PAPERS FROM THE STINGER SYMPOSIUM

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MEDICAL MANAGEMENT OF MARINE STINGS

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This paper deals with stings from Chironex fleckeri and Carukia barnesi. While other stings may be important in terms of numbers, these two produce severe consequences for the victim, and require further study. While both animals are jellyfish, the clinical picture produced by each animal is quite different and requires different management strategies. Without in any way wanting to diminish the very important role of prevention, I do not intend to discuss this aspect of management.

BOX JELLYFISH - Chironex fleckeri

THE PROBLEM

There are several separate problems due to the type of venom and the envenomating apparatus of this animal.

1. Envenomation method

   The nematocyst is a very efficient method of venom delivery to the prey of the animal. It injects the venom below the integument of the prey where absorption into the general circulation is swift. If multiple nematocysts are able to inject simultaneously then the effects are even more rapid in onset. Translated to the human victim, the same process can be seen. Millions of minute venom injections are made into the skin giving a large surface area for absorption. This ensures a rapid onset of action for the venom.

2. Venom effects

   The high molecular weight mixture of venom components have several effects:

   i. neurotoxic
   ii. dermatonecrotic
   iii. cardiotoxic
   iv. haemolytic
   v. immunologic

   i. The neurotoxic effect may be produced by the effect on calcium channel conductance. The effect is not a neuromuscular blockade. Whether the venom is principally toxic to the central or to the peripheral nervous system is not known. The duration of the effect may not be prolonged. The venom is quite thermolabile, being inactivated after 20 to 30 minutes at body temperature. This is consistent with the observation that neurotoxic effects are not obvious 30 minutes even after very large and potentially lethal envenomations. Expired air resuscitation (EAR) is therefore lifesaving. Return of spontaneous respiration may well occur after a short period of EAR.

   ii. Severe skin damage resulting in skin death and subsequent healing with scarring is a feature of large stings. Early repeated doses of antivenom may be effective in decreasing the amount of skin death which occurs.

   iii. The effects on the heart of experimental animals has been well documented. Clinical cases of large envenomations who have survived support the theory that this effect is not significant in humans.

   iv. The destruction of red blood cells (haemolytic effect) is not important in the general circulation, but may play a role locally in producing skin death.

   v. The immunologic effects of this complex mixture of proteins are discussed elsewhere in this issue.

3. Locality of the stinging

   The fact that the stings occur in the water may cause a problem if the victim is in deep water and rescuers are not immediately at hand. No deaths are known to have occurred because of this but the potential is present. Most victims get to the beach unaided, and it is here that treatment must commence if the life is to be saved. A quick response at this site is imperative.

4. Pain

   Pain is the immediate symptom of a sting. The pain can be extremely severe and cause sufficient distress to prevent the victim from acting rationally. Communication may be impossible. Some venom effect on the central nervous system may be operative in this extreme case.

THE PLAN

Management needs to be considered in two stages:

1. On the beach

2. In hospital

Obviously, not all stings need to go to hospital.

ON THE BEACH

A rapid response is of the utmost importance. the order of priorities is:

1. CPR if necessary.

2. Inactivate unfired nematocysts to prevent further envenomation. This means liberal application of vinegar to all sting areas.

3. Decrease absorption of the venom already injected:

   i. keep the victim still.
   ii. apply compressive bandages in life threatening stings.

   There is no evidence that compressive bandages

are effective in preventing or delaying the absorption of venom into the circulation. Snake venoms are certainly trapped at the injection site by compressive bandages. I can see no reason why compressive bandages should not work for the jellyfish envenomations. If the venom is as heat labile in vivo as is reported, then trapping it for a period of time would allow inactivation and avoid problems when the bandages are removed. The disadvantage of the bandages is that they may worsen skin death by trapping venom locally.

4. Neutralise absorbed venom with antivenom.

5. Lessen the acute pain, which is unaffected by vinegar.

6. Obtain medical advice and transport the patient to medical aid. The patient should be taken to hospital for all stings greater than one half of one limb in area.

IN HOSPITAL

Principles of management.

1. Restore and support the circulation and respiration as necessary.

2. Neutralise any venom in the circulation with antivenom. Multiple doses of antivenom may be necessary.

3. Minimise skin death:

   i. Antivenom appears to be partially effective if given in high doses.
   ii. All other treatments seem to have little or no effect. Topical and parenteral steroids do not seem to work.

4. Treat pain.

   Once in hospital, this is usually accomplished by administration of narcotic analgesics by intermittent injection or continuous infusion.

5. Treat immediate or delayed hypersensitivity reactions.

DIRECTION OF RESEARCH

1. Development of a better antivenom. There are several steps in this process:

   i. Isolate the various components of the venom in pure form.
   ii. Test each component to ascertain its specific action.
   iii. Use monoclonal antibody techniques to produce specific antivenoms to the individual actions of the venom.

   Eventually we may have several antivenoms, each being specific for a feature of the envenomation. A mixed antivenom may still be the most practical. The volume of the injection and the chance of allergic reactions will each be reduced.

2. Animal model studies to test the effectiveness of compressive bandages is needed. These will need to be done on primates ie. monkeys.

3. A method of pain reduction which can easily be applied on the beach by lay persons is needed. This may not be lifesaving, but would reduce the distress felt by all victims of Chironex stings. We know that the antivenom is highly effective in decreasing the pain and local skin reaction, but there are problems with storage and administration, and it should not be used for minor stings. Even small stings can be very distressing for the victim. A topical application would be ideal, but it is difficult to imagine a topical agent rapidly penetrating the skin barrier to reach the nerve endings stimulated by the venom. We are no further advanced in this area than before.

IRUKANDJI - Carukia barnesi

This small carybdeid jellyfish, described by Ron Southcott and Jack Barnes, and commonly known as the irukandji stinger, causes a very unpleasant syndrome. Other small jellyfish may also cause the same or a similar syndrome. Unfortunately, no study of the venom has been carried out to date.

THE PROBLEM

1. Delay in the onset of symptoms.

   Unlike the Box jellyfish, local pain from initial contact and envenomation is not marked, and the major symptoms occur after a delay of 15 to 30 minutes. This could be due to:

   i. Larger molecules
   ii. Local vasoconstriction at the sting site from venom action
   iii. Lymphatic rather than capillary absorption (do lymph nodes swell or become tender?)
   iv. Possibly more complex pharmacological/ receptor mechanisms

2. Pain.

   The pain is generalised, prolonged, and severe. How the venom causes pain is unknown. Possibilities seem to be:

   i. Direct effect on neurones causing spontaneous depolarisation
   ii. Painful contraction of skeletal muscle bundles
   iii. Damage to muscle, either direct or ischaemic.

3. High blood pressure.

   This feature has been documented in several cases now. The following features have also been seen in these cases: pilo-erection, sweating, restlessness, headache, cold extremities, decreased urine output.

   These may all be explained if the venom causes stimulation of the sympathetic nervous system. The venom of the funnel web spider (Atrax robustus) causes severe hypertension leading to heart failure and death by an action of initiating spontaneous transmitter release from nerve terminals. In the sympathetic nervous system, such an action could cause the symptoms and signs listed above. A similar action causing acetylcholine release at neuromuscular junctions with resultant inco-ordinate muscle contractions could occur. This may produce pain in a similar

fashion to that caused by the muscle relaxant, suxamethonium. No fasciculation has been described in Irukandji stings to my knowledge and so this mechanism is only a remote possibility.

THE PLAN

ON THE BEACH

1. Early recognition of possible Irukandji stings is important. The minor nature of both pain and skin reaction immediately following the sting makes this difficult. Once recognised, it is claimed that resting the skeletal muscle may decrease the severity of the subsequent pain.

2. Vinegar application is indicated to inactivate any unfired nematocysts.

3. Seek medical aid as soon as generalised pain commences.

IN HOSPITAL

1. Pain relief by narcotic analgesics has usually been necessary. It gives good relief but needs to be maintained for up to 48 hours. A continuous infusion is the most effective mode of administration.

2. High blood pressure may need treatment. I would start treatment with an alpha-adrenergic blocking drug. eg. IV chlorpromazine in 5-10 mg increments. If a more powerful effect were required, I would use a direct vasodilating drug such as hydrallizine. Phentolamine has also been used.

3. No other effective treatment has been described.

DIRECTION OF RESEARCH

Research will not be easy because the animals are not common, and large numbers will be needed to obtain sufficient venom for study. It is not even certain which animals to collect if a group of small jellyfish can all cause a similar clinical picture!

Once the venom is available, then all of the research so far done on the venom of Chironex fleckeri will need to be repeated on the new venom. This will take a considerable time unless our methods of catching the animals improve. Clinical documentation of all of the effects observable in victims is important. The stinger phone and associated initiatives are a move in this direction and after a few years we may have a better idea of the range of effects caused by the Irukandji stinger.

We are at the beginning of the jellyfish story as it applies to its effects on victims. The full elucidation of the story will require:

1. Hard work by researchers in the field and in the laboratory.

2. Funding for that research.

3. Some luck or serendipity to shorten what will otherwise be a long haul.

It may take a considerable time, but it will be well worthwhile in the end.

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Advice about jellyfish envenomation and its treatment can always be obtained via the National 24-hour toll-free Stinger Phone 008-015-160.

TOXIC REACTIONS TO INJURIES CAUSED BY THE SPINES OF THE CROWN OF THORNS STARFISH (ACANTHASTER PLANCI)

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SUMMARY

Information relating to the toxicity of the crown of thorns starfish, Acanthaster planci is presented. Examples are given of the different types of reactions which may occur following injury by the spines of this animal. Whilst the severity of the reactions tend to vary widely, they generally include; mild to severe pain (which may last from days to weeks), oedema, erythema enlargement of lymph glands and vomiting. The pattern of symptoms exhibited by patients may depend on the extent of the injury, the sensitivity of the patient to the toxin or toxins and the particular starfish. Responses of an allergic nature, involving extensive oedema and later itchiness, have been reported and these may cause discomfort and may last for several weeks. Present treatments are useful in relieving, over the short term, the pain experienced by some patients and preventing the onset of secondary infections. While the toxin responsible for these sometimes severe reactions has not been identified. One suggestion is that it may contain a neurotoxic component and even possess anti-coagulant properties.

INTRODUCTION

The crown of thorns starfish, Acanthaster planci, which has been recorded from many reefs throughout the Indo-Pacific region, is one of the most well known of tropical marine animals. Unlike animals such as the box jellyfish, Chironex fleckeri its notoriety does not stem from its ability to cause injury and the death of humans but rather its propensity to occur in large aggregations (commonly called outbreaks) which can cause the death of extensive areas of coral.[1] However, it is generally not known (particularly by the public) that the spines of this starfish are capable of producing a toxic reaction(s) which may be worrying to victims.

Acanthaster planci was first reported in the scientific literature by Rumphius in 1705[2] and classified by Linnaeus in 1758.[3] Several papers around that time made reference to the toxic nature of this starfish. Madsen,[4] in reviewing these sometimes conflicting reports, concluded that it was not known whether the animal was itself toxic as such wounds may have become infected. Concurrent with the first documented outbreaks in the late 1950's and early 1960's, further reports of the toxic nature of Acanthaster planci came to hand. In general, these reports reinforced the view that specimens of Acanthaster planci were capable of not only inflicting