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Unexpected Bluefish attack on human: surgical implications and forensic bite analysis

Inaspettato attacco di un pesce azzurro a un essere umano: implicazioni chirurgiche e analisi forense delle caratteristiche del morso

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Summary
The authors described and discussed a case of a woman who suffered a Bluefish bite at the right thumb with a severe lesion of the tendons and sensitive nerve. Many newspapers reported schools of Bluefish attacking human, but no scientific reports were found in literature, because of the difficult in paternity of the bite. The authors focused on the epidemiological and clinical aspects of the injuries, as well as on the Bluefish biology, to gain a better understanding of the natural history of bites.

Key words: Pomatomus saltatrix, Bluefish, bite, hand, human attack

Riassunto
Gli autori descrivono il caso di una donna attaccata da un Pesce Serra che riportava una grave lesione del pollice destro con interessamento dei tendini e delle strutture nervose. Molte riviste descrivono attacchi di Pesci Azzurri agli esseri umani, ma pochi lavori sono disponibili nell'ambito della letteratura scientifica, a causa della difficoltà nell'identificare la tipologia del morso animale. Gli autori si sono concentrati sugli aspetti clinici ed epidemiologici della lesione, nonché su quelli della biologia marina, al fine di meglio comprendere le caratteristiche del morso.

Parole chiave: *pesce serra, pesce azzurro, morso, mano, attacco umano*

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Conflitto di interessi
Gli Autori dichiarano di non avere alcun conflitto di interesse con l'argomento trattato nell'articolo.

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Introduction

Around the word many species of fishes are known by humans to have dangerous or terrifying aspects. Over the estimated 1,200 venomous fish species on earth (from toxic to lethal), many other scaring ones are described according to their human attacks and bites.
The Pomatomus saltatrix is commonly known as Bluefish. This predaceous fish

is perhaps the most ferocious one in the seas, leaving in his wake a trial of dead and mangled fishes on which it preys. No one fisherman can say enough to the saltwater fishing about the care needed when handling a Bluefish because of his razor-sharp teeth.
Bluefish is a marine pelagic fish usually found in oceanic beaches facing the open sea, in bays or in estuaries, being also able to survive a wide range of salinities and freshwater. It is a migratory fish widespread around the world from Brazil to Australia passing through the Mediterranean, foraging both on the bottom and near the water surface. Attacks are conducted in schools or alone. Preferred prays are pelagic fishes, like clupeids, squids as well as stripers and mullets according to the feeding habitat. Variety in chase may be associated with the environment differences between the sites [1].
Estimated adult bluefish lengths were grouped [2] into 3 size Classes (< 40 cm; 40-60 cm; > 60 cm), describing since to 130 cm length and 12.5 kg weight. In Italy the Bluefish is mostly recorded in the central-west (Fig. 1) and south coasts (from Sardinia and Tuscany to Calabria and Puglia) with a common body length from 30 to 60 cm, with a maximun of 78 cm and weight up to 8.5 kg [2,3].
Preferred preys in Italy are M. Cephalus and Persico Spigola, attacked from behind with the body often mangled and sliced at the tail level. Bluefish in Class 3 size can easily cut large prey fish in two with one bite, swallowing half and often give up the remnant. The clean and wide amputation of the prey's body reveals how dangerous to humans may be the powerful bite of the teeth like razors of the Bluefish. One of the distinguishing characteristics is that lower jaw is extended downwards and is substantially aligned with the upper jaw (Fig. 2), both with extremely sharp teeth located on the dentary and premaxillary bones. The large, dagger-shaped and deeply socketed teeth exhibit features related to feeding on large and active prey. These are atypical of tooth anatomy in teleosts, rather resemble aspects of the dentition observed in predatory vertebrates associated with extreme carnivory, such as crocodilians, great barracuda etc. [4].
There are many reliable records of human attacks by Bluefish schools on bathing people, from 1974 to current days. Despite the folklore about these attacks reported in many newspapers from Florida to Spain and Italy, no one Bluefish attack was described and discussed in medical and surgical literature. The purpose of this article is to improve the knowledge of the Bluefish biology, anatomy and environment, as well as to provide biologists and medical practitioners a basic knowledge for assessing the Bluefish paternity based on bite features and tooth imprint. In addition to ecological and behavioural data, forensic analysis may provide critical information for achieving the bite identification on human attack without provocation.

Materials and methods

The authors describe a case of a 61 years old female who suffered a Bluefish bite in the Italian south coasts of the Mediterranean during summer time. The victim was about 15 meters from the shoreline in shallow water, relaxing with his upper limbs dangling and floating into the water with the forearm in pronation. Suddenly she was hit on the right thumb. One rapid bite, then severe pain and she pulled herself out for shore, bleeding. The patient appeared to be seriously injured and was hospitalized for the first clinical treatment consisting in intensive cleaning of the wound, evaluation of the deep tissue lesions in local anesthesia, and temporary skin suture. The patient had regular antitetanus vaccination. Because of the tendinous and nervous lesions reported at the hand, the patient was transferred to the authors' Hand and Microsurgical Center. According to the bacterial flora of the marine environment and the extensive tissue damage, without information about the oral flora of the marine animal, prophylaxis was strongly desired and a broad spectrum antibiotics that covers Gram-positive and Gram-negative bacteria, such as Ciprofloxacin, was imme-

Figure 1. Original photograph of a Class 3 size Bluefish caught in the Italian central-west coast of the Mediterranean.

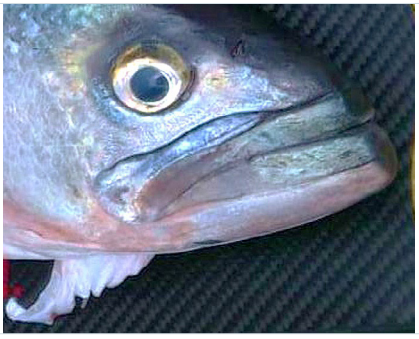

Figure 2. Particular of the characteristic mouth of the Bluefish, with prominent lower jaw.

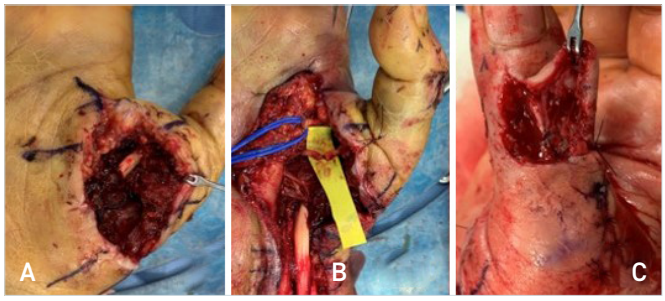

Figure 3. Lesion of the flexor pollicis longus **(A)** and radial sensitive nerve **(B)**. Lesion and suture of the extensor tendon **(C)**.

diately started [5]. During the surgical treatment, performed in the Hub Center three days after the attack, the bite damage was analyzed for both tissues repair and pattern of the animal jaws. The fish bite was typified by a series of ragged-edged, roughly parallel lacerations that overlapped to form a crescent-shaped perimeter around the base and first phalanx (P1) of the thumb.
Bite circumference was measured according to the forensic proposed method by Lowry et al. [6].
The flexor pollicis longus suture was performed before the suture of the radial collateral sensitive nerve (Figs. 3A, B). On the dorsal side the extensor tendon was sutured at the P1 level (Fig. 3C).
The post-operative rehabilitation program had no differences with the common nerve and tendon sutures [7,8].
A literary review was performed recurring to the PubMed and Medline Plus databases and Researchgate, searching: Pomatomus saltatrix, bluefish, tailor, snapper and Serra (to include also paper not only in English language). The same terms were used for an Internet-based research on the world wide web to collect bites reported in newspapers. The bites reported in the discussion forum, when the anglers try to unhook the fish, were excluded.

Results

Despite none Bluefish bites and human attacks were recorded or discussed in scientific literature, many reports were recorded in various newspaper around the word.
The Internet-based research revealed about 49 human attacks. The first report of a sort of bite outbreak, with 11 swimmers and surfers bitten, was in Florida (north Miami) and was documented by The New York Times in April 1974, underlining how the Commissioner of Fisheries just officially urged the US Congress to take action to eradicate bluefish in 1873 because of its pernicious voracity. The same newspaper reported a similar bite outbreak (22 wounded bathers, one lost an index finger) in Deerfield (Florida) during the

Figure 4. Original photographs of a Class 3 size Bluefish caught in the Italian south coasts of the Mediterranean, in the water of the beach before the human attack reported.

April 1976, as well as the Sun Sentinel described 5 human attacks in April 1987 in the same water close to Deerfield. In July 2006, as well as in July and August 2019, The Sun reported 4 cases of human attacks (one woman and three children) along the beaches of Alicante in Spain. In 2021 The Mirror described another bite outbreak in Spain's Costa Blanca (5 tourists) In Italy, Il Tirreno reported 2 different human attack by Bluefish in 1999 and 2015 in the coasts of Tuscany. All the injured persons were mostly near the shoreline in a rest position (bathing, slowly swimming or floating on the surf). Bites were described both in the feet or hands, mostly close to the toes and fingers. Only one case of not specified "lost finger" was reported. All other case were mostly wounds, rather few tendon lesions. In all attacks the Bluefish responsibility was detected only by the local officers and authorities, often closing the beaches in presence of bite outbreak.
In the current reported case the presence of a Bluefish school in the water in front the beach of the Italian south Mediterranean coast was confirmed by the local anglers, who supplied to the parents of the victim a photograph of a Bluefish caught in the early morning of the day of the attack in the same water (Fig. 4).
On the other hand, the analysis of the bite damage and shape onto the hand of the patient, revealed elements highly sustaining the Bluefish hypothesis. The analysis of the correct length of bite circumference is affected by several bias, erasing by angles of attack as well as by the use of an incomplete portion of the jaw during the bite, which may lead to less than a full bite circumference being present on the bitten hand. Despite these limits, the upper and lower jaws presented a similar aspect and circumference (6.8 cm the lower jaw impressed volarly to the thumb bitten in pronation, 7 cm the upper jaw impressed dorsally), supporting the characteristic tooth of the Bluefish, which has a similar cir-

cumference between the jaws because of the down-warding lower one. The bite circumference approximately of 14 cm was compatible with a C3 specimen of Bluefish (55-65 cm). These could quite distinguish the Bluefish bite by shark and barracuda.
Healing time and outcomes had no particular aspects neither infective complication.

Discussion

The Bluefish bites described in the current paper, according to the case report and the reviewed newspapers, took place in warm and shallow waters, where and when tourism was high. The biological and environmental Bluefish characteristics explain that human attacks occur during warm and wet period, following the prey close to the shoreline, at a time when large number of bathers are in the water. Of the 49 accidents recorded in very few cases appeared the be necessary a special surgical attention, and the most severe one resulted in index finger amputation. In only three cases, included the current case report, tendons and nerve repairs were performed. However, all lesions by Bluefish requires prompt medical assistance because of deep wounds and extensive bleeding.
The severity of the lesions is strictly related to the size of the Bluefish, reconducting the potentially mutilating events to the classified Class 3 size, and in any case in more than 50 cm length specimen.
Limbs are the bitten body parts in all accidents in bathers [9-11], feet are clearly the most available into the water, but the hand and the fingers are often bitten by the Bluefish because of his characteristic predatory technique of attacking from behind, near the surface of the water, and of swallowing the bottom of the prey. During bathing or slowly swimming the fingers are suitable to be swallowed and bitten by the formidable sharp teeth of the Bluefish.
Despite the occurrence of bluefish school or alone specimen close to shore into the warmth of the coastal waters is not rare, the reports of severe injuries and their causes are factual. The events appear to have a rare combination of natural circumstances according to the local saltwater environment, wind, rising tide, temperature, as well as the size of the bluefish and the poor visibility into the shallow waters of the well-used bathing beach area, being murky from swimmers. As a result, the bluefish could not see well and could be striking at anything that remotely resemble a prey.
There are no reports on Bluefish human attack, because of issues in paternity of the bite. However, species identification is paramount after a marine human attack with severe lesions for profiling a dangerous specimen, as well as for responding to the patients' queries. The assessment may be done through measurements of the bite width and circumference, as well as by other details of the wound, such as the shape and the margin that directly depend on the jaw characteristics. Analysis may be complemented by ecology and behavior for a more reasonable conclusion.
The presence of Bluefish schools is widespread in the warm water and coasts, and is easily detected by local anglers. Its bite may be adequately distinguished by other toothy marine animals thanks to the unique aspects and characteristic of the tooth and teeth. The dentition of the Pomatomus saltatrix is more closely related to bigger and dangerous predators and the bite of specimen in Class 3 size has relevant mutilating capacity. Furthermore, one of the distinguish characteristic of the Bluefish is that the lower jaw is extended downwards, so the bite circumference of the upper jaw is not greater than lower, as usual in the other biting fishes. The bite is more circular and less elongated than the Moray and the big Barracuda, which have also longer and bigger teeth. It is bigger and deeper than the craterlike one of the Piranha. It is considerably smaller, more cutting and less lacerative than the patterns of the various shark species. Considering also the shallow water and the proximity to the shoreline it is possible to identify the Bluefish bite with adequate scientific reasonability, such as in the current case report.

Conclusions

Bluefish occasionally injure bathers in the warm shallow water near the shoreline. The focus remains on the data that should be collected and analysed from the wound and the bite on a victim, adding the ecological, environmental, behavioural aspects which are critical part of the holistic analysis of a human attack in order to identify the species potentially involved in the interaction. The predatory and the tooth anatomical characteristics of the Bluefish allow to identify its bite in the human attacks.

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Authors' contributions
All authors contributed in study concept and design, data acquisition and analysis, drafting of the manuscript, and critical revision of the manuscript, with approval of the final manuscript.

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