

Cubozoan Jellyfish Envenomation Syndromes and their Medical Treatment in Northern Australia

Fenner PJ

Coelenterate Biology: Recent Research on Cnidaria and Ctenophora. R. B. Williams. P. F. S. Cornelius. R. G. Hughes & E. A. Robson (eds). Hydrobiologia 216/217: 637-640, 1991. Kluwer Academic Publishers, Belgium

ABSTRACT

The stings of *Chironex fleckeri*, *Carukia barnesi* and two unidentified carybdeids cause severe or fatal symptoms to swimmers in tropical Australia. The cubozoans and their envenomation syndromes are described. First-aid and medical treatment are reviewed, and safety precautions to prevent envenomation are recommended.

INTRODUCTION

The coastal waters of tropical Australia attract numerous swimmers during the summer when venomous jellyfish occur. The cubozoan *Chironex fleckeri* Southcott has caused some 80 human deaths in Australia since 1884 (Cleland & Southcott, 1965; Williamson, 1985). A small carybdeid *Carukia barnesi* Southcott (the 'Irukandji') causes a near-lethal syndrome (Fenner et al., 1986, 1988). Two unidentified but similar carybdeids, although not lethal, may cause symptoms resembling the 'Irukandji' syndrome (Cleland & Southcott, 1965; Fenner et al., 1985). This account summarises present information about the jellyfish and the symptoms and treatment of stings.

It is important to identify offending jellyfish. Nematocysts obtained by skin scraping are useful especially if, as in the 'Irukandji syndrome, the skin gives little other evidence of stings. If scrapings from the recently stung area are placed on a slide with physiological saline, microscopic examination reveals nematocysts from which the jellyfish may be identified. In view of the potentially lethal effects of some stings, rapid identification may be critical.

Envenomation syndromes

Chironex fleckeri (family *Chirodropidae*)

This lethal jellyfish is found along most of the tropical coastline of Australia (Hartwick, 1987). A mature specimen may be 25 cm in diameter and slightly less in height. There are 4 pedalia, each with up to 15 tentacles 3 m in length (Hartwick, 1987). A 4-year-old boy died within 10 min of a sting from 4 m of tentacle and other deaths have occurred within 3 min (Lumley et al., 1988).

A major or life-threatening sting is estimated as more than 2 m of tentacle length on a child or 8-10 m on an adult, or else as an area > 50% of one limb (Williamson, 1985), or one which causes symptoms such as impaired consciousness, breathing difficulty, or weak, irregular heartbeat. Respiratory failure may ensue (Williamson et al., 1984; Williamson, 1985). The 4-year-old boy mentioned above died despite cardio-pulmonary resuscitation (Lumley et al, 1988).

Minor tentacle contact causes severe localized skin pain with weal formation. Within 8 h blistering of the skin usually occurs and in the next 24 h the skin often becomes blackened, and then scarred for life. Tentacle marks make the skin appears 'burnt' and a 'ladder pattern' maybe seen due to the arrangement of batteries of nematocysts on the tentacle. Ice or cold packs alleviate minor skin pain but they are of limited benefit after major envenomation because of deep skin damage and severe pain.

***Carukia barnesi* (the 'Irukandji') (family Carybdeidae)**

Carukia barnesi also occurs off tropical Australia but, unlike Chironex, it is an open-water jellyfish and is also found along the Great Barrier Reef (Williamson, 1985). Despite its small size, 13-2 cm diam., it can prostrate and almost kill a healthy adult male (Fenner et al., 1986, 1988). It has 4 tentacles, extending to 35 cm, but 6 cm when contracted (Southcott, 1967).

Sting cases are usually sporadic and occur far from medical help but vinegar inhibits nematocyst discharge in all cubozoans tested so far (Hartwick et al., 1980; Fenner et al., 1985; Fenner & Williamson, 1987), including *Carukia* (see Fenner et al., 1986). A typical case of *Carukia* envenomation starts with a small or insignificant sting, usually at or near water level. The skin mark is faint and often difficult to see. As noted, skin scrapings show undischarged nematocysts (Fenner et al., 1986).

The 'Irukandji' syndrome starts some 5-40 min after the initial sting (usually 30 min) and comprises pain, effects of catecholamine excess, and other venom-mediated effects (Fenner et al., 1988).

Severe and 'boring' pain starts in the sacral or lower back area. Cramping muscle pains then develop in the upper thighs and in the abdomen, chest and upper limbs. They are severe and come on in waves, building up in intensity over a few minutes before fading, only to return within minutes: they can go on for hours and are described by the victims as excruciating. The chest pain or 'tightness' is due to cramping of the intercostal muscles and diaphragm.

A severely envenomated victim will exhibit most or all of the following symptoms of catecholamine excess. Mild envenomation produces only a few of these: a) Hyperventilation. b) Marked restlessness (the victim cannot find a comfortable position). c) Anxiety, wretchedness, and a feeling of impending doom. d) Uncontrolled tremor or shaking. e) Nausea to severe vomiting. f) Severe headache. g) Localized pilo-erection, not necessarily around the sting; sometimes generalised. h) Sweating, usually generalised and profuse but sometimes localized, maybe far from the sting. i) Tachycardia, often with extra-systoles. j) Hypertension, which may reach 260/130 mm Hg.

A rare venom-mediated effect is pulmonary oedema (Fenner et al., 1988). Active medical treatment is essential, or death may ensue.

Unidentified carybdeid spp.

Large carybdeids of uncertain identity (Southcott, 1967) are also found off tropical Australia and as far south as Moreton Bay near Brisbane ('Moreton Bay Stingers' or 'fire jellies'). They now appear to comprise 2 species. One (Type 1) is up to 8 cm diam. and 6 cm high and has tentacles 10-50 cm long. The other (Type 2) is much larger and of different shape with a bell up to 14 cm diam. and 18 cm high. The tentacles may be 1 m long and 1 cm wide (Fenner et al., 1985).

Before 2 types were discerned, Southcott (1985) suggested the name 'Morbakka' (derived from 'Moreton Bay carybdeid'). The name refers only to Type 1 specimens, as these alone have been collected in Moreton Bay, and off southern Queensland and northern New South Wales, whereas Type 2 specimens have been found only off Queensland north of Mackay (21° 9' S). Large carybdeids from Darwin and Western Australia are now being examined.

Study of Type 1 by Simon Moore (pers. comm.) at The Natural History Museum (London) suggests it may be a *Tamoya* sp. (possibly *Tamoya virulenta* Kishinouye), but examination of type specimens from Japan is necessary for confirmation. Type 2, although generally resembling a *Tamoya*, shows many minor differences. Possibly Types 1 and 2 are both undescribed species.

Their stings are similar. Skin markings are characteristic raised, red weals surrounded by red 'flare' and victims may complain of local burning pain (hence the name 'fire jelly'). Sometimes skin lesions are itchy and painful. Victims may also have 'tightness' in the throat (Fenner et al., 1985). Stings from both Types may cause a minor 'Irukandji' syndrome. To date there have been no fatalities.

Medical treatment of envenomations

Chironex fleckeri

- 1) Secure a clear airway and assess breathing and circulation. Expired-air resuscitation may be required with or without external cardiac compression.
- 2) Flood the area with vinegar (i.e., 4-6% acetic acid) for a minimum of 30 s before applying a compressive bandage. Immobilise the area to reduce blood flow.
- 3) To block the effects of the venom, give 3 ampoules of specific CSL (Commonwealth Serum Laboratories) Chironex antivenom intramuscularly. In hospital, give one ampoule of antivenom mixed with 5 mg of verapamil intravenously.

Antivenom also reduces the acute skin pain within a few minutes of intravenous injection (Williamson et al., 1984). When cardiogenic effects are encountered, or if they might occur, combined intravenous verapamil and antivenom are more effective than antivenom alone (Burnett & Calton, 1983; Burnett et al, 1990).

Carukia barnesi (the 'Irukandji')

Flood the envenomated area with vinegar for 30 s before applying a vinegar-soaked pack with compressive bandaging. Since severe symptoms may ensue, all victims should be hospitalised. Medical treatment follows 3 principles:

- 1) Relief of the excruciating pain, which responds only to intravenous narcotics in high doses. Intravenous pethidine (50 mg) is given immediately, followed by an infusion of 30 mg/hr. Alternatively, 5 mg of morphine is given intravenously once, followed by 2.5 mg increments repeated every 5 min as necessary for continued pain relief. This should be carried out only with respiratory resuscitation facilities at hand.
- 2) Control of excessive catecholamine release by phentolamine, an alpha-adrenergic blocker (Fenner et al, 1986). A slow intravenous dose of 10 mg is given and repeated until symptoms are alleviated.
- 3) Treatment of other venom mediated effects. Pulmonary oedema is treated with oxygen, diuretics and sublingual nitrates, and if necessary artificial ventilation after inserting an endotracheal tube.

A specific antivenom is not yet available. The calcium channel blocker verapamil is effective for other jellyfish envenomation syndromes caused by excessive release of calcium ions (Burnett & Calton, 1983; Burnett et al., 1985), but has not yet been tried: it might relieve symptoms of the 'Irukandji' syndrome. The suggested dose would be 5-10 mg intravenously, repeated as necessary until symptoms were alleviated.

Unidentified carybdeid spp.

Wash off any tentacle fragments with vinegar (Fenner et al, 1985) and apply cold packs locally for 15 min (Exton et al., 1989). Should an 'Irukandji reaction' occur, hospitalise the patient.

Prevention of jellyfish stings in Australia

In northern Australia, the following measures are recommended to prevent envenomation:

- 1) Swim at beaches patrolled by the Surf Life Saving Association, preferably avoiding the summer months.
- 2) Wear protective clothing to prevent penetration of skin by nematocysts. 'Lycra' suits have been developed which cover the chest, abdomen and limbs.
- 3) Swim in 'stinger-resistant enclosures', areas up to 75 x 50 m protected by a net hanging to the seabed under a pontoon, and fine enough to exclude both *Carukia* and *Chironex*.

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