5.2 Nematocyst Inhibition

Various chemicals totally prevent nematocyst discharge after prolonged contact with the tentacular material (eg. vinegar totally inhibits discharge of *Chironex* nematocysts when poured over the tentacles for a minimum of 30 seconds). Other chemicals when they come into contact with tentacular material will not cause discharge, but do not actually inhibit discharge of the nematocysts. This means that they can still discharge and cause consequent envenomation when stimulated in other ways – either tactile or chemical. This difference is important in the consideration of the first aid treatment.

Burnett *et al* (1983) studied nematocyst inhibition on *Chrysaora quinquecirrha* and found that slurry of baking soda (sodium bicarbonate) was an effective nematocyst inhibitor. As *Chrysaora* spp. are similar to *Pelagia* spp., it was suggested that the same first aid treatment to prevent further stinging should be applied to both species.

Methylated spirits was originally used on *Chironex* stings until Hartwick, whilst watching *Chironex* tentacles under a microscope, was surprised to see every nematocyst discharge when methylated spirits was accidentally poured into a Petri disc containing sections of *Chironex* tentacles. He repeated his studies many times to make sure there was no mistake, and then further experiments were tried using many common substances. Fortunately, vinegar (4-6% acetic acid), which was very easily available, very cheap and very safe (non-inflammable, unlike methylated spirits) caused total inhibition of all *Chironex* nematocysts when poured on for a minimum of 30secs (Hartwick *et al* 1980). Proven for *Chironex,* this treatment became the recommended first aid treatment for the prevention of further stings from adherent tentacular material for all jellyfish stings treated by surf lifesavers as from 1985.

Further experience was to modify this regime.

Vinegar

The author found in his travels in the Philippines and Malaysia that vinegar, along with many other traditional remedies, had been used for many decades to treat chirodropid envenomations. With the success of Hartwick *et al* in 1980, the author set out to test any jellyfish that he could to study the effects of vinegar on nematocyst discharge.

Morbakka

The author's first work in this area was with the cubozoan, `Morbakka' (Fenner *et al* 1985) (note: only the northern sub species *Tamoya haplonema fenneri* was tested).

A number of chemicals including vinegar, methylated spirits, dilute bleach (sodium hypochlorite), a `slurry' of baking soda' (a thickened solution of sodium bicarbonate in a little water) and 20% aluminium acetate ("stingose" – proprietary name for a sting remedy in Australia) were used. Sea water was used as a control and each substance was dropped on isolated tentacle extracts under direct vision using an operating microscope.

Results

Methylated spirits caused sudden and immediate firing of what appeared under the microscope to be 100% nematocysts discharge. When this piece of tentacle was then rubbed on the skin of the forearm, no stinging could be felt, suggesting that discharge was complete.

The 20% solution of aluminium acetate and dilute bleach caused no discharge of nematocysts, the slurry of baking soda caused minimal discharge (less that 5% of nematocysts appeared to have charged. However, when these tentacle pieces were tested on the skin of the forearm, stinging could be felt and the area became itchy and erythematous, suggesting that discharge had occurred – i.e. these substances do not inhibit nematocyst discharge.

Household vinegar (4-6% acetic acid in water) was found to be 100% effective in total inhibition of nematocysts. No stinging, itching or erythema was visible on the skin, and when the tentacle then had methylated spirits poured on it under direct vision of the operating microscope, no nematocyst discharge could be seen.

Vinegar was recommended for use in stings from this species.

Cyanea capillata

Vinegar was tested on the isolated tentacle of the scyphozoan, *Cyanea capillata* (the "hair jelly") in 1985 (Fenner & Fitzpatrick 1986). Surprisingly the tentacle fixed in vinegar discharged most of its nematocysts. Experiments were tried using isolated

pieces of *Cyanea* tentacle. These were mounted in solutions of seawater, vinegar (4-6% acetic acid) and methylated spirits (`metho') and studied under the microscope.

The slides with the tentacles in the seawater and the methylated spirits showed that very few of the nematocysts had discharged; they could however, be made to discharge after this treatment with other stimulants – ie. these chemicals cause no discharge, but do not inhibit discharge of *Cyanea* nematocysts. Conversely the slide with the tentacle fixed in vinegar showed that most of the nematocysts were discharged.

The experiment was also tried with tentacles still attached to the whole animal to see if there may be a `nervous' response that cause a reflex discharge of the nematocysts but the results remained exactly the same with vinegar causing discharge of the nematocysts, whereas `methylated spirits' did not. As stated above, the latter still remained capable of further stinging.

This research has little practical effect on treatment. Changes in the treatment solutions used to inhibit discharge of tentacular material can only confuse the first-aider. *Cyanea* (known as the “hair” jellyfish because of the hundreds of fine, hair-like tentacles) causes only a minor irritating sting. In the author’s extensive experience in the treatment of *Cyanea* in the Surf Life Saving Association (see the database of stings below) it is rare (if ever) to have remaining adherent tentacles on the skin. It is thus unnecessary to try to prevent further stinging before treating the actual skin pain of the envenomation.

Carybdea rastoni

In Western Australia during the 1986/87-summer season, large numbers of swimmers were stung by what appeared to be greater than usual numbers of the cubozoan (carybdeid) *Carybdea rastoni* (the “Jimble"). In the recent National Surf Life Saving Championships in March 1987 on Scarborough Beach, Perth, many of the water competitors received stings from this species. The stings themselves caused an irritating white papular skin wheal with surrounding erythema, but no systemic symptoms.

Treatment was with household vinegar (4-6% acetic acid), in accordance with the then-current recommendations from the Surf Life Saving Association. However, at that time no specific discharge experiments had been assessed, some specimens

of *Carybdea rastoni* were captured and the reaction of their nematocysts to various common substances was tested, using methods previously described.

In these experiments it was found that vinegar, a `slurry' of baking soda, and `stingose' (aluminium acetate 20% w/v) were all very effective in inhibition of nematocysts discharge in *Carybdea rastoni*. In contrast, methylated spirits caused an immediate mass discharge of the nematocysts, and saline, used as a control, had little, if any, effect on the nematocysts (Fenner & Williamson 1987).

Vinegar is an effective inhibitor of the discharge of nematocysts from all cubozoans tested to that date, including *Chironex fleckeri*. As it is cheap, easily available and safe to use, it is again recommended as the primary first aid treatment of all cubozoan jellyfish stings - simultaneously with assessment of the conscious state. Although baking soda and "stingose" (20% aluminium sulphate) appear equally effective for *Carybdea rastoni* ("Jimble") stings, the availability on the beach, and high cost compared to vinegar makes them less useful for immediate treatment (Fenner & Williamson1987).

Carukia barnesi

In 1988 after catching two specimens of *Carukia barnesi* (the Irukandji), in an experiment similar to those above, vinegar, methylated spirits and 20% w/v aluminium sulphate were applied to isolated tentacle segments. The nematocysts of this carybdeid were completely inhibited by the vinegar and 20% aluminium sulphate (“stingose”), whereas methylated spirits resulted in mass discharge (Fenner & Williamson 1987), similar to that reported in *Chironex* (Hartwick *et al* 1980).

Due to the severity of the syndrome and Barnes experience with self-stinging when his son, a friend and Barnes himself ended up in hospital (Barnes 1964), no attempts were made at the above stinging experiments to see if inhibition or “failure to discharge” had occurred after the use of the above chemicals. However, these experiments seem to continue those proving to date, that vinegar is effective when used for nematocysts inhibition on any cubozoan sting.

After envenomation with *Carukia* there has never been a recorded case of tentacles remaining on the skin. However, it has been shown that there are still remaining, unfired nematocysts (Fenner 1986b). The envenomated area is scraped with a

scalpel blade in the manner first suggested by Barnes (1960). This technique has since been modified by Currie & Wood (1995) who also found that sticky tape was just as effective as it lifted the remaining nematocysts off the skin. These could then be observed under a microscope and as each nematocyst is different and a "blueprint" of its species. This test can be used to help identify the actual jellyfish responsible, as this is not always certain; many stings occur from unseen, or unknown, jellyfish.

It would be difficult for a nematocyst present on the surface of the skin in the envenomated area that is not anchored to tentacle substrate, to be able to fire sufficiently perpendicularly to be able to penetrate through to the dermis and cause envenomation. However, because the systemic symptoms and effects are so devastating for such a small total envenomation, the author suggested to the lifesavers and lifeguards who treat these stings, that further envenomation, should it be possible, should be prevented.

The suggested treatment was vinegar poured on the envenomated area for a minimum of 30 secs, similar to that suggested for *Chironex* stings. Because of the time delay from the time of envenomation to the time of onset of symptoms is usually some 30 minutes (from 5-40mins), there is a "window of opportunity" for possible treatment. Experienced lifesavers and lifeguards will be able to identify the small mark of envenomation with its pinkish appearance, local sweating and piloerection. If the first sting should be missed, they frequently come in multiple stings (see 5.6.2) and subsequent stings should be recognised much earlier. Consequently a further suggested treatment was that a vinegar-soaked pad be placed over the sting, and then a compression bandage be placed over the area, and then covering that limb. The idea was to try to trap venom locally until the victim could be admitted to hospital, as many stings occur on isolated beaches a long distance from hospital. It is only in a hospital environment that the victims can be treated efficiently with narcotic analgesia; there is no other effective treatment - both penthrane and entenox have been used by the transporting ambulance, but without significant effect.

A trial was started for this first aid treatment five years ago. However, as the local Casualty Superintendent felt that it would not work, the trial was necessarily cancelled. There are now two new Casualty Superintendents in the same area who are willing to trial this again. As from next season, any victim stung will be divided into one group that receives no treatment except transport to hospital, and the other group who have vinegar poured on the area, a vinegar-soaked compression pad

and compression bandaging applies to the limb. In this group there will be a form filled out in triplicate, all with the same questions. The first part will be completed by the lifesaver/lifeguard who will answer questions on whether he (she) felt that the compression bandage delayed, or reduced the symptoms. The second part is completed by the transporting ambulance who will answer the same questions, and the third part is completed by the hospital, again with the same questions.

It is hoped that in a year with significant numbers of stings, that with this information from three sources, that a statistically significant result might be available.

Physalia spp.

It had previously been shown that vinegar did not cause nematocyst discharge in the single-tentacled *Physalia utriculus* species (Hartwick et al 1980)

Using the previously described technique, experimental exposure of tentacles from the "new" Australian *Physalia physalis* specimens to vinegar caused discharge in up to 80% of the nematocysts in the more proximal parts of the tentacles of some, but not all of the specimens. Conflicting results were obtained if other tentacle parts were tested, even from the same animal. Thus, approximately 30% of the total of tentacle pieces tested in this way showed some nematocyst discharge (Fenner *et al* 1993a). This effect cannot be fully explained, although nematocysts may possibly be "switched off" and be unable to discharge, as appears to happen with *Chironex fleckeri* (Rifkin & Endean 1988).

To test if vinegar caused total discharge of nematocysts, when tentacles from these jellyfish in which vinegar provoked discharge were subsequently rubbed on skin, pain and whealing still occurred. This suggests that vinegar does not totally discharge, nor does it inhibit discharge of the remaining nematocysts - which may still continue to cause envenomation the longer they are in contact with the integument of their victim.