

UNDER THE SEA: ALLERGY AND ENVENOMATION FROM MARINE CREATURES

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ABSTRACT

The scope of this article is to provide an overview of the toxic and dangerous marine creatures occurring in South African waters and provide some advice regarding the management of symptoms resulting from injury, envenomation or allergic reactions. Three relevant cases are briefly discussed and the reader is reminded of the role of marine envenomation in the early scientific investigation of allergy and anaphylaxis. The potential for immune-mediated reactions to bluebottles and jellyfish is reviewed and common jellyfish envenomation syndromes discussed. Precautions are suggested for patients with suspected prior sensitisation.

INTRODUCTION

The South African coastline is renowned for its breathtaking scenery and rich biodiversity. A special situation arises from the meeting of the Agulhas and Benguella currents, with water temperatures ranging from frigid to tropical, and a resultant abundance of sea-life species. Ample opportunity for recreational activities such as fishing, diving, surfing and swimming exists, but this does put human beings in contact with potentially hazardous marine wildlife. Although relatively rare, injury, envenomation or allergy may occasionally occur and a healthcare practitioner may either be confronted with an acute case, or a request for allergological work-up or investigation after an incident has occurred. The toxicological and immunological mechanisms are not fully understood and limited commercial tests are available, so a thorough history remains very important during evaluation.

CASE REPORTS

1. Dr Super Surfski was reported to be paddling 1.5 km offshore on a downwind run from Miller's Point to Fish Hoek in a strong South-Easter and heavy swell, when he was stung by a bluebottle. Tentacles wrapped around his calf muscle, resulting in intense pain. Shortly thereafter he developed a sensation of swelling at the back of throat which raised concern regarding possible laryngeal oedema or anaphylaxis. Fortunately, it stabilised and he could reach the shore and self-treat with antihistamines. It was thought that prior sensitisation may have occurred in childhood.¹
2. A published case describes Ms July Jelly as a 15-year-old female who was stung by a jellyfish while surfing in the Mediterranean. She had a history of multiple previous uneventful stings, but in this case

developed immediate breathing difficulty, hoarseness and pruritus. She was transferred to hospital with adrenaline administered on the way. Peri-orbital swelling and facial oedema were later treated with systemic steroids and antihistamines. She was discharged after 48 hours with antihistamines, an adrenaline auto-injector and advice to avoid the ocean. An allergy clinic follow-up was recommended, with a view to do possible prick-to-prick testing or immunoblotting with jellyfish materials.²

3. Mr Wounded Williams was a teenage boy presenting to a local district hospital after stepping on a stingray at Surfer's Corner, Muizenberg and being stung on the foot. He was in severe pain, but otherwise stable with no remnants of the barb in situ. The doctor on duty tried various analgesics, but there was no response even with morphine. After specialist advice the leg was immersed in very warm water, resulting in prompt resolution of the pain and he was discharged during the same evening. Anecdotal verbal communication with lifeguards suggested approximately eight cases of stingray injuries during the summer of 2007/2008, which is unusual for the area.

HISTORICAL PERSPECTIVE RELEVANT TO IMMUNOLOGY AND ALLERGOLOGY

In 1901, Prince Albert of Monaco invited Frenchmen Richet and Portier to conduct research aboard the royal yacht, *Princesse Alice II*, in order to investigate the effect of Portuguese man-of-war (*Physalia physalis*) venom on dogs. They postulated that sub-lethal doses may 'immunise' against toxic effects, but found the opposite – prior exposure led to severe reactions to even minute secondary doses. This was early evidence that immune

TABLE I: PRAGMATIC CATEGORISATION OF HAZARDOUS MARINE CREATURES (AS PER DR F CRONJE, DAN)⁴

GROUP	MECHANISM OF INJURY	EXAMPLES
Stingers	Nematocysts	Bluebottles, jellyfish, sea anemones
Stickers	Spines, barbs	Sea urchins, stingrays, devil fire fish, stonefish
Shockers	Electric charge	Electric eels, electric rays
Scrapers	Nematocysts, bacteria	Fire coral, colonising marine bacteria
Snappers	Teeth, claws	Sharks, moray eels

mechanisms could have adverse effects and contributed to the development of the terms 'allergy and anaphylaxis'. They continued their research in Paris and published two papers in *Comptes Rendus de la Société de Biologie* in 1902. Only Richet was, slightly controversially, awarded the Nobel Prize in Physiology or Medicine in 1913.³

OVERVIEW OF TOXIC AND DANGEROUS MARINE CREATURES IN SOUTHERN AFRICA

False Bay has been termed the 'Serengeti of the Sea' and, when considering danger, emotive images of apex predators such as the Great White shark (*Carchacodon carcharias*) come to mind first. However, drowning remains the major risk in entering the ocean and a mere two per cent of diving injuries or accidents relate to marine animals.

The mnemonic 'Stingers, Stickers, Shockers, Scrapers and Snappers', as proposed by Dr F Cronje of the Diving and Aeronautical Network (DAN), may help with developing a pragmatic approach. This is not a taxonomic classification, but rather based on shared mechanisms of harm and treatment requirements.⁴

GENERAL MANAGEMENT PRINCIPLES

Basic life-support principles should be applied, but may be complicated by factors such as an aquatic environment, remote location and panic response. Three general principles to remember are: to remove the cause, treat the effects and prevent further harm.⁴



Figure 1: Blue stingray *Dasyatis chrysonata*

MANAGEMENT – 'STINGERS'

Specialised envenomation cells known as 'nematocysts' inject an irritating protein venom through an inverted dart mechanism. Bluebottles (*Physalia* species) are thought to contain a potent neurotoxic venom, but very little is transferred to the victim. In the local context, allergy and pain are the most frequent manifestations. Anaphylactic reactions to the venom may develop and facial stings constitute a danger to the airway. Nematocysts remain viable after being washed up on shore, so need care in handling. Rinsing with vinegar or meat tenderiser will inactivate the cells and neutralise the venom. Even urine is used and anecdotally reported effective. Remaining tentacles can be removed with sea water or a blunt knife. (Hypotonic water should be avoided as this will allow discharge of the nematocysts.) Antihistamines may be used for swelling or mild local allergic reactions and adrenaline required for severe reactions. Hospitalisation for observation is needed if there are signs of facial swelling, hoarseness or neurological involvement.

Local anaesthetic cream may contribute some relief and stings from South African sea wasps (relative of the 'box jellyfish' – class *Cubozoa*) may require topical cortisone to minimise scarring.⁴

MANAGEMENT – 'STICKERS'

These possess barbs or hollow spines filled or covered with venom, which are protein-based and denatured by heat. Injuries from stingrays or stonefish typically result in severe pain and this may put divers at risk of incoherent behaviour, drowning, air embolism or pneumothorax. Anaphylaxis or cardiopulmonary arrest due to envenomation may occur in extreme cases and quick action and cardiopulmonary resuscitation may be needed.

Double gloves should be worn by the rescuer and the injured part immersed in hot water at approximately 40–50 degrees Celsius (as in the case of a hot bath – avoid scalding the skin). Hot packs may also be used. Local anaesthetic wound infiltration may be used and radiographic examination ordered if remnant spines are suspected. Wound hygiene, tetanus toxoid and antibiotics



Figure 2: Bluebottles *Physalia utriculus*



Figure 3: Devil firefish *Pterois miles*

for deep penetrating wounds should be given, and hyoscine butylbromide may relieve symptoms in the case of stonefish envenomation.⁴

MANAGEMENT – ‘SHOCKERS’

Electric rays and eels generate electrochemical energy and can deliver electric shocks in order to stun prey or predators. They are found in shallow water and are easily disturbed by bathers, who may be unfortunate to tread on them barefoot. Treatment is not usually needed as shocks, though quite powerful up to 220 V, rarely result in any serious disability unless the diver or swimmer loses consciousness and aspirates water.⁴

MANAGEMENT – ‘SCRAPERS’

Abrasions sustained on coastal rocks or coral reefs are common injuries. Some corals contain nematocysts where again vinegar, meat tenderiser or sodium bicarbonate paste may give relief. Wounds may also be at risk of contamination from colonising bacteria found on marine plants and animals. Excellent wound care with prompt cleansing and application of antiseptics is important. Tetanus toxoid should be given and prophylactic antibiotics considered, especially for puncture wounds. If oral antibiotics are used, quinolones, trimethoprim-

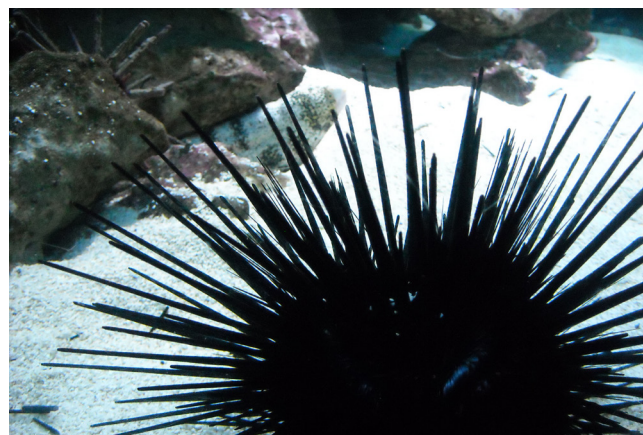


Figure 4: Needle urchins *Diadema setosum*

sulphamethoxazole or doxycycline are options.⁵ Inpatients may be given quinolones, third-generation cephalosporins or aminoglycosides. Topical corticosteroids may be helpful should contact dermatitis occur.⁴

MANAGEMENT – ‘SNAPPERS’

Australia and South Africa have the highest number of shark attacks in the world, although most cases seem unintentional and probably due to mistaken prey identity. Prevention of attacks while simultaneously protecting endangered species such as the Great White shark is a priority. The local Shark Spotters early-warning programme was the first of its kind in the world, starting out with a car guard on lookout with binoculars and a megaphone. The spotters and shark research teams now employ modern technology such as drones and locally produced image-recognition software (Identifin) to safeguard beaches and research shark behaviour. Other shark species such as Zambezi or Tiger sharks may occasionally be implicated. Divers' fingers can also be at risk of bites from moray eels.⁶

If an attack does occur, basic trauma principles apply. Importantly, rescuers should stay calm, get the victim out of the water, control bleeding and *first* stabilise the victim prior to transportation.^{4,5}

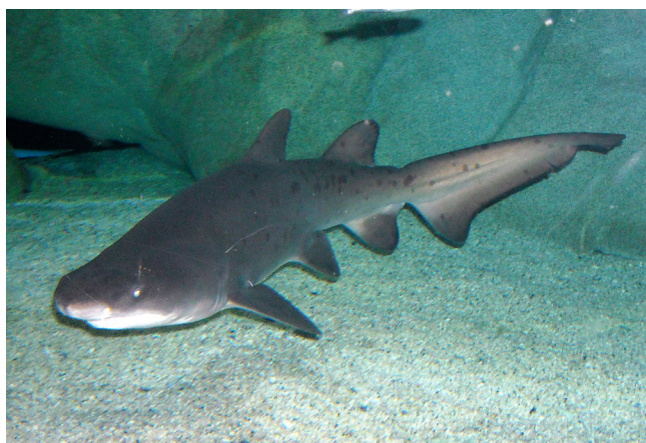


Figure 5: Ragged tooth sharks *Carcharias taurus*



Figure 6: Moray eel *Gymnothorax favagineus*

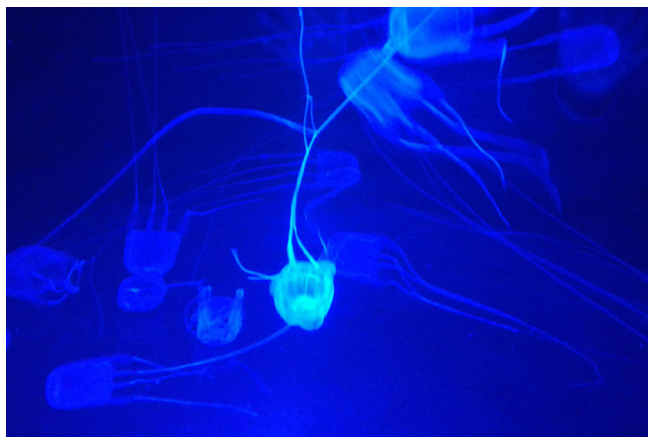


Figure 7: Box jellyfish, class Cubozoa

SPECIAL CONSIDERATIONS FOR ALLERGIC PATIENTS

In South Africa this applies mainly to the phylum *Cnidaria* incorporating bluebottles (class *Hydrozoa*) and less poisonous jellyfish species.

There are two species of bluebottle: *Physalia physalis* (Portuguese man-o'-war) in the Atlantic and *Physalia utriculus* (Blue bottle) in the Indian Ocean.⁶ These float in vast 'armadas', often blown into east-facing bays by the prevailing summer winds. Most cases involve cutaneous reactions and pain only, but anaphylaxis is the main risk factor for a fatal episode. The mechanism is not clear and it seems that IgE-mediated and non-IgE-mediated immediate reactions may occur, as well as delayed hypersensitivity. Anaphylaxis at sea is a high-risk situation and drowning may occur, so avoidance of the ocean would be the safest course if allergic reactions have occurred in the past, however, this may not be acceptable to the patient. Use of protective clothing such as wetsuits may help and the person should never swim, surf or paddle alone. An Allergy Action Plan, Medic-Alert bracelet, Epipen, antihistamines and Salbutamol inhaler are recommended to be kept on the person, in the kayak or on the beach, depending on situation.

Cold urticaria and jellyfish envenomation syndromes should be considered in the differential diagnosis of a patient presenting with possible *Cnidaria*-induced anaphylaxis.

JELLYFISH ALLERGY AND ENVENOMATION SYNDROMES

Envenomation by jellyfish is well described, especially involving the class *Cubozoa* or 'box jellyfish'. The South African box jellyfish or sea wasp (*Carybdea* species)⁶ can deliver a very painful sting, but is fortunately not as venomous as its infamous Australian cousin *Chironex fleckeri*, which is deadly. The Australian box jellyfish has up to 48 tentacles which can be two metres long. Death due to cardiovascular collapse may occur within minutes of the sting, possibly through pore formation in the myocardium. It is thought to be a direct effect of the venom and not

an immune-mediated process. Antivenin is available but rapidity of symptom onset limits its usefulness. High-quality cardiopulmonary resuscitation with extracorporeal life support is the only hope for survival, but many victims never reach the shore.⁷

Another well described jellyfish envenomation syndrome induced by some of the smaller four-tentacled box jellyfish species is Irukandji Syndrome, with symptoms of sweating, anxiety, muscle spasm, severe hypertension and potentially late hypotension and cardiac failure. This occurs in Queensland, Australia, Indo-Pacific regions and the Caribbean. Treatment is with magnesium sulphate (MgSO₄) infusion.⁷

Cases of suspected immune-mediated reactions to jellyfish have been reported in the literature since 1985. The presumed first case report refers to possible anaphylaxis with hypotension and bronchospasm. The authors proposed that 'the patient's basophils released histamine in response to nematocyst venom from the Chesapeake Bay sea nettle; this sensitivity could be passively transferred by a heat-labile serum factor'.⁸ Once again, reaction to jellyfish could be due to envenomation, IgE- or non-IgE-mediated mechanisms.

CONCLUSION

Injury, allergy or envenomation due to recreational or occupational contact with marine creatures is well described and it is helpful for healthcare practitioners to have an approach to classification, differential diagnosis and management. However, in local waters fatalities are rare and most cases result only in irritation or pain. Special considerations and precautions apply to known allergic patients at risk of anaphylaxis.

DECLARATION OF CONFLICT OF INTEREST

The author declares no conflict of interest.

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