Bites & stings

Venomous marine Creatures

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Background. Many venomous marine creatures inhabit Australian waters, causing significant morbidity and occasional fatalities. No antivenom is available for most of these creatures. Little is known about the venom or syndromes produced by many of these creatures.

Objective. This article discusses the features of envenomation by some of the more commonly encountered venomous marine creatures, and the recommended first aid and medical management of such envenomations.

Discussion. The information contained within this article is intended to provide the reader with an overview of some of the more common marine envenomations, and hopefully with the knowledge to effectively manage such problems.

Australian waters contain a great variety of venomous creatures, including jellyfish, stinging fish, blue-ringed octopus, cone shells and stingrays. All of these creatures have caused fatalities or severe illness.

Jellyfish

Box jellyfish

The box jellyfish, *Chironex fleckeri, (Figure 1)* is found in the coastal waters of northern Australia during the summer months, from Gladstone in Queensland to Broome in Western Australia, but not on the Great Barrier Reef *(Figure 2).* It is the most dangerous jellyfish, if not one of the most dangerous venomous creatures, in the world. It weighs up to 6 kg and measures about 20-30 cm across the bell. It is transparent in the water. It has up to 60 tentacles arranged in four bundles. Each tentacle can stretch for 2 metres and contains many millions of nematocysts (or stinging cells) that discharge venom through the skin on contact. Contact with a number of tentacles can thus result in massive envenomation *(Figure 3).* Most stings occur in the summer months in shallow water near the beach, and are particularly common in children. (In two studies in the 1970s the average age of box jellyfish sting victims was 14 years with a median age of 11 years.)

Precautions that should be taken to avoid potentially fatal box jellyfish envenomation are summarised in *Table 1.*

Death can occur within 5 minutes following massive envenomation. The mechanism(s) of toxicity are poorly understood, but death is thought to be due to respiratory failure, possibly central in origin, or to direct cardiotoxicity leading to AV conduction disturbances or to paralysis of the cardiac muscle in systole. Patients may become unconscious before they can leave the water. There have been at least 63 confirmed deaths from envenomation by *C fleckeri* in the Indo-Pacific region. In addition to cardiotoxic and neurotoxic properties, the venom also contains dermatonecrotic components producing patches of full thickness skin necrosis that result in severe and permanent scarring without, or sometimes despite, treatment. There is also a haemolytic component in *C fleckeri* venom, although it is of doubtful clinical significance.

Symptoms and signs of envenomation

➤ Severe localised pain, often associated with vigorous attempts by the patient to remove the tentacles (this may make the envenomation worse by causing the discharge of further nematocysts).

➤ Wide (0.5-1.0 cm) erythematous lines where the tentacles have been in contact with the skin *(Figure 4).* These may cover a large area, an indication of severe envenomation.

➤ Confusion, agitation, unconsciousness.

➤ Collapse with respiratory failure and/or cardiac arrest.

Immediate management

Due to the rapid onset of symptoms, immediate first aid is vital and cardiopulmonary resuscitation may be required. Remaining undischarged nematocysts should be inactivated with large quantities of dilute (3-5%) acetic acid (ie, house-hold vinegar) once the patient has been safely removed from the water. Antivenom may need to be administered by life saving or other paramedical personnel at the scene. For this reason, it may be given intramuscularly, although the intravenous route is preferable if appropriately skilled personnel are available.

Table 1. How to avoid jellyfish envenomation

➤ Don't swim at northern beaches during jellyfish season (usually September-March).

➤ Heed beach warning signs.

➤ Don't swim alone or at remove beaches.

➤ Use 'stinger suits' in known box jellyfish water.

➤ Swim at beaches patrolled by life savers, preferably equipped with antivenom and basic resuscitation facilities.

➤ Use caution on entering the water (do not dive or run into the water).

➤ Supervise children. They are more prone to stings, and more susceptible to the effects of venom.

➤ Swim at beaches netted to exclude box jellyfish. (NB. This will not prevent irukandji stings. They are small and can fit through the gaps in the mesh of jellyfish nets.)

Indications for box jellyfish antivenom

The box jellyfish antivenom, which has been available since 1970, consists of purified sheep immunoglobulin and no adverse reactions have been reported following its use in well over 100 cases. Its efficacy has been established by in vitro neutralisation and subsequent protection of experimental animals.

It is recommended for all but minor stings. Specific indications include:

➤ cardiorespiratory arrest, or cardiac arrhythmias

➤ difficulty with breathing, speech or swallowing

➤ severe pain

➤ extensive skin lesions, or skin lesions in cosmetically important areas such as face, neck, hands and forearms.

Early administration of antivenom may result in decreased scarring secondary to dermatonecrosis. This may be particularly important in younger patients.

Where definitive treatment (ie, antivenom) is not available, pressure/immobilisation first aid may be used on limbs after inactivation of nematocysts while the patient is transported to an appropriate medical facility. In hospital, intravenous antivenom should be administered promptly if it has not already been given or if the patient remains symptomatic. Assisted ventilation and narcotic analgesia may be required.

Chiropsalmus quadriagata

This is similar to, but smaller than *C fleckeri*. The bell measures up to 7 cm, and the number of tentacles seldom exceeds nine. Its venom also contains lethal, dermatonecrotic and

haemolytic properties in the same proportions as *C fleckeri* venom, but the stinging potential of Chiropsalmus is estimated to be only around 10% of the *C fleckeri,* and no deaths have been reported. Scarring is usually minimal.

Irukandji

Carukia barnesi (Irukandji) is a small (~2 cm diameter bell) jellyfish and unlike *C fleckeri,* Irukandji are found mostly in the deeper waters of the reef, although they may be swept ashore by prevailing currents. Divers and snorkellers are particularly at risk. Stings have been recorded from Childers to Broome, and elsewhere in the Pacific.

Clinical syndrome

Every summer, more than 60 people are hospitalised with Irukandji syndrome. The sting itself is only moderately painful, with little associated tissue damage, but approximately 30 minutes later, the patient develops a complex of systemic symptoms including severe abdominal pain plus or minus back, limb or joint pain, nausea and vomiting, profuse sweating and agitation. They may also experience numbness or paraesthesia. Hypertension and tachycardia are frequently seen, and are thought to be related to catecholamine release. Victims frequently require hospitalisation for analgesia and intravenous antihypertensive therapy. Alpha-blocking agents such as phentolamine have been used for this purpose. Supraventricular tachycardia and transient dilated cardiomyopathy have been reported following Irukandji stings, and it has been suggested by P. J. Fenner (personal communication, 1997) that serial echocardiography may be performed to monitor the progress of severely affected patients. Analgesia is usually required, and may need to be given intravenously when pain is severe. First aid consists of analgesia and reassurance. The role of vinegar to inactivate undischarged nematocysts remains uncertain, with initial work proving inconclusive (Fenner, P. J, personal communication, 1997). No definitive treatment is available for the potentially life threatening Irukandji syndrome. The Australian Venom Research Unit is currently involved in research to develop an antivenom to treat Irukandji envenomation.

Physalia or bluebottle jellyfish

Physalia physalis, the Portuguese man-o-war or bluebottle jellyfish, is well known throughout Australian waters (and both the Pacific and Atlantic oceans) for causing painful stings. No fatalities have been confirmed in Australia. The float measures 2-15 cm and the main or fishing tentacle may be up to 10 m long and is responsible for most of the stings. The larger Atlantic specimens probably represent more of a threat to human life. The venom contains lethal and haemolytic components and has been shown to produce nerve conduction disturbances, flaccid paralysis and smooth muscle contraction in experimental animals.

In human envenomation, pain is the most prominent feature, along with localised skin lesions with a 'string of beads' appearance; discrete wheals surrounded by erythema. Systemic symptoms are uncommon but may include headache, nausea and vomiting, abdominal pain and occasionally collapse. First aid consists of removal of the tentacles, preferably with forceps.

Vinegar is not recommended. Analgesia may be required, although most stings respond to ice packs and/or topical anaesthetic agents.

Blue-ringed octopus

The blue-ringed octopus *(Hapalochlaena spp)* is a small brown octopus that develops brilliant blue ring-shaped markings when disturbed *(Figures 5, 6).* The genus is found throughout Australia's coastal waters. *H maculosa* (the Southern blue-ringed octopus) in southern regions and *H lunulata* (the Greater blue-ringed octopus) in more tropical areas. A third species, *H fasciata* (the blue-lined octopus) has also been described along the east coast of Australia. Envenomation are uncommon (11 cases had been reported up to 1983 including two fatalities). This genus has been associated with severe envenomation resulting in respiratory failure, and in human fatalities.

The blue-ringed octopus is found in tidal rock pools and is very attractive, especially to children, who are at risk of envenomation when they pick up the octopus. Bites can also occur when the creature is trodden on by waders. The venom contains tetrodotoxin (also found in puffer fish) that is secreted in the saliva of the octopus. It causes blockade of sodium channels and thus neurological problems such as weakness, numbness or paraesthesia, breathing difficulties and paralysis. The patient may be completely paralysed and unable to respond, sometimes with fixed dilated pupils, but the sensorium is often intact. Supportive treatment, including mechanical ventilation may be needed until the effects of the venom wear off. There is no antivenom available in Australia for blue-ringed octopus envenomation.

Stinging fish

Stonefish

Stonefish *(Synanceia spp)* are found throughout the world, and may be described as the world's most dangerous stinging fish. The two Australian species, *Synanceia trachynis* and *S verrucosa*, are found from Brisbane to 500 km north of Perth *(Figure 7).* They are extremely well camouflaged and dig themselves into the surrounding sand or mud, making them almost impossible to see *(Figures 8, 9).* Thirteen dorsal spines project from venom glands along the back, involuntarily expelling venom when the spine is pressed upon. The sting is extremely painful and swelling develops rapidly. The severity of the symptoms is related to the depth of penetration of the spines and the number of spines involved. Systemic effects of the venom may include muscle weakness, paralysis and shock. Fatalities have been recorded in the Indo-Pacific region, but not in Australian waters. First aid consists of bathing or immersing the stung area in hot water to relieve pain. Hospitalisation for intravenous narcotic analgesia plus local anaesthetic infiltration or regional block may be required. Definitive management consists of administration of stonefish antivenom, which is usually given intramuscularly *(Table 2).*

Table 2. Indications for stonefish antivenom

➤ severe pain

➤ systemic symptoms or signs of envenomation (weakness, paralysis)

➤ multiple punctures indicating the injection of a larger amount of venom.

Tetanus prophylaxis should be undertaken depending on the patient's immunisation status. Severe stings may produce an area of tissue necrosis, particularly if there is a delay in the administration of antivenom. This may require surgical debridement or even skin grafting. Consideration should also be given to the presence of a foreign body (ie, broken spines) within the wound. If in doubt, X-ray the wound.

Other species

There are numerous stinging fish distributed throughout Australian waters. Many of these are found in tropical areas, but others are present in temperate waters or throughout Australia. The major clinical features of these fish stings is immediate severe pain which may be prolonged and difficult to manage even with narcotic analgesia. The pain will usually subside within 24 hours, but swelling may persist for several days. First aid consists of immersion of the affected area (almost always a hand or foot) in hot water. This is thought to inactivate the venom and to improve local blood flow thus dispersing the venom. Infiltration of the wound with local anaesthetic agents provides dramatic relief in most cases, although occasionally a regional nerve block will be required. Tetanus prophylaxis should be updated, and the wound should be examined for signs of infection or retained foreign material in the form of broken spines.

Cone shells

More than 70 species of cone shells *(Conus spp)* are found in the warmer waters of Australia. Several of these are known to be dangerous to humans. They are attractive shells, and may be picked up by children or visitors to the reef who may be unaware of the danger *(Figure 10).*

Cone shells are predatory gastropods living in shallow reef waters. They kill their prey with venom which they inject via a radula tooth like a small harpoon *(Figure 11).* The venom consists of numerous neurotoxic peptides that act pre- and post-synaptically to give rise to neurological symptoms of weakness, lack of coordination and disturbance of vision, speech and hearing. Less common systemic symptoms include nausea and generalised pruritus. Local symptoms of pain, swelling and numbness are common. Severe envenomation may result in death secondary to respiratory muscle paralysis. Pressure immobilisation first aid should be applied and left in place until resuscitation facilities are available, as assisted ventilation may be required to avoid hypoxia. There is at present no antivenom for cone shell stings. This wound should be

regarded as potentially contaminated and tetanus prophylaxis should be updated if required.

Summary of Availability of Anti-Venom

	Antivenom	Medical management
Box jellyfish (Chironex fleckeri)	+	vinegar analgesia life support
Irukandji	-	analgesia reassurance use of vinegar uncertain
Blue bottle jellyfish	-	ice packs topical anaesthetics analgesics if necessary vinegar NOT recommended
Blue-ringed octopus	-	assisted ventilation
Stonefish	+	bathe affected area in hot water local anaesthetic regional nerve block analgesics
Stinging fish (other than stonefish)	-	same as above
Cone shells	-	pressure immobilisation assisted ventilation
Stingrays	-	management of laceration analgesia referral for ongoing wound management.

Stingrays

Stingrays are found throughout Australian waters. Although they are venomous, the major clinical problem is often related to mechanical trauma from the sting itself, which may produce deep penetrating injuries or severe lacerations. Fatalities have occurred from penetrating chest or abdominal wounds caused by stingray barbs. Envenomation may result in increasing local pain which may spread to involve the entire limb. Swelling may occur and the wound has a characteristic bluish-white appearance. Symptoms include cramps, syncope, cardiac arrhythmias

and convulsions. Treatment consists of analgesia, tetanus prophylaxis, X-ray of the affected area and surgical exploration and debridement if necessary. Infection of the contaminated wound may develop, and may involve poorly characterised marine bacteria requiring special culture media. Consideration should be given to antibiotic prophylaxis in contaminated wounds, particularly if there has been delay between the sting and medical treatment. There is no specific treatment for stingray envenomation.

Summary of Important Points

➤ Box jellyfish stings can be rapidly fatal. Immediate treatment consists of topical vinegar to inactivate undischarged nematocysts. Use antivenom as soon as possible for severe stings.

➤ Stings by the Irukandji jellyfish cause a potentially life threatening syndrome of abdominal, back and joint pain, hypertension and tachycardia. Development of an antivenom is under investigation.

➤ Fishes sting in all Australian waters. Antivenom is only available for the stonefish. Treat by immersion of the stung area in hot water and with analgesia. May require local anaesthetic infiltration or regional nerve block.

➤ Blue-ringed octopus venom contains tetrodotoxin, which may cause paralysis and respiratory failure, requiring ventilation. No antivenom is available.

➤ Cone shells can inject neurotoxins leading to paralysis and respiratory failure. There is no antivenom.