ANZICS
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*We are grateful to the Queensland Regional Committee of the Australian and New Zealand Intensive Care Society for permission to publish papers which were presented at their inaugural annual meeting here in Rockhampton. The guest speakers were Dr Struan K Sutherland of the Commonwealth Serum Laboratories and Dr John Knight of SPUMS. Transcripts of the papers given at the second session on envenomation and the second session on underwater medicine appear below.*

## MANAGEMENT OF SPIDER BITE

Struan K Sutherland

I want to talk briefly about three spiders, the Red-back spider, Sydney Funnel-web spider and our Mystery spider, and to finally mention the Paralysis tick.

There are at least 2000 named species of spiders in Australia and perhaps 1000 unnamed. They all have poison glands except some of the little humped spiders. Even the Daddy-long-legs spiders have venom glands. Spiders are the most widely distributed venomous creatures in Australia and they show enormous variety. They are also one type of venomous creature that is found both inside houses and outside. This increases the opportunity for bites and stings.

### RED-BACK SPIDER

The commonest reason for giving antivenom in Australia is the Red-back spider. This spider is found the length and breadth of this country and it is not just limited to outside toilets and back sheds. It is very common in the bush. Most people are bitten when they bring the spider into contact with their skin. This is a passive action such as when old clothing is picked up or gloves are used for the first time that day. It is the female which causes the harm, the male having fangs that are too small to penetrate human skin. It is closely related to the Black Widow spider in America. In most countries there are representatives of this spider which produce the syndrome called latrodectism. Per head of population we seem to get more cases of latrodectism than any other country in the world. Some countries like Italy have a little epidemic of the spiders every 10 years whereas we have it as a perennial problem.

The main toxin is alphalatrotoxin and it specifically acts at nerve endings. It releases transmitter substance and changes to nerves can be seen with the electron microscope. At the motor end plate this loss of transmitter substance produces a patchy sort of paralysis but most of the signs and symptoms are due to the effects on the autonomic nervous system where it releases catecholamines, to produce the classic syndrome. One can be bitten on the left hand and after a while there will be quite severe pains perhaps in the left foot and the right shoulder and arm will sweat profusely and then after a few more hours things will shift around. It is a strange disease.

#### First-Aid

In fact you really do not need any first-aid. The bite is moderately painful, it is like a mosquito sting at first but it then becomes quite painful over an hour or so. The venom works very slowly, so we do not recommend pressure immobilisation, you just take the spider and yourself safely to hospital.

#### Red-back Spider Antivenom

The antivenom has been available since 1956 and no-one has died since it became available. It is a very small volume antivenom and very rarely are there any reactions to it. Perhaps I should have mentioned this earlier but we do not believe in skin testing for any antivenom for sensitivity. It is quite unreliable and it wastes time.

### THE SYDNEY FUNNEL-WEB SPIDER

A more interesting spider in some ways is the Funnel-web spider. It is unique to Australia and is the potentially most dangerous spider in the world. It is the only one which, for example, killed children in less than 90 minutes. Although bites and fatalities are rare, some three million people are at risk in the area around Sydney. The numbers of spiders are apparently increasing as people put in swimming pools and barbeques which produce more of the damp earth areas that the female spider likes. The male is the highly dangerous one. Without being sexist, this is the reverse of the normal situation in which the female spider is the more poisonous.

There are two very special features about the venom. One is that the venom affects mainly man and primates. The funnel-web venom will not kill rabbits, normal laboratory animals, mice, cats, dogs and so on. The other feature is that the venom has a specific action. Basically it attacks the outer covering of the nerves and causes spontaneous action potentials. It also disrupts some of the normal monitoring impulses coming down the nerve. The venom acts quite quickly and apart from hitting motor nerves, it attacks the autonomic nervous system releasing transmitter substance in a much more extensive fashion than with Red-back venom.

If someone is envenomed then within a few minutes they will get central effects such as nausea and headache. Muscle twitching can be extremely grotesque because everywhere the motor end-plates are firing off transmitter substance. Blood pressure can rise very dramatically perhaps up to 250 mm Hg systolic. The pulse rate of children can go over 200. Most patients develop generalised sweating.

Strangely enough it was not until 2 years ago that we finally determined why patients died. Dr Alan Duncan and Dr Jim Tibballs at the Royal Children's Hospital in Melbourne did a lot of work with CSL on monitored monkeys. The most important thing found was that sometimes when a monkey had received venom there would be a dramatic rise in the intracranial pressure which disturbed cerebral perfusion. It had the occasional effect of producing neurogenic pulmonary oedema so a monkey could have both impending brain death and pulmonary oedema. After looking back over the case histories we believe this is how many patients died. The unaided

clinician cannot detect sudden fluctuations in intracranial pressure. During this work Dr Duncan and Dr Tibballs helped greatly in the testing of the antivenom.

Funnel-web Spider Antivenom

The antivenom is different from any other type of antivenom in the world, being of very small dosage and consisting of a pure rabbit immunoglobulin. It works very quickly because it is an intact immunoglobulin. Fortunately the toxin that it is going to attack is mostly still on the outside of nerves so it is easily reached. Experimentally one can see a reverse occurring within 2 or 3 minutes.

The first time the Funnel-web antivenom was used was for a 49 year old man who was transferred from the Ryde Hospital to the Royal North Shore some 90 minutes after he had been bitten by a Funnel-web. When admitted he was comatose with pupils widely dilated. They had great trouble controlling him because he was extremely irrational and tore out his IV line and so on. On admission his blood pressure was over 200 and his pulse rate was 160. He had 2 doses of antivenom and within about 30 minutes or so his blood pressure was down to normal and he had regained consciousness. Dr Malcolm Fisher reported that half an hour later monitoring was no longer required and the patient was sitting up in bed waiting for his dentures to come in so he could go on television. This shows the speed at which the specific biological antidote can work in a situation where the toxin is easily reached. The antivenom has been used a number of times now.

There is another Funnel-web which we have kept fairly quiet about which is found all the way up from Central NSW right up north to Toowoomba and it is probably more dangerous than the Sydney Funnel-web. It is the tree dwelling *Atrax formidabilis* which is much bigger and the female is highly poisonous. Bites by this spider are very rare because it inhabits areas where there are few people. Fortunately, the antivenom made against the Sydney Funnel-web spider neutralises this spider's venom.

A MYSTERY SPIDER

There is a new disease which we really first became aware of some 5 or 6 years ago when a housewife suffered a strange injury. She lived in a farm house in Northern Victoria. She went out mid-morning one day and planted a couple of bulbs immediately outside her back door. That was the only time she left the house that whole morning and the actual planting only took a few seconds. About half an hour after she had planted the bulbs her hand became painful. Over the next 24 hours she developed a critical illness with severe full thickness damage to the skin of the hand and a systemic illness involving diarrhoea, vomiting and extreme toxicity. There was a total lack of positive laboratory findings. A marked feature of this case was the severe pain. She had had her second baby four weeks beforehand and found the pain of this episode something like ten times worse and wanted her hand cut off.

Since then, we have collected perhaps 35-40 cases of various degrees of injury in which often the bite is not noticed or is considered very minor. They have then progressed to either just superficial injury which resolved or full thickness skin loss.

One severe case involved a little girl of two and a half. She went into a storeroom with her father just as the school was opening up in February in Melbourne. She came out and sat down looking at the top of her foot, she just had a thong on and said something had bitten her. After a while she ignored it and ran round quite happily for a few hours but then became ill. Over the next 24 hours she developed a wide area of cyanotic skin that went on to break down to full thickness necrosis. At the same time she developed a systemic illness which was equated to cholera. She required something like a quarter of her circulating volume to be replaced as an emergency

I will summarise what we have gathered from these cases.

They have occurred in all eastern states of Australia. The problem is that the creature involved is usually not found. This is quite different to bee sting and snake bite and so on where one generally at least sees the culprit. There are variable changes that occur at the bite site. Possibly there are three or four different types of spiders that are producing these effects. It might be the spider is sometimes injecting a lot of venom and at other times not.

Some cases develop quite marked local pain and a sterile cellulitis. It may be very very painful for 24 hours and then the area returns to normal. Sometimes small punched out neighbouring lesions are seen as though the creature crawled along and made a couple of bites. Gardeners may have such injuries by Thursday if they have been gardening during the weekend without gloves.

Sometimes there are horrifying local changes with gross oedema. When the surgeon removes the dead tissue it looks as though a cytotoxic drug has been injected subcutaneously, because the fat is liquified and it just pours out. It is these severe cases which are associated with the general illness. There is no temperature initially, they might be in fact hypothermic. They can be quite demented with pain. There may be shock and quite prolific diarrhoea. The laboratory investigations really have not helped us other than to exclude things. The biochemistry and coagulation profiles are basically normal. Sometimes the white cell counts are elevated and there is a toxic suppression of neutrophils change but nothing that is particularly special. In some cases we have found the IgM has been elevated but that has not been consistent. All cultures of blood and lesions have grown nothing to date and the histology of the ulcer margins has been unproductive.

The most likely culprit at the moment is the White Spotted spider *Lampona cylindrata* which is very common right around Australia. It is a grubby looking little spider which drags its cylindrical tummy along. Often it is found in bathrooms or bedrooms. We have got definite cases of bites by this spider that have broken down and caused marked ulceration. That is the end of the story to date.

We are just waiting for more cases as we have to have the proven culprit to work on and then get support to work on an antivenom. In the meantime, as the cases come along we cannot do anything about them apart from photograph them.

AUSTRALIAN PARALYSIS TICK

Just for completeness since we are talking about spiders and arachnids, mention should be made of the Australian Paralysis tick which is found in a wide area from Mallacoota to Cairns. The adult form is particularly dangerous because as it is engorging and burying itself temporarily in the skin of a human it may release a very potent neurotoxin. It is an unusual neurotoxin because it works extremely slowly. One can inject it into a dog and nothing will happen for 18 hours and then the dog will start getting paralysed. This toxin acts presynaptically and reverses quite slowly. First-aid is to gently remove the intact tick. There is an antitoxin but it is one type of paralysis which recovers, in most cases, with just standard intensive care. Once the tick is removed, the victim generally improves quite rapidly.

## THE BOX JELLY FISH STING

John Williamson

By any accounts *Chironex Fleckeri* is a significant animal and the number of fatalities that it has produced will support that statement. The Northern Australian and Western Indo-Pacific box jellyfish has now been responsible for 68 documented human deaths in this country, 70% of whom were women and children, due to their generally smaller body mass and hairless skin. The whole crux of the problem of the box jelly fish is related to the speed with which this animal can produce envenomation in human beings and of course in its natural prey. It has already been pointed out today by Dr Sutherland in his opening address that animals including this one have no interest whatever in human beings. All envenomations by this animal are due to accidental encounters and it is the human's fault. The animal does not attack. It is pertinent to say that none of these fatalities have received any effective form of resuscitation to date.

When a snake envenomates, or a spider or a blue-ringed octopus or a cone shell, the venom is all deposited in one place so there is a limited surface area, although obviously an effective one, between the venom parcels and the blood bearing tissues and the lymph bearing tissues where the absorption occurs. However, with the box jelly fish, the venom is divided into many thousands of millions of tiny parcels spread over the architecture of the tentacles. The nematocysts occur on transverse bar-like patterns on the tentacles. Consequently, when envenomation occurs the venom bearing nematocysts or microbasic mastigophores, as our colleague Bob Hartwick likes to call them, discharge their venom in multiple million tiny doses and inject them into the victim in many different sites at the same time. The trajectory of most of these nematocysts is something just under a millimetre which will carry the venom into the subepidermal, richly vascularised tissues. This arrangement of envenomation offers an enormous area for absorption so the speed at which high blood levels of toxin are achieved following a serious envenomation by one of these animals is extremely rapid. It is measured in minutes.

Small victims die very rapidly on the beach. A large number of the fatalities and the non-fatal stings involve the Aboriginal population in this country.

In a survivor of a serious sting, there is a much more vigorous inflammatory response. One can see the actual cross hatched or ladder pattern which is diagnostic of the sting of this jelly fish. The only other jelly fish that may produce a pattern like this, and it will not be as dramatic, is the fire jelly.

Three to ten per cent acetic acid in water (vinegar), as far as our studies have shown, renders the nematocysts of the box jelly fish irreversibly inactive within a period of about 30 seconds. Nothing we have been able to do can provoke them to fire following exposure to that concentration of acetic acid. Methylated spirits causes a massive discharge of nematocysts from the tentacle of the box jelly fish. If that tentacle happens to be applied to a human victim, then there will be increased envenomation. When the tentacle has been treated with vinegar (4-6% acetic acid), it does not matter whether it is brown vinegar or white vinegar, and then methylated spirits is applied there is no response. Time prevents me from discussing the role of vinegar in the treatment of other jelly fish stings.

I must emphasize that it is important to understand that vinegar does nothing for the pain. It inactivates the unfired nematocysts but it has no effective role to play whatever in the treatment of the pain of the sting of the venom that has already been injected. Vinegar does work for other jelly fish but certainly not for all. Vinegar certainly renders the nematocysts quite harmless and useless.

We advocate, purely by extrapolation and without any experimental proof at this stage, the use of compressive immobilisation. We would advocate in any serious sting, and certainly any sting where resuscitation becomes necessary, the immediate application of vinegar followed by the application of a compressive immobilisation bandage over as much of a sting area as possible. Remember compressive bandages are not tourniquets. This treatment appears reasonable to us at this stage while we await experimental confirmation that this will trap the venom in the skin. However, remember this has to be done immediately, because the speed of absorption of this venom is such that unless it is done immediately it is unlikely to have any greatly beneficial effect.

Critics of this approach, in the absence of experimental verifications could well say that one is not doing the best for the patient because this will trap the venom in the skin and will produce increased pain. The answer is, I feel, that priorities are important. If the victim is unconscious increased pain will not matter. If he or she has been seriously stung, it is better to have severe pain than to run the risk of losing ones life. The dermato-necrotic, or skin killing, effect will have, theoretically at least, been made worse by this action. There is no doubt about the powerful skin killing effects of the venom. However where life is threatened, this may be the lesser of two evils. The circumstantial evidence that we now have, which is extensive and strong, shows that the administration of antivenom will reduce both the pain and the skin killing effects. Obviously resuscitation takes absolute priority. Our recommended emergency treatment on the beach now consists of vinegar dousing, "pressure-immobilisation" of the sting area, and application of ice-water through the compressive bandages for partial pain relief in the conscious