# Further Understanding of and a New Treatment for "Irukandji" (Carukia Barnesi) Stings.

Fenner PJ, Williamson JAH, Callanan V, Audley I.
(Med J Aust 1986; 145: 569-574)

**ABSTRACT**
A brief analysis is presented of the large recorded',' numbers of swimmers who have been stung by the '1rukandjV' (Carukia barnesi) jellyfish during the 1985-1986 summer season in north Queensland, and the results are discussed. Many of the victims may suffer from symptoms of over stimulation of the sympathetic system, and hypertension is shown to be another complication of this syndrome. This hypertension seems to respond well to intravenously administered phentolamine, an alpha-adrenergic receptor blocking drug. Phentolamine also reduces the excessive shaking and sweating that appears to be part of the "Irukandji syndrome". Diazepam relieves the anxiety, which is part of the syndrome, but antihistamine agents and hydrocortisone seem to have no beneficial effect.

Carukia is a member of class Cubozoa,' as is the more dangerous Chironex fleckeri. However, it is part of the family Carybdeidae whereas Chironex is from the family Chirodropidae. Carukia is a carybdeid and is similar in looks to the "Morbakka" 1,2,3 both having four tentacles (one from each corner) and mammilations of nematocysts on the actual bell; however, Carukia measures only 20 mm in diameter and 25 mm in depth of the bell. Its tentacles, which contain large numbers of nematocysts (stinging cells), may extend to 650 MM.

Nematocysts are also present on the bell and may cause envenomation, although they are of a different morphological form (Bob Hartwick, personal communication). At the current meagre level of knowledge, it is not known if there is any difference in the signs and symptoms of envenomation from the types of nematocyst.

**The "Irukandji syndrome"**

"Type A" stingings were first described by Southcott in 1943.11 In 1953, these were named the "Irukandji syndrome" by Flecker after a local Aboriginal tribe that lived near Cairns where most of the stings had occurred.7 The offending jellyfish itself was neither seen nor captured until 1964, 8 as it is a very small, open-water jellyfish and is very difficult to collect. It was named Carukia barnesi in 1966 by Southcott,' after its discoverer, Dr Jack Barnes. However, Barnes was also of the opinion that at least three other small carybdeids caused the "Irukandji syndrome".9.10

In spite of its small size, Carukia has a very potent venom, which causes prostration, even in fit young adults. Previous authors have described the "Irukandji syndrome", with its severe backache, muscle pains, chest and abdominal pains, headache, nausea, vomiting and restlessness, together with localised piloerection, localized sweating, a reduced urine output and, occasionally, an irregular pulse rate.1,8

Cases of the "Irukandji syndrome" have been accurately identified and reported from Mackay in the south of Queensland, throughout the tropical Australian waters, to Dampier in Western Australia. They have also been reported by Barnes as far north as West Irian, and from the swimming-pools of some ships which have been filled at sea.8 Barnes also reported a similar syndrome occurring in the Moreton Bay area just south of Brisbane, Queensland, but in view of more recent evidence this may well have been due to envenomation from the "Morbakka' 1.3

**Increased incidence of stings**
"Large numbers" of "Irukandji" stingings were reported in troops who were stationed in north Queensland during World War ll,' although the exact numbers were never stated. Barnes mentioned that up to 40 people were stung in one day in Cairns, although in his first description of the search and discovery of Carukia in the years 1956-1962 he mentions only 65 cases, which is an average of 11 per year.' Small numbers of stingings have been reported in most years since. Large numbers seem to have recurred in the 1985/1986 summer season - 36 stingings were reported from Cairns Hospital on Christmas Day - making it the worst on record.

There may be a number of explanations for the periodicity in the appearance of these jellyfish, including the effects of winds and ocean currents which are known to influence the appearance of the jellyfish on coastal beaches.' Another possible indirect explanation may be the design of nine new 'stinger-resistant enclosures" on northern Queensland beaches. These enclosures were originally designed specifically to keep out the larger and most dangerous of the deadly north Australian box jellyfish (Chironex fleckeri). Because of their success, many persons have again taken to swimming in the ocean inside these enclosures during the summer months. These 'stinger-resistant enclosures" were designed by the Civil and Systems Engineering Department of the James Cook University in north Queensland. Each enclosure consists of a floating tube that is attached to the shore and extends out into the water for some 50-75 in, and then runs parallel to the shore for another 50-75 m before being secured back on shore. The corners are held out in position by heavy sea anchors. Hanging from the floating tube is a net with a mesh size of 50 mm X 21 ply, which is small enough to keep out any Chironex that are large enough to cause a painful or dangerous sting to a bather. However, it is not small enough to exclude the "Irukandji", and appreciable numbers of swimmers have now been stung inside these enclosures.

Design variations of these nets to prevent the entry of the "Irukandji" will be tested during the 1986-1987 summer season and the successful modifications will be incorporated into future enclosures. Existing installations will be upgraded (K. Stark, James Cook University, personal communication).

**Reporting of cases**
This (1985-1986) is the first season that marine envenomation records from many sources have been collated with a modicum of accuracy. Record forms were sent to all coastal hospitals in tropical Queensland and several in the Northern Territory, and were collated at the end of the season; these have formed part of the study of 61 case histories that are summarised below.

**No of case reports of Carukia Barnesi stings:- 61**

| LOCATION | |
|---|---|
| Cairns | 36 |
| Darwin | 1 |
| Proserpine | 3 |
| Cooktown | 2 |
| Mackay | 2 |
| Magnetic Island | 17 |
| PATIENT'S AGE | |
| Less than 5 years | 6 |
| 5 – 15 years | 19 |
| 15 years and over | 36 |
| PATIENT'S SEX | |
| Male | 29 |
| Female | 32 |
| BODY SITE OF STING | |
| Face | 1 |
| Legs | 19 |
| Abdomen | 3 |
| Chest | 11 |
| Arms | 11 |
| Neck | 3 |
| Not recorded | 13 |
| TIME OF STING | |
| Morning | 5 |
| Afternoon | 39 |
| Unknown | 17 |

The treatment for these cases was mainly intravenously administered pethidine. There were verbal reports of sting numbers, but with no documented case reports, from the following centres: Airlie Beach, 15 stingings; Bowen, 10; and Cairns, 8 stingings.

In addition to these, at least 33 other cases are believed to have occurred; the source of this figure being surf club reports, verbal reports that were obtained from doctors' surgeries, hospitals that did not complete our record form, and some cases that were reported in local northern newspapers.

We now report the cases of three recent victims in whom significant hypertension accompanied the typical features of Irukandji" envenomation. We suggest a new treatment for such patients, and discount the effectiveness of some other suggested treatments.

## 1. Clinical records

### Case I

While snorkelling at Green Island a healthy 30 year-old man sustained a sting on the neck from k an unseen marine stinger. Five minutes later, nausea and generalised muscular pains developed. He was given 50 mg of pethidine by the intravenous route and was transported by helicopter to Cairns Base Hospital. On arrival he had severe pain, and a further 50mg of pethidine was administered by the intravenous route. The sting site showed a small (30 mm x 10 mm) area of erythema.

On admission to a ward, the patient had cold, clammy extremities, and piloerection, and he complained of severe chest and abdominal pain. e He was shaking violently and was slightly c confused; his blood pressure was 200/130 mm Hg. S Phentolamine (5 mg) was administered intravenously and some improvement in the sweating and shaking resulted. A second intravenously administered dose of 5 mg of phentolamine with 1 50 mg of pethidine produced considerable relief of the sweating and shaking and the pain. Two hours later all his signs and symptoms had returned and his blood pressure was 160/100 mm Hg. More phentolamine was administered as an intravenous infusion of 2.5 mg per hour; this controlled all symptoms except the pain, which responded to repeated doses of pethidine.

The phentolamine infusion was ceased after'24 hours when the patient's blood pressure was 140/90 mm Hg. He suffered no further symptoms.

### Case 2

At 11.00 a.m. on December 25, 1985, a warm, calm day, a healthy 30-year-old woman was swimming inside a "stinger-resistant enclosure". She felt a small sting behind her right armpit, close to water level, after which she left the water and took a warm shower.

Approximately 10 minutes after the sting she noticed aching and cramps in her legs. She then developed generalised muscular aching, with sweating and dry retching. An ambulance was called and she arrived at hospital at approximately 12.30 p.m.

On arrival, she was sweating profusely, shaking violently and complaining of generalised pain. She had generalised piloerection, an irregular tachycardia of 135 beats per minute, and a blood pressure of 160/110 mm Hg. There was no coolness of her extremities apparent.

She was given a test dose of 25 mg of pethidine by the intravenous route, followed by another 50 mg when this produced no improvement. An automatic blood pressure recording device was applied, after which her blood pressure was observed to rise slowly to 195/135 mm Hg. Her electrocardiogram tracing showed some slowing, with an occasional ventricular ectopic beat.

At this stage, she was very distressed and felt that she "was about to die" (an opinion shared by her medical attendant!). Thirty minutes after admission to hospital, 10mg of phentolamine was given slowly by the intravenous route and gave dramatic relief of the shaking, sweating and anxiety. Her blood pressure dropped within 10 minutes to 125/85 mm Hg and was maintained below a diastolic pressure of 110 mm Hg with intermittent injections of 5-10 mg of phentolamine. She was also given pethidine and Entonox (a mixture of equal volumes of nitrous oxide and oxygen) for pain relief.

At 11.45 p.m., more than 12 hours after the original envenomation, the patient finally passed urine (320 ml; specific gravity, 1.022), having received approximately 3000 ml, of fluids by the oral and intravenous routes. Estimations of serum levels of urea and creatinine were within normal ranges.

She required a total of 30 mg of phentolamine, the last dose being given at 3.55 p.m. on the day of admission to hospital, after which her blood pressure remained at an acceptable level (140/90 mm Hg when she was discharged from hospital.)

Her pain persisted for a further three days during which time she required a total of 800 mg of pethidine (administered intravenously) in the first two days, and 100 mg (administered intramuscularly) on the third day. She was a stoical person and probably should have received more pethidine.

She was discharged home on December 27, 1985, but had muscle soreness and tiredness for at least one week.

**Case 3**
A healthy 38-year-old man sustained a sting on the arm while swimming off a Mackay beach. There was no pain until 30 minutes later when backache developed; within 10 minutes this was severe and accompanied by severe leg pain and restlessness. He was transferred to hospital by ambulance and received Entonox by inhalation during transport but with only slight relief of pain.

On admission to hospital he complained of severe central chest pain with no radiation and a tight feeling while breathing. Peak expiratory flow measurements and an electrocardiogram tracing showed no abnormalities. He was given 100 mg of pethidine intramuscularly which relieved the pain, although he was aware of the muscles tightening in his back and legs. His blood pressure was 175/120 mm Hg.

Muscle enzyme studies revealed a normal myocardial creatine kinase level, but the skeletal muscle creatine kinase level was 425 U/L (normal range, 20-200 U/L).

Ninety minutes after admission to hospital, he was given 5 mg of phentolamine and 2.5 mg of diazepam by the intravenous route. This reduced the blood pressure to 185/105 mm Hg, but within 15 minutes it had risen again to 190/110 mm Hg. Phentolamine (10mg, administered intravenously) reduced this to 175/95 mm Hg in spite of the recommencement of severe muscle pain.

Localized sweating was noted on his right forearm and leg. Promethazine (50 mg) and hydrocortisone (250 mg) both administered intravenously had no effect on the signs or symptoms, but a further 100 mg of pethidine by the intramuscular route relieved the pain.

Two hours later his blood pressure rose to 190/115 mm Hg. Intravenously -administered phentolamine (10 mg) reduced the blood pressure to 180/100 mm Hg where it remained until the patient's discharge. At this time he had no muscle aches or pains. In spite of feeling unwell for a further two days, he was free of other symptoms. Four days after envenomation, his blood pressure was 140/90 mm Hg.

**DISCUSSION**

A common belief is that most "Irukandji" stings occur on the upper torso, and in deep water. However, a number of the above-mentioned patients were stung below the waist, in shallow water. When Barnes first discovered Carukia he saw the organism swimming close to the surface of the water, and so the most plausible explanation of the sting patterns is that Carukia swims close to the surface of the water, and the victims are stung at water level (upper torso, if they are swimming). A large majority of victims were stung in the afternoon. It is difficult to believe that such a large difference could be due solely to more people swimming in the afternoon.

A number of cases have been reported in the past after "boom-netting". This was once common in tropical waters, where tourist boats travelled at slow speeds with nets trailing from booms, which were held out over the water. Tourists were able to hang on to these nets and "cool off" in the sea water, thus risking a sting from Carukia which is usually an open-water jellyfish. These older boats have now been replaced by high-speed catamarans which travel too fast for boom-netting, and this may account for the decrease in numbers of stings in the Airlie Beach area since last year (D. Gillman, Airlie Beach, personal communication).

Immediate first-aid treatment of Carukia stings by the use of vinegar (3 01o - 10016 acetic acid) to inactivate unfired nematocysts has been proven to be effective in vitro.13 However, symptoms of the "Irukandji syndrome" do not usually present for periods of 30 minutes or more, when there may be few, if any, remaining nematocysts on the skin; this is supported by skin scrapings that were taken in several such cases and examined by one of us (P.F.) by means of a technique that has been described previously.'

In humans, the excessive release of catecholamines can cause tachycardia, systemic and pulmonary hypertension, increased pulse pressure, hyperventilation, pallor, ventricular extrasystoles, restlessness, apprehension, headache, tremor, localized sweating, piloerection, peripheral cyanosis from vasoconstriction, reduced renal blood flow (causing oliguria), and increased plasma sodium and chloride levels. Many of the signs and symptoms of the "Irukandji syndrome" envenomations that were described by early observers, and which are presented in our case studies, are similar to the above picture. This suggests that the toxin that is injected by the nematocysts of the jellyfish causes the excessive release of catecholamines; however, the delay in onset may be more difficult to explain.

As the "Irukandji' is a small, open-water jellyfish, it is very difficult to collect. Very few live specimens have been captured, and because they are so small, it has been impossible so far to collect the venom as Barnes did with Chironex. 11 For this reason there has been no research on the actual toxin, and studies to date are limited to morphological observations and records of anecdotal stings.

Hypertension appears to be one of the problems that may occur from Carukia envenomation. Phentolamine, an alpha blocking agent, reduced the blood pressure in the above cases and seemed to help the anxiety and shaking in the. others. It is intended that further clinical studies be performed, and perhaps other medication, such as beta-blocking agents or combined alpha- and beta-blocking drugs, be tried.

The most effective treatment for the muscle pains is narcotic analgesia by the intravenous route, and, as large doses may be needed, they are best administered by continuous infusion in a critical care unit so that the dose can be carefully titrated to give the maximum effect with safety. Other treatments, such as antihistamine agents and hydrocortisone, seem to offer little benefit; diazepam helps to allay the anxiety that is associated with the envenomation.

**ACKNOWLEDGEMENTS**
We would like to thank Cec Dinsdale for his exact description of his symptoms and of the relief, if any, he received from the different treatments that were tried in spite of his intense discomfort. We would also like to thank Dr Rod Brodribb, and the late Dr Maureen Duke, Consultant Physicians in Mackay, for their expert advice on the interpretation of the electrocardiogram in the second case, and Dr Struan Sutherland for his helpful suggestions in the presentation of this article.

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