their natural environment the fish can reach up to 70 cm in length; however when bred in an aquarium they are significantly smaller [10]. Stinging catfish are dangerous because of the connection between the stings in the pectoral fin and the venom cells [10, 11, 12]. In Asia, fishermen are afraid of this fish and if they catch it in their nets they remove it with a piece of cut-off net with great care. The stinging catfish has become a popular aquarium fish in Poland and is available in almost every pet shop. It is also bred on a large scale. Cases of freshwater catfish *H. fossilis* and *C. gariepinus* stings envenomation are presented here.

MATERIALS AND METHODS

In the Clinic of Toxicology of the Jagiellonian University Medical College, various patients are evaluated and hospitalised due to bites inflicted by animals occurring naturally in Poland [9], as well as those bred in home aquariums [10]. Additionally, the Centre for Toxicological Information of the Jagiellonian University Medical College records and documents cases of animal-induced envenomation in southern Poland. Co-operation between toxicological centres from other regions of the country enables the registration and analysis of all cases of poisonings that occur in Poland. Cases of catfish-induced envenomation were subject to analysis – 17 patients were injured by freshwater

catfish in the monitored areas; 10 caused by stinging catfish and 7 caused by African catfish. Observations were carried out in the years 2003–2007. Medical history was collected from patients who had to answer a questionnaire related to the epidemiological and clinical aspects of envenomation. The course of poisoning was analysed on the basis of case records and correlated with the catfish venom composition. Three African catfish and 3 stinging catfish were used for the analysis of the pectoral stings. The fish were killed after anesthesia in triacaine (MS 222) solution. The pectoral fins were separated and each of them observed under a light microscope.

RESULTS

Seven cases of envenomation with African catfish venom were reported. The exposure took place during contact with the stings of the pectoral fins. The affected persons were staff of supermarkets, and injuries occurred during fish preparation for sale. Injuries were puncture wounds in all cases. The wounds were on the right hand in 5 victims, left hand in 2. Intense pain was the main symptom in the acute phase of envenoming, but other inflammation manifestations, such as oedema and erythema, were also common in all cases. Treatment consisted of surgical wound debridement, and removal of the remnants of broken fin rays in 2 cases, hot water immersion for 40 min. in 5 cases as well as pain management, antibiotic therapy and tetanus prophylaxis were given in all cases. Over 1–2 months, the wound healed slowly by second intention. No residual deficits in motor or sensory functions were observed. Aid was usually provided by first-contact physicians in 4 cases and the Toxicological Centre consulted. In the pectoral fins of African catfish there are 8 rays, the first of which are much larger than the others (I 7); they are serrated and connected with the shoulder girdle by an articulation. Three well developed articulations allow the stings erection and locking when the catfish is disturbed (Fig. 1). The stings are responsible for most of the morbidity cases resulting from catfish encounters.

The toxicological centres in Poland have recorded 10 cases of envenomations caused by stinging catfish. The affected persons were aquarium fish breeders, and envenomations occurred during tank tending and fish feeding. Injuries were puncture in all cases. The wounds were on the left hand in 2 victims, right hand in 8. The injury was accompanied by intense pain, numbness of the site, dizziness, local oedema and erythema. In addition, symptoms such as tachycardia, weakness, arterial hypotension, loss of consciousness, respiratory distress and unusual sensations (tingling, pricking) were observed (5 cases). We consider these envenomations as moderately serious accidents. The first aid treatment for stinging catfish stings was removal of all foreign material and irrigating the site with whatever clean liquid is available, warm water immersion and pain management. Radiographs aimed at the inspection for

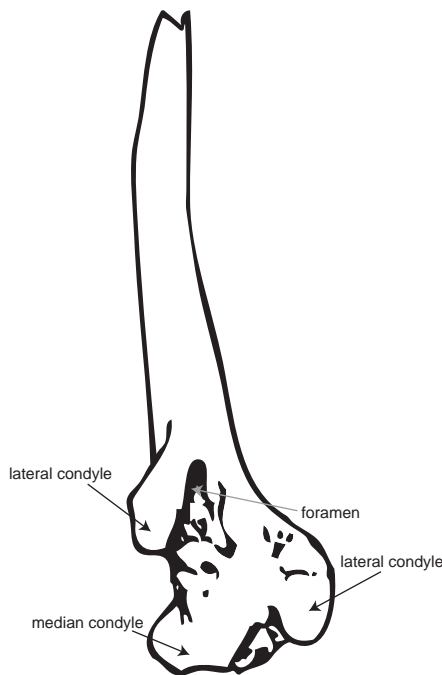


Figure 1. Pectoral sting of *Clarias gariepinus*.



Figure 2. Pectoral sting of *Heteropneustes fossilis*.

foreign bodies was used in all cases. The patients received a prophylactic short course of oral therapy with trimethoprim-sulfamethoxazole. Tetanus prophylaxis was given when indicated (7 cases). Some patients were observed for 24 hours (5 cases). In all cases, no residual deficits in motor or sensory functions were noted. Over 2 months, the wounds healed slowly by second intention. Pectoral fins of stinging catfish possess 8 rays (I 7). The first ray (spine) is well-developed: serrated with a sharp end, it looks like a harpoon. Three articulations allow erection and locking (Fig. 2).

DISCUSSION

After catfish envenomation the following may occur: persistent cutaneous oedema, erythema, intense burning or throbbing pain that may appear at the wound site. Paresthesias, weakness, localized sweating, and muscular fibrillation can be accompanied by cyanosis and inflammation around the puncture site. Lymphangitis, cellulitis, and septicaemia may be sequelae [1, 2, 6, 10, 11]. Other systemic symptoms may also be present, including tachycardia, hypotension, nausea and vomiting, dizziness, respiratory distress, and loss of consciousness [1, 2, 6, 10, 11]. Immersion of the injured part in 45°C water for at least 30–90 minutes may be beneficial to relieve muscle spasms and intense pain; it may also inactivate some venom in the wound [1, 6, 10]. The use of parenteral analgesics may be necessary to control pain. Tetanus prophylaxis should be given when indicated. Antibiotic management depends on several factors: the age and immune status of the victim,

the interval between the injury and the presentation, and the presence of a foreign body. As injuries inflicted by catfish may result in delayed presentation of infection, it was suggested that the patients should be admitted for observation [1, 2, 10]. In the case of injury inflicted by catfish, infection may develop even within 3 months of the incident; the patients were therefore instructed to have check-ups [1, 10]. It has been demonstrated that tissue extracts from stinging catfish and walking catfish *Clarias batrachus* (L) induced cardiotoxic activity in isolated hearts of frogs, and the extracts from *H. fossilis* had a greater influence than those of *C. batrachus*. The epidermal secretions of stinging catfish and walking catfish are rich in lipids and proteins while carbohydrates are very low. It has been shown that lipids are the principal constituents of the skin of these fish. Most of the lipids are phospholipids [12]. The concentration of proteinaceous material secreting cells around the pectoral sting has led to the evolution of the venom gland in catfish [3]. Rupture of this epithelium during envenomation is the source of the venom injected into the victim's body. The severity of the envenomation depends on the fish species, the number of stings, and the amount of venom released – the amount of venom is correlated with the size of the fish. The management of the envenomation caused by African catfish venom, noted in Poland, was predominantly symptomatic. The aid was usually provided by first-contact physicians and sometimes the Toxicological Centre was consulted. In the case of stinging catfish poisoning the treatment is mainly symptomatic [10, 11]. Although these injuries are intensely painful, most such envenomations heal without sequelae. Occurrences of this

type of fish injury is therefore likely to become more common, and with freer movement of goods within the ECG, more widespread. Every, even small, injury caused by African and stinging catfish healed very slowly. The skin is a part of the non-specific immunological system protecting the body against potential environmental pathogens. Fish bites, stings and scratches facilitate the penetration of microorganisms across the skin into underlying tissues that are susceptible to infection [4, 8]. Freshwater catfish generally stay in slow, still, and often dirty waters, thereby potentially increasing the risk of infection. Increased inflammatory response and necrosis caused by fish venom may bring about extensive destruction of the integument as well as dysfunction of the humoral and cell-mediated response, which is conducive to infections caused by opportunistic microorganisms and physiological flora of the body. The microbiology of infections that accompany fish-inflicted wounds usually reflects the bacterial flora of the mouth in the case of a bite, and that of the body surface in the case of sting; however, microorganisms living in the water and the skin of the affected persons may also be found [8, 9]. Antibiotic therapy is recommended in all cases of wound infections caused by fish; the choice should be based on the most probable etiological factor related to the specific fish species, and later – on the basis of culture and Gram-staining [8]. It is often very difficult to differentiate the symptoms of infection from those of venom-induced reactions. In fresh-water reservoirs and coastal salt waters there are 2 species of Gram-negative bacteria belonging to the Pseudomonadacea family. In the case of fish stings and bites one should consider possible infection caused by the above-mentioned bacteria. *Aeromonas* bacteria may infect wounds inflicted by fish living in fresh and salt water. Persons injured by fish are exposed to bacteria: *Erysipelothrix*, *Klebsiella*, *Escherichia*, *Edwardsiella*, *Nocardia*, *Chromobacterium*, *Actinomyces*, *Mycobacterium*, *Aeromonas* and *Vibrio*. In persons with a reduced immunity, infection caused by the presence of microorganisms and their toxins in blood and tissues may be the cause of sepsis, (*Aeromonas* and *Vibrio*, mainly). Another threat related to catfish exposure is erysipeloid – an infectious skin disease that

develops following immediate penetration of *Erysipelothrix rhusiopathiae* (Migula 1900, Buchaman 1918), bacteria, the source of which are predominantly fish and pigs. Erysipeloid is usually occupation-related – it occurs in fishermen and fish traders, hence its English name ‘fish-handler’s disease’ [8]. After the period of incubation, which usually takes several days, a very strong pain occurs with oedema and circumscribed bluish-red skin lesion.

CONCLUSIONS

The envenomation caused by some species of exotic freshwater catfish (*C. garipepinus* and *H. fossilis*) noted in Poland was usually moderate, the management was predominantly symptomatic.

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