



# Managing injuries by venomous sea creatures in Australia

Geoffrey K Isbister, Senior Research Fellow, Tropical Toxinology Unit, Menzies School of Health Research, Charles Darwin University, Northern Territory, Clinical Toxicologist and Emergency Physician, Calvary Mater Newcastle Hospital, New South Wales, and Clinical Toxicologist, New South Wales and Queensland Poison Information Centres

## Summary

Marine injuries or stings are common, but the majority cause only minor effects and do not require medical intervention. Injuries from venomous marine creatures can be divided into jellyfish stings due to contact with nematocysts, and penetrating injuries from spiny fish, stingrays and sea urchins. Box jellyfish are the most dangerous and may cause severe and potentially life-threatening effects. First aid for jellyfish stings includes removal of the tentacles, and hot water immersion for bluebottles or vinegar for major box jellyfish. In addition to vinegar, major box jellyfish stings are treated with analgesia and local dressings. Early resuscitation is required in the rare severe cases. Irukandji syndrome causes severe generalised pain associated with autonomic effects with little local pain or reaction. Treatment is symptomatic but may require large amounts of analgesia. Spiny fish and stingrays cause a combination of traumatic injury and venom-mediated effects. First aid is hot water immersion and treatment includes analgesia, thorough wound cleaning and regular review for secondary infection. Stingray injuries can be associated with significant trauma and sometimes result in penetrating abdominal or thoracic injury.

Key words: antivenoms, jellyfish, stingray, stonefish.

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## Introduction

Injuries from venomous marine creatures are an increasing problem seen by healthcare workers in coastal regions. The majority of injuries are relatively minor and may not require medical intervention. The most frequent marine stings are from

jellyfish, mainly bluebottles. Box jellyfish (taxonomic class Cubozoa) are more dangerous and may cause severe and potentially life-threatening envenoming in northern Australia. Injuries from spiny fish and stingrays make up most of the remaining injuries and are a combination of traumatic injury and envenoming. Injuries from sea urchin spines, contact with marine sponges and bites from blue-ringed octopi or sea snakes are less common in Australia.<sup>1,2</sup>

## Jellyfish stings

There are over 100 medically important species of jellyfish belonging to the phylum Cnidaria. In Australia, the important groups include:

- *Physalia* (bluebottles or Portuguese Man-of-War)
- *Chironex fleckeri* (major box jellyfish)
- *Carukia barnesi* and other box jellyfish causing Irukandji syndrome.

## Bluebottle (*Physalia species*) stings

Bluebottle stings are common in many parts of Australia. Many thousands of stings occur each summer and a significant proportion of the population has been stung at least once. Stings usually occur in shallow waters in the surf when swarms are washed ashore, so large numbers of cases occur for a short period before the beach is closed. The main clinical effect is immediate and intense local pain which lasts for about an hour, or occasionally longer in more severe cases. This is associated with characteristic linear erythematous raised eruptions. A rash or localised redness at the sting site may remain for hours to days. Uncommonly a delayed localised vesicular reaction occurs within 48 hours, but scarring is rare. Only a few patients develop systemic symptoms such as nausea, vomiting, abdominal pain, myalgia and rarely respiratory distress.<sup>3</sup>

## Treatment of bluebottle stings

The bluebottle should be washed off with seawater or carefully removed and then the sting site immersed in hot water. There is now good evidence to support this first aid. An open-labelled randomised controlled trial found that immersion in hot water at 45°C for 20 minutes caused a clinically important reduction in pain in 87% of patients compared to only 33% treated with

ice packs.<sup>3</sup>The venom is heat labile and immersion of the sting in hot water is thought to inactivate the venom and therefore relieve the pain. If hot water immersion is not possible then a constant flow of hot water on the sting site or a hot shower is an alternative. Vinegar is not recommended for bluebottle stings.

### Major box jellyfish

*Chironex fleckeri* is our most dangerous jellyfish. It is found in waters north of the Tropic of Capricorn (from about Gladstone in the east to Exmouth in the west). At least 65 deaths have been attributed to *C. fleckeri* and fatal cases in children occur every few years. Fatalities in the last 15 years have followed rapid envenoming with death due to cardiovascular collapse occurring within 20–30 minutes at remote beaches.<sup>4</sup> Severe envenoming requires skin contact with several metres of tentacle in an adult, but a death has been reported with 1.2 metres of contact in a child.<sup>4</sup>

In the vast majority of cases there is severe local pain and erythematous wheal formation at the sting sites which appear as dark red or purple whip-like lesions. In more severe cases superficial necrosis occurs along the sting lesions. This rarely causes permanent scarring. Delayed hypersensitivity reactions characterised by papular urticarial reactions along the sting sites occur in over half of cases.<sup>4</sup>

Confirmation of jellyfish stings by skin scrapings or 'sticky tape testing' is helpful in patients seen in hospital, particularly after box jellyfish stings. The test is best for tentacle stings such as those of *C. fleckeri*. Sticky tape is placed over the sting site, removed and then placed on a microscope slide for identification of the stinging cells (nematocysts).<sup>5</sup>

### Treatment of *Chironex fleckeri* stings

First aid consists of immediate removal of any tentacles and generous application of vinegar. Vinegar deactivates the remaining nematocysts and therefore prevents further envenoming. Local pain can initially be treated with ice packs, but may require oral or parenteral analgesia. Most skin lesions will heal without any interventions, but more severe and necrotic lesions need local dressings. Delayed hypersensitivity reactions can be treated with topical corticosteroids.

The rapid onset and the almost 'all or none' characteristic of systemic envenoming has meant that almost no-one with severe envenoming arrives in hospital alive unless early basic resuscitation has been successful. Severe *C. fleckeri* envenoming is managed as a medical emergency with immediate basic life support and intervention to manage airway, breathing and circulation. Cardiovascular collapse should be managed with fluid resuscitation, intravenous antivenom (large initial dose of six vials) and adjunctive treatment with inotropes or magnesium in unresponsive cases.<sup>4</sup>

The sheep-derived antivenom specific for *C. fleckeri* has never been tested in controlled trials and its efficacy in humans

is unclear.<sup>6</sup> Intramuscular antivenom is not recommended due to delayed and partial absorption, particularly in haemodynamically compromised patients.

### Irukandji syndrome

Irukandji syndrome is most commonly reported in northern Australia.<sup>5,7,8</sup> Most clinical studies are of stings by *Carukia barnesi*, but other box jellyfish can cause the syndrome.<sup>7,9</sup> These include *Carybdea xaymacana*, *Alatina nr mordens*, *Malo maxima* and an unnamed 'fire jelly'.<sup>9</sup>

Irukandji syndrome is characterised by minor local effects, but severe generalised pain and autonomic effects. The sting may be painless or cause only mild irritation with a patch of erythema. Over 20–30 minutes, severe generalised back, abdominal, chest and muscle pain develop which are associated with tachycardia, hypertension, nausea and vomiting, anxiety, agitation and sweating. In more severe cases there can be cardiac involvement with ECG changes (T wave inversion and ST segment depression), progressing to myocardial depression with elevated troponin and then cardiogenic pulmonary oedema and cardiogenic shock. At least one death has been attributed to Irukandji syndrome.<sup>7</sup> The generalised pain usually takes 6–12 hours to resolve, but cardiac involvement may require supportive care for 2–3 days.

Skin scrapings are required for nematocyst identification. These are placed in 1–4% formalin and then examined under the microscope.<sup>7</sup>

### Treatment of Irukandji syndrome

The mainstay of treatment for Irukandji syndrome is supportive care and pain relief. Titrated intravenous opioid analgesia is recommended (fentanyl or morphine). Large and repeat doses are often required. Pulmonary oedema should be treated with supportive care, including oxygen, positive pressure ventilation and inotropes.

Magnesium has recently been used in Irukandji syndrome as an initial bolus and then infusion to treat the pain and hypertension.<sup>8</sup> There has not been universal success and adverse effects due to hypermagnesaemia have been reported.<sup>8</sup> Further study is required before magnesium can be recommended as first-line therapy.

### Other jellyfish

Information on other jellyfish in Australia is based on isolated case reports and expert opinion due to the lack of epidemiological studies of definitely identified jellyfish stings. In many cases the clinical effects of local pain and irritation make particular jellyfish stings impossible to distinguish from each other without identification of the jellyfish. Treatment is similar to bluebottle stings although there is little direct evidence for this (Table 1).

Table 1

## First aid and treatment of jellyfish stings and venomous fish injuries

Type	First aid	Medical treatment
Bluebottles ( <i>Physalia species</i> )	<ul style="list-style-type: none"> <li>Wash the sting site with seawater and remove any tentacles</li> <li>Immerse in hot water at 45°C for 20 minutes or hot shower</li> <li>Do not use vinegar</li> </ul>	<ul style="list-style-type: none"> <li>The patient rarely requires transport to hospital or medical intervention</li> <li>Severe local stings or bullous wounds may need dressing</li> </ul>
Major box jellyfish ( <i>Chironex fleckeri</i> )	<ul style="list-style-type: none"> <li>Immediately remove any tentacles</li> <li>Apply vinegar immediately and liberally</li> <li>Apply ice packs</li> <li>Resuscitate (airway, breathing and circulation) patients who are unconscious or have cardiovascular collapse</li> </ul>	<ul style="list-style-type: none"> <li>All but very minor stings require transport to hospital</li> <li>Give oral and parenteral analgesia for sting site pain</li> <li>For severe life-threatening envenoming:               <ul style="list-style-type: none"> <li>give first aid</li> <li>resuscitate</li> <li>administer intravenous antivenom</li> <li>consider magnesium therapy</li> </ul> </li> </ul>
Irukandji syndrome	<ul style="list-style-type: none"> <li>Apply vinegar immediately and liberally</li> <li>Remove any tentacles if present</li> <li>If vinegar is not available wash the area with seawater</li> </ul>	<ul style="list-style-type: none"> <li>Transport to hospital for:               <ul style="list-style-type: none"> <li>parenteral analgesia with titrated intravenous fentanyl or morphine</li> <li>cardiac monitoring, ECG and cardiac enzymes</li> </ul> </li> <li>Cardiac involvement and pulmonary oedema will require supportive care and management of breathing and circulation</li> </ul>
Other jellyfish: <ul style="list-style-type: none"> <li>mauve stinger (<i>Pelagia species</i>)</li> <li>hair jellyfish (<i>Cyanea species</i>)</li> <li>jimble (<i>Carybdea rastoni</i>)</li> <li>other box jellyfish (<i>Chiropsalmus bronzeii</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Wash the sting site with seawater and remove any tentacles</li> <li>Consider hot water immersion or ice packs</li> <li>Do not use vinegar</li> </ul>	<ul style="list-style-type: none"> <li>Patients rarely require transport to hospital or medical intervention</li> <li>Severe local stings or bullous wounds may need dressing</li> </ul>
Venomous fish stings: <ul style="list-style-type: none"> <li>stonefish</li> <li>catfish</li> <li>other venomous stinging fish</li> </ul>	<ul style="list-style-type: none"> <li>Wash the wound site and immerse in hot water about 45°C for a maximum duration of 90 minutes</li> </ul>	<ul style="list-style-type: none"> <li>Irrigate the wound and remove foreign debris</li> <li>Radiograph to exclude retained spiny material</li> <li>Give oral or parenteral analgesia and occasionally local or regional anaesthesia for severe pain</li> <li>Stonefish antivenom is available for stonefish stings with severe pain or systemic effects</li> <li>Surgical consultation for involvement of joints or bones</li> </ul>
Stingray injuries	<ul style="list-style-type: none"> <li>Wash the wound site and immerse in hot water about 45°C for a maximum duration of 90 minutes</li> <li>Apply local pressure for bleeding and resuscitate if there are thoracic or abdominal injuries</li> </ul>	<ul style="list-style-type: none"> <li>Irrigate and debride the wound</li> <li>Titrate intravenous analgesia and/or local or regional anaesthesia</li> <li>Surgical consultation for deep injuries, injuries to the chest or abdomen, or with retained material</li> <li>Resuscitation and surgical intervention for major trauma from thoracic or abdominal injuries</li> </ul>
Sea urchin injuries	<ul style="list-style-type: none"> <li>Wash the wound site and immerse in hot water about 45°C for a maximum duration of 90 minutes</li> </ul>	<ul style="list-style-type: none"> <li>Radiograph or ultrasound to identify any retained spines</li> <li>Remove spines close to the surface</li> <li>Review regularly until resolved</li> <li>Wound may require further spine removal and further radiographic imaging or ultrasound</li> </ul>

Mauve stingers (*Pelagia* species) cause local pain and skin irritation and have been confused with bluebottle stings in southern waters.<sup>3</sup> Hair jellyfish (*Cyanea* species) also occur in southern waters and are named for their hair-like tentacles. Skin contact results in minor and transient pain associated with spreading erythema. There have been numerous reports of corneal stings by this jellyfish. The eye should be irrigated with large amounts of fluid and topical steroids instilled.

Other species of box jellyfish occur in Australia but cause less severe effects and may present similarly to other jellyfish stings. One large box jellyfish, *Chiropsalmus bronzeii*, occurs in far north Queensland and causes only local pain and skin reactions. The jimble (*Carybdea rastoni*) is well-known in southern and western waters and will cause local pain and erythema.

## Venomous fish

The important groups of fish with venomous spines include catfish, stonefish and scorpion fish.<sup>2,10</sup> They cause puncture wounds with localised pain, which can be severe and persistent with significant envenoming such as with stonefish, bullrout or marine catfish. There is usually associated erythema and oedema occurs in more severe cases. Uncommonly the fish spine may break off and require removal. The most important complication is secondary infection with marine or aquatic organisms.

Stonefish camouflage themselves on the sea floor and most commonly cause injuries when trodden on. The spines are covered by sheaths that push back as the spine covered in venom enters the tissues. This causes immediate severe pain which may radiate from the injury site with associated swelling and erythema. Although systemic effects are often described these are more likely secondary to pain rather than systemic envenoming. Bullrout occur in tidal estuaries and slow-moving streams of eastern Australia. They are also bottom-dwellers which commonly cause injuries to the feet with similar severity to those of stonefish.

Catfish are a common cause of spiny injuries although many catfish do not have venom associated with the spines in their dorsal and pectoral fins. More severe injuries occur with the oriental or striped catfish (*Plotosus lineatus*), which possesses potent toxins. Most injuries occur in fishermen trying to pull the fish off lines.

There are numerous other venomous or spiny fish, such as red rock cod in New South Wales, and soldier fish and cobblers in southern Australia. Most of these cause injuries when they are handled, for example by fishermen. Scats are less well known but occur in the Indo-Pacific ocean. They cause immediate severe pain that lasts for up to an hour with minimal other effects.

## Treatment

First aid for venomous fish stings is hot water (45°C) immersion of the affected limb for up to 90 minutes.<sup>1</sup> The temperature must

be tested with an unaffected limb first. Anecdotally hot water provides symptomatic relief, but the pain may recur when the affected limb is removed from the water.<sup>10</sup> With more severe or non-responsive pain, oral and occasionally parenteral analgesia is required. Infiltration of the wound with local anaesthetic or a regional nerve block is often more effective. However, the patient must be warned that hot water treatment should not be used after the limb is anaesthetised because of the risk of thermal injury. All wounds must be thoroughly cleaned and irrigated. Any pieces of spine should be removed and radiographic or ultrasound imaging may assist in identifying foreign bodies.

Stonefish antivenom should be used in any stonefish sting that does not respond to hot water immersion and adequate analgesia. This horse-derived antivenom is likely to be more effective if given intravenously and soon after the injury.

Swabs from obviously infected wounds should be cultured and antibiotics prescribed. The role of prophylactic antibiotics is unclear. Large series of cases and experience in the aquarium and catfish industries suggest that prophylactic antibiotics are not required.<sup>10</sup> However, all penetrating marine injuries must be regularly reviewed so that any emerging infection can be treated early. Confirmed infection requires antibiotic therapy and the opinion of an infectious diseases specialist should be sought.

## Stingrays

Although stingrays have venom in their tail, the trauma of the injury is usually more important than venom-mediated effects. Stingrays usually rest on the bottom of the water and most commonly cause an injury when they are unwittingly trodden on. This makes the stingray reflexively whip its tail upward and into the person's foot or ankle. Injuries to the hands can occur if the fish are handled and rarely divers can sustain injuries to the chest or abdomen that cause serious trauma or death. The sharp bony spine produces a laceration and simultaneously leaves venom in the wound. The major effects of the venom are intense local pain and slowly developing necrosis. Systemic effects are uncommon and most likely secondary to severe pain. The most important complication is secondary infection, especially in wounds that penetrate a joint space or tendon sheaths, or wounds that are not cleaned or debrided when appropriate.

## Treatment

The treatment of stingray injuries is similar to spiny fish injuries (Table 1) except there is often more trauma. First aid may require control of haemorrhage as well as hot water immersion. Lacerations should be left open for delayed primary closure, ensuring adequate drainage. Wounds containing foreign material, or which enter sterile body cavities, or present late, usually require surgical exploration and debridement. Again,



there is controversy over prophylactic antibiotics and they should be considered with large wounds, retained foreign material or delayed presentation.<sup>10</sup>

## Sea urchins

Most sea urchin injuries are from non-venomous spines and the main problem is removal of broken-off spines. Venomous spines are less common but cause more intensely painful puncture wounds. Hot water immersion is appropriate first aid. Treatment consists of radiographic or ultrasound examination to locate retained spines. Some spines are a chalky material that breaks easily, making removal difficult, while others are stronger. It is reasonable to remove spines close to the surface and then follow the patient until the symptoms resolve. Patients with persistent pain may require surgical removal of the remaining spines.

## Sponges

Sponge contact reactions are uncommon and may be difficult to diagnose if they are delayed. Only a few Australian species produce toxic secretions, including fire sponges (*Tedania* species) and *Neofibularia* species.<sup>11</sup> Initially there may only be a mild sensation with localised itchiness and stinging developing after minutes to hours. In some cases this sensation increases and can cause intense symptoms for 2–3 days. Usually there is only erythema, but occasionally vesicles and bullae, local swelling and joint stiffness develop. Fire sponges are reported to cause delayed reactions and desquamation can occur after 2–3 weeks.<sup>11</sup>

No specific treatment has been recommended except washing the sting site. The effects resolve over days to weeks irrespective of treatment. Symptomatic relief with analgesia or antihistamines can be used.

## Blue-ringed octopus bites

A number of species of blue-ringed octopi occur in tidal areas around Australia. Their saliva contains tetrodotoxin, a potent sodium channel blocker. They will only bite when disturbed or handled. The bite is often painless and associated with small puncture marks. Generalised paraesthesia, nausea, dizziness and malaise may develop, but the majority of cases do not progress. In severe cases there is rapid progression to a flaccid paralysis and respiratory failure. Early basic resuscitation to provide ventilatory support is essential in severe envenoming. Medical management is supportive and the effects usually last 2–5 days. Pressure immobilisation is recommended for first aid.

## Conclusion

Minor injuries from venomous marine creatures are common but most people do not seek medical attention. This is typified by the thousands of bluebottle stings that occur annually which are treated by first aid stations and where hot water immersion

has now been shown to be effective. Major injuries are less common and range from severe box jellyfish stings that occur mainly in northern Australia to trauma and secondary infections from penetrating injuries from fish such as stingrays.

## References

1. Isbister GK. Marine envenomation and poisoning. In: Dart RC, editor. *Medical toxicology*. 3rd ed. Philadelphia: Lippincott, Williams & Wilkins; 2004. p. 1621-44.
2. Williamson JA, Fenner PJ, Burnett JW, Rifkin JF. *Venomous and poisonous marine animals: a medical and biological handbook*. 1st ed. Sydney: University of New South Wales Press; 1996.
3. Loten C, Stokes B, Worsley D, Seymour JE, Jiang S, Isbister GK. A randomised controlled trial of hot water (45 degrees C) immersion versus ice packs for pain relief in bluebottle stings. *Med J Aust* 2006;184:329-33.
4. Currie BJ, Jacups SP. Prospective study of Chironex fleckeri and other box jellyfish stings in the 'Top End' of Australia's Northern Territory. *Med J Aust* 2005;183:631-6.
5. O'Reilly GM, Isbister GK, Lawrie PM, Treston GT, Currie BJ. Prospective study of jellyfish stings from tropical Australia, including the major box jellyfish Chironex fleckeri. *Med J Aust* 2001;175:652-5.
6. Currie BJ. Marine antivenoms. *J Toxicol Clin Toxicol* 2003;41:301-8.
7. Huynh TT, Seymour J, Pereira P, Mulcahy R, Cullen P, Carrette T, et al. Severity of Irukandji syndrome and nematocyst identification from skin scrapings. *Med J Aust* 2003;178:38-41.
8. Corkeron M, Pereira P, Makrocanis C. Early experience with magnesium administration in Irukandji syndrome. *Anaesth Intensive Care* 2004;32:666-9.
9. Little M, Pereira P, Carrette T, Seymour J. Jellyfish responsible for Irukandji syndrome. *QJM* 2006;99:425-7.
10. Isbister GK. Venomous fish stings in tropical northern Australia. *Am J Emerg Med* 2001;19:561-5.
11. Isbister GK, Hooper JN. Clinical effects of stings by sponges of the genus *Tedania* and a review of sponge stings worldwide. *Toxicon* 2005;46:782-5.

*Conflict of interest: none declared*

## Self-test questions

*The following statements are either true or false (answers on page 135)*

1. Bluebottle stings should be washed off with vinegar.
2. Lacerations from stingray injuries should be left open for delayed primary closure.