5.8 First aid and Medical treatments

5.8.1 Educational policy: prevention of jellyfish envenomation

The facts derived from stings described above, and early work conducted by Jack Barnes for Surf Life Saving Queensland, assisted in the development of an Educational policy on the prevention of stings from dangerous jellyfish in tropical Australian waters. This was first formulated by the author for Surf Life Saving Queensland and then accepted as the standard by Surf Life Saving Australia in their Training Manual. With its success in simplicity and effectiveness it was then presented, and accepted for teaching in schools in tropical Queensland (see below). The most important points are awareness of the problem and prevention of envenomation, rather than the treatment: -

Awareness

Time of the year

Box jellyfish (*Chironex fleckeri*) become more prevalent as the weather becomes warmer. They do not move down the coast from the north to the south as once was believed, but breed locally in creeks and mangroves (Hartwick 1987; 1990). Early heavy rainfall seems to increase the numbers for *Chironex* that season. This is still believed to be due to the young polyps being washed from the creeks by the early rainfall and then quickly growing into adult *Chironex*; Hartwick (1987, personal communication) disputes this theory.

The critical temperature that *Chironex* exist for a longer periods closer to the equator was suggested to be above 28^{o} Celsius for their appearance (at the beginning of the season), and 23^{o} Celsius for their disappearance (at the end of the season)(Barnes 1960). This is disputed by Hartwick (Williamson *et al* 1996, p264). These are the summer months in the Southern Hemisphere, and the opposite for the Northern Hemisphere. In Australia the further north (ie closer to the equator), the longer the season.

An approximate incidence of box jellyfish according to the month of the year and the geographical location is shown above in Table 10.

Weather

First suggested by Barnes (1960), agreed by Williamson (1965) and regarded as accurate by the author over his 15 years of study, the warmer the weather, the warmer the seawater becomes in shallow sandy water, and the greater the incidence of *Chironex* in that water. Thus they are more common in shallow waters

on hot, still days with the gentle, hot, northerly winds when the sea is calm (and warm). This situation is ideal for both *Chironex,* and swimmers wanting to cool off.

It is for this reason the author has been arguing for a number of years that all warning signs stating that box jellyfish may be present in the waters, and situated at practically all beaches in northern Queensland and the Northern Territory, should state “do not enter into these waters”. Most currently read “do not swim” but most children stung are simply wading and playing in shallow water (Fenner *et al* 1995; database results below).

Chironex do not usually like rough weather as with breaking waves and rough water their tentacles may be damaged (Williamson 1985a) however, they sometimes DO occur in choppy water also (see above).

Prevention of envenomation

Knowing some of the habits of *Chironex* it is possible to use strategies to prevent envenomation, rather than the need to treat it. The thread tubes of the stinging nematocysts are just long enough to penetrate the dermis. Consequently, any clothing worn on the outside of the skin will prevent penetration of the integument, and abort envenomation: -

Protective clothing

`Stinger suits' are lycra suits that cover the body and limbs, but not the head, hands or feet. Most stings occur on the lower limbs, with less than 5% occurring on the face (Table 7). So long as people do not dive into the sea, they will not be stung on the face. If they walk slowly into the sea, *Chironex* will invariably swim away (see above). If the victim should be unfortunate enough to sustain a sting on the feet whilst walking slowly into the water, the area stung, although being acutely painful, will not allow a sting of sufficient size as to cause potential fatal effects.

Prior to the introduction of these stinger suits in Townsville in 1985, lifesavers and people entering the sea used to wear ladies pantyhose! One pair were worn on the bottom as normal, although with the feet cut out and the ends taped to the ankles, the other pair was worn upside down with a hole cut in the crutch for the head to go through, the arms in the leg holes, hand holes cut out and the ends taped to the wrists.

Any clothing covering these major areas of the body is sufficient for protection, however, normal “street clothing” carries with it the danger of the weight when waterlogged, and may present a problem of possible immersion if the wearing should accidentally find themselves in deep water where swimming is necessary. For this reason it cannot be recommended as such.

`Stinger resistant enclosures'

Originally conceived by the late Professor Stark of James Cook University of North Queensland, enclosures are large, safer areas in the sea that effectively exclude larger, lethal box jellyfish such as *Chironex*. They consist of nets, hanging from a floating pontoon that extends 50-100 meters out into the sea, a similar distance along the beach and then back to shore. The pontoon is held in position by strong anchors and the net hangs down from the pontoon, secured by weights to keep it on the bottom. These nets were designed by the Engineering Dept. of the James Cook University to prevent *Chironex* of a lethal size entering the enclosed area. This they do exceptionally well as *Chironex* only becomes lethal at a certain size - this is when there are sufficient tentacles to kill a child (approximately 7cms diameter across the bell [Hartwick 1987]).

These enclosures are NOT effective against smaller jellyfish such as the Irukandji (see below) as they are small enough to swim through the mesh net.

Slow entry to water

As stated above, most people who are stung run into tentacles trailing up to 3 meters behind the bell whilst *Chironex* swims in shallow water over the sandy bottom, `fishing’ for its food. The bell and the tentacles of *Chironex* are transparent and very difficult to see, sometimes only seen by those experienced in `spotting’.* When people run into the water there is insufficient time for *Chironex* to retract its tentacles and swim away.

- Spotting is a technique developed by Dr Jack Barnes for Surf Life Saving Queensland. An experienced operator stands in the bow of a slow-moving IRB (inflatable rescue boat), wearing polaroid sunglasses to reduce glare on the water so that either the jellyfish bell may be spotted, or the shadow of trailing tentacles may be seen on the sand below.

Slow entry into the water allows *Chironex* time to withdraw, or the victim may gently touch against the tentacles, allowing a rapid withdrawal from the water. Rapid entry

will cause entanglement with the tentacles which will usually break off, thus causing greater envenomation and making a possible small sting, life-threatening.

Swim on a patrolled beach

All surf lifesavers in north Queensland are taught how to recognise times and places when dangerous jellyfish may be present. They also have on hand large quantities of vinegar and compressive bandages, if needed, and are taught how to treat jellyfish stings, particularly the dangerous sting of *Chironex*.

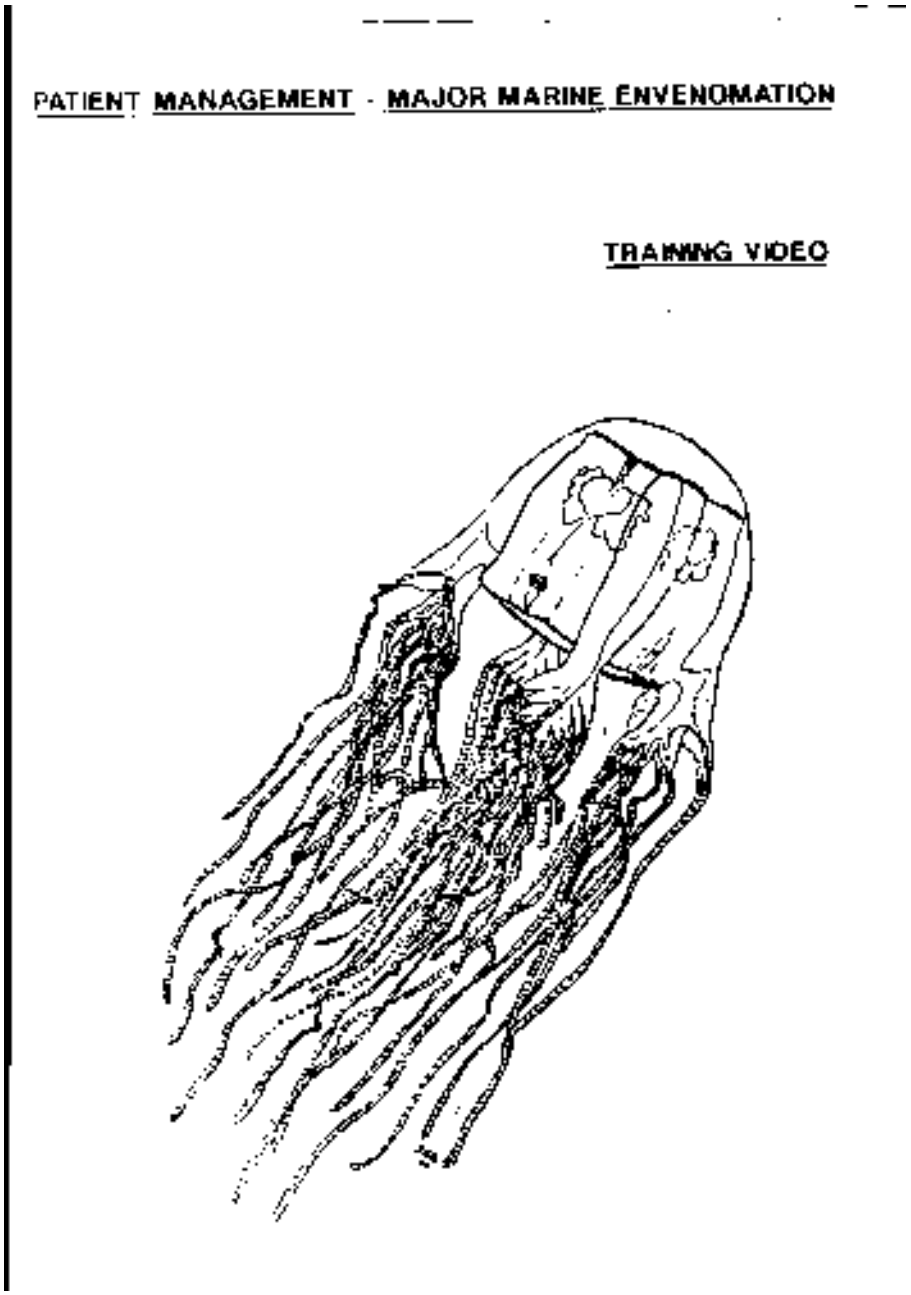
All surf lifesavers are well taught in resuscitation and first aid techniques and have oxygen on hand if necessary.

5.8.2 Chironex antivenom

Chironex antivenom was kept in Surf Life Saving Clubs in north Queensland from 1976 for 12 years. Qualified surf lifesavers with advanced resuscitation awards were trained to give intra-muscular (outer thigh) antivenom injections, first in Townsville, north Queensland, and then by the author and other qualified Medical Practitioners. They were also taught when, where and to whom it should be administered, although a Medical Officer had to give permission by phone or in person. It was withdrawn from Surf Life Saving Clubs in 1988 because of increasing cost and availability problems, and also because there had never been a major *Chironex* sting on a patrolled beach during that 12 year period. (This perhaps emphasises the efficacy of the Surf Life Saving Association beach patrols in preventing potentially dangerous envenomation situations for swimmers).

At almost the same time the antivenom was withdrawn from the Surf Clubs, the author conducted the original training course in which ambulance officers from the then Queensland Ambulance Serviced (QAS) were taught how to differentiate between the various jellyfish stings and when, and how, to give intra-muscular injections of the CSL *Chironex* antivenom, if a major sting *Chironex* sting occurred. A video was made of the training seminar for future training of ambulance officers. The antivenom was then made available to all Ambulance Centres in north Queensland.

Figure 8 - Training video for Queensland Ambulance



The timing of this training and antivenom availability was fortuitous. Within a month of the course there were two separate cases of the successful use of this antivenom by Ambulance Officers on victims with severe, life-threatening *Chironex* stings, who were still on the beach. In both victims there was a noticeable improvement in conscious level, blood pressure and cardiac rhythm (Fenner *et al* 1989).

Since then there have been a number of victims of *Chironex* stings who have received antivenom on the beach from Ambulance Officers; at least one was a life-threatening sting whose clinical condition improved with *Chironex* antivenom (Beadnell *et al* 1992).

5.8.3 Current first aid treatments of jellyfish envenomation

(Fenner *et al* 1989; Exton *et al* 1989; Fenner *et al* 1993)

Table 18

First aid treatment of non-chirodropid envenomation
• If fresh, adherent tentacles are present on the skin, they should be flushed off with seawater. If this is unavailable, tentacles can be picked off the skin with the fingers (only a harmless prickling of the fingers will be felt). • Ice in a polythene bag, wrapped in a cloth or cold packs are applied to the stung area and left in place for 5 – 15 minutes. This will relieve most skin pain. • The ice or cold packs can be re-applied if the skin pain is unrelieved, or returns. • Unresolved pain, or any further systemic symptoms are immediately referred to medical care. • Inhaled analgesia (such as entenox or penthrane) may be available from the local Ambulance for more severe pain, but further medical aid should be sought.

Table 19

First aid treatment of chirodropid envenomation
1. Retrieve the victim from the water and restrain them, if necessary.
2. If others are available, immediately send them for ambulance / medical help (emphasise the sting is from a Box jellyfish as the Ambulance may have antivenom available).
3. Check the victims Airway, breathing and circulation (ABC). Treat with mouth-to-mouth resuscitation (EAR), or heart massage (CPR), if necessary.
4. If others are available, or if resuscitation is not needed, pour vinegar over the stung area for a minimum of 30 seconds to inactivate remaining stinging cells on any adherent tentacles left on the skin.
5. AFTER vinegar application, apply compression bandages directly over major stings, ie. those: a) covering an area more than half of one limb b) causing impairment of consciousness c) causing impairment of breathing d) causing impairment of circulation If vinegar is unavailable, the rescuer should pull tentacles off using their fingers (only a faint, harmless prickling will be felt) - before applying the compression bandages
6. If available, use CSL *Chironex* antivenom for all major cases (see above). Three ampoules each containing 20, 000 units may be given intramuscularly, above the bandages, by a trained health professional on the beach. One ampoule intravenously may be given by medical personnel.
7. Cold packs may be used (15 minutes and repeated when necessary) to help ease the skin pain in conscious victims.
8. In severe envenomation, use oxygen if available; Inhaled analgesia (ie entonox or penthrane) can be administered for unremitting pain in conscious, breathing, cooperative patients; its use should be discontinued if the patient's condition worsens.

5.8.4 Current medical treatment of jellyfish envenomation

(Fenner *et al* 1989; Beadnell *et al* 1992; Fenner *et al* 1993)

Table 20

Medical treatment of jellyfish stings
1. If necessary, continue resuscitation with endotracheal intubation and 100% oxygen (if appropriate) monitoring the oxygen haemoglobin saturation and electrocardiography.
2. Insert an intravenous line and administer a crystalloid solution, monitoring urine output.
3. In major chirodropid stings, administer a minimum of 1 ampoule of diluted antivenom (20, 000 units) intravenously. If the clinical response is inadequate, 3 (or more) ampoules may be given intravenously, according to clinical response.
4. If there is persisting, life-threatening cardiac decompensation or arrhythmia, then consider giving verapamil intravenously (0.1 mg/kg up to 5-mg adult dose) under ECG monitoring until the cardiac arrhythmia reverts or other unwanted effects occur.
5. Inotropes such as adrenalin or dopamine should be considered for persisting hypotension - however, calcium should not be given.
6. Intermittent positive pressure ventilation with 100% oxygen will also assist in control of pulmonary oedema.
Note: - Cardiopulmonary resuscitation, employing oxygen-enriched air (preferably 100% oxygen) should be continued and not abandoned in the patient with ongoing circulatory arrest until after consideration of further therapy with even more antivenom (at least 6 ampoules total dose, if available) and consideration of more verapamil and inotropes.
7. Intravenously administered analgesia may be necessary (1 mg/kg of pethidine up to 50 mg adult dose initially). For pain not relieved by cold packs and narcotic analgesia, in chirodropid stings, consider administration of 1 ampoule of antivenom intravenously as above.
8 Intravenous antivenom (administered as above) may provide cosmetic benefits in stings involving cosmetically sensitive areas (eg. face or neck, especially in females).

Irukandji Envenomation - Protocol

(Fenner *et al* 1986b; Fenner *et al* 1988; Carney & Fenner 1997)

Table 21 - Primary hospital treatment of Irukandji stings

Accident and Emergency
• Identify the Irukandji syndrome: - late onset symptoms after minor sting, back pain, sweating, piloerection, **hypertension**, chest pain, limb cramps, headache, vomiting, anxiety, restlessness • IV cannulation - morphine infusion with boluses 5 - 10mg (adult) - phentolamine 5 - 10mg boluses (adult) OR - IV GTN (50mg in 500ml 5% dextrose) commence at 3ml/hour • Pulse occimetry – administer oxygen to keep haemaglobin oxygen saturation > 93% • Check BP 15 minutely (automatic machine – dynamap, if possible) • Monitor ECG • Chest X-ray • Skin scrapings for nematocysts: - - scrape a scalpel blade over stung area, place in saline and centrifuge. Nematocysts are placed on a microscope slide and examined. OR - put sticky tape onto skin of stung area. Inspect this under a microscope. • Blood for cardiac enzymes - CK, CK:MB, cardiac troponin, serology for jellyfish stings, catecholamines. • fill in data sheet: - - time, place, winds, temperature, weather conditions, clothing, ? stinger suit ? T-shirt ? sunsuit ? wet suit, other people in water, other people stung, tide, time interval to onset of symptoms, ? jellyfish seen, ? tentacles/bell seen, skin marks, treatment ? vinegar, ? fresh water exposure, ? other, site of sting/pain/marks, name, age, sex, address, holidays, ? stung before, activity when stung - ? swimming, surfing, ? wading ? snorkelling, ? diving brief patient medical history • Admit to high dependency ward

(Carney & Fenner 1997)

Table 22 - Possible ICU treatment of Irukandji stings

High Dependency Medical Ward / ICU
• Analgesia - IV morphine infusion • Control BP - Phentolamine 5-10mg bolus, IV GTN 3ml/hour • Monitor - ECG, oxygen saturation • if heart failure - high flow oxygen, CPAP, increase GTN, frusamide, CVP line, inotropes • IPPV if necessary for control of the oedema and of hypoxia. • blood at 8 - 12 hours, 16 - 24 hours, 48 hours - CK - CK:MB, cardiac troponin • Chest X-ray at 24 hours • Echocardiogram within first 24 hours • Serology for jellyfish stings on day of discharge

Table 23 - Follow-up treatment of Irukandji stings

One Month After Discharge
• Repeat echocardiogram if first one abnormal • Serology, CK, CK:MB, cardiac troponin • CXR if any abnormality on previous CXR in hospital

Table 24 - Medical treatment of stings involving arterial compromise

Stings involving arterial compromise
• Preservation of local limb blood supply by keeping the patient warm takes priority over concern for possible increase in systemic absorption of the venom. • Peripheral pulses over the involved extremity should be monitored by direct physical examination and/or Doppler measurements and circulatory compromise treated aggressively with: - ➢ intra-arterial urokinase (50, 000 i.u.) infused over a period of 30 minutes and repeated if necessary (heparin, cervical sympathectomy and tolazoline gave little apparent benefit) ➢ Rehydration, maintenance of good fluid balance, analgesia and oxygen (preferably 100%) are essential. ➢ If necessary, anticoagulation and intravenous infusion of lignocaine, vasodilators (such as papaverine), prostaglandin$_E$ or antiplatelet aggregation agents (ie. prostacyclin) should be tried. ➢ Monitor for possible development of a compartment syndrome. • Surgical intervention and/or hyperbaric oxygen therapy reserved for unresponsive cases, but needs to be early when indicated. (Burnett, in Williamson *et al* 1996, p.115)