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 held in Rockhampton. The Guest speakers were Dr Struan K Sutherland of the Commonwealth Serum Laboratories and Dr John Knight of SPUMS. Two sessions were devoted to envenomation and two to underwater medicine. Transcripts of most of the papers given during the first two sessions appear below.

MANAGEMENT OF SNAKE BITE IN AUSTRALIA

Struan K Sutherland

Introduction

The important thing about snake bite and indeed all our venomous creatures is that man being stung or bitten is an accident. By and large all the venoms and all the important animal toxins are to paralyse prey so that, for example, the snake does not have to fight with a marsupial rat. It can bite it and that creature will be paralysed and helpless within a minute, sometimes in seconds, and it can then be eaten. If man gets in the way it is an accident and the same toxins can have the same serious effect.

Fundamentals

Unfortunate things sometimes happen in managing a snake bite because people do not really consider the fundamentals. It is very unusual to have two identical cases because of the large number of variables. The first variable is the creature that bites. It may be a highly poisonous creature or it maybe one that only produces a small amount of weak venom. Secondly, the dose of venoms will vary enormously. The amount of venom that the snake or spider puts in may be zero or it may be a massive amount.

This brings me to a very important point. The presence of fang marks does not mean that a significant amount of venom has gone in. We must try and break the reflex action, "Look fang marks. We must give antivenom", because with a snake bite, generally speaking, only one in ten cases becomes seriously ill.

The site of the bite will determine to some degree the rate of absorption of the venom as will the health of the person, the blood supply and lymph drainage of the area. Then one has to take the size of the patient into consideration. Obviously a small child bitten by a large snake will have more venom per kilogram of body weight and will become more seriously ill than would a very healthy 20 stone man receiving the same amount of venom.

Another danger that sometimes occurs is that people think that when giving antivenom to a child, the child must need less antivenom than an adult. It is just the opposite. Because of the child's lower body weight, the child might need a lot of antivenom to neutralise the relatively larger dose of venom. Antivenom is the only specific antidote to any of our snake toxins. There are no pharmacological agents that will significantly reverse the effects of venom. So if there is antivenom available and the person is significantly poisoned, antivenom must be given.

How much antivenom should one give? One really cannot tell before treatment. If one does not give antivenom when it is indicated, the venom may win and kill the patient. The amount of antivenom has to be balanced. There must always be an excess of antivenom. Envenoming is a very dynamic business. A snake bite may produce a severe coagulation defect. If one takes a sample from the patient when he or she comes through the Emergency Department and the result of that investigation comes to the ward an hour or so later and the coagulation profile may be normal. That really does not mean anything because that was what was happening an hour ago in Casualty. In the meantime considerable venom has been absorbed and there may be a very severe coagulation defect. So the dynamic aspect of envenoming must be considered all the time. This is terribly important when a patient is transferred from one hospital to another or from the Emergency Department to the Intensive Care Unit. Unless someone stays with that patient all the time, the new doctors are quite often unaware of the subtle changes that have occurred.

Most venoms are specifically designed to paralyse and they do it in a phenomenally wide range of fashions. Snake venoms are a little bit different in the fact that, apart from having toxins that will cause paralysis, they have a lot of other active components as well. For example, Tiger snake venom and Taipan venom have at least 18 separate components. Some of these components cause severe clotting disturbances. This allows you to distinguish between snake bite and some other envenomations. A combination of paralysis and coagulopathy must be due to snake bite. It cannot be spider bite or any other bite.

If you want to take a deep breath, a nerve impulse starts from your brain, goes down the nerve and releases a transmitter substance at the end of the nerve and the muscle will then contract. That is putting it in its simplest fashion. Anything which can stop that message getting down and causing the muscle to contract will cause paralysis. There are many ways this is done. Snake venom does it at several sites. For example, both Tiger snake and Taipan venom have three separate neuro-toxins. Two hit post-synaptically acting on the acetylcholine receptors and work pretty quickly. The third is a much bigger, presynaptic, toxin which works very slowly. It gets into the membrane at the end of the nerve and causes steady changes. The dramatic new finding of recent years is the realisation that this big neurotoxin also attacks skeletal muscle. About seven or eight of our most important snakes all have this component which will cause rhabdomyolysis, so in delayed cases there is rhabdomyolysis leading to renal failure from blockage of renal tubules with myoglobin. On the other hand a certain number of our snakes do not have this. Brown snake and Death Adder do not cause rhabdomyolysis. The clinical differences between different types of snake bite are now being established. Hence the importance of venom detection kits.

Snakes

We can be very proud of our snakes in Australia. We have the most impressive collection in the world. As one goes north the variety, size, and shall we say deadliness of our snakes steadily increases. Tasmania has got a pretty nasty Tiger snake which is fairly sluggish but that State needs only one antivenom. In Victoria there are also Brown snakes, Copperhead snakes and the Red-Bellied Black snake. We require two antivenoms in Victoria. Once across the border, there are broadly five distinct and extremely dangerous species of snakes all requiring their own individual antivenom. By the time one gets to Queensland there is quite a collection of very, very special snakes, including the three most dangerous snakes in the world.

Snake Identification

Only one in ten cases of snake bite is the snake correctly identified. Sometimes it is mistakenly identified even by the so-called experts. The patient may then be given the wrong antivenom and may die. The problem of identification of snakes has been solved to some degree by venom detection kits. In reality many people do not see the snake that bit them or they are bitten at night or they were walking through grass and they just see the tail disappearing. They may be children who cannot identify the snake. Some of our common snakes are quite confusing in their appearances. There is not much point knowing the difference between the Brown snake and a Tiger snake when the difference can only be determined by looking at the anal scales. If you have just been bitten by a snake, the last thing you are going to do is get on the ground and examine its fundamental orifice. The Tiger snake is the commonest cause of serious snake bite because it is found around the more heavily inhabited areas of Victoria and New South Wales. The standard Mark I banded Tiger snakes are reasonably easy to identify. However these snakes are often unbanded. If one saw such a snake and did not know snakes one might call it a Brown snake, and that really would not help the patient.

The common Brown snake is the second most important cause of snake bite. Its venom is the second most potent of all the snakes in the world. When they are young, they often have stripes for the first eighteen months. So when a child says it was bitten by a snake with stripes the doctor might dismiss Brown snake envenomation.

The Red-Bellied Black snake is the least dangerous of these snakes. Generally speaking, one holds back antivenom if someone is bitten by a Red-Bellied Black snake.

The Copperhead is the only venomous Australian snake found above the snow line.

The Death Adder which has a highly neurotoxic venom, is a bit different to our other snakes. Most snakes will get out of the way if they are awake and sense people approaching. Death Adders do not, they stay perfectly still.

Our heaviest snake is the King Brown which causes occasional deaths amongst aborigines.

The Taipan is our longest and most venomous snake. Very few survived an effective bite by a Taipan before antivenom was available, at least 8 out of 10 died.

The Small-Scales or Fierce snake disappeared as far as man was concerned for 100 years. They were known last century and then it was not until 1976 that live specimens were found in Western Queensland. When Jeanette Covacevich sent us the venom from this snake, it killed mice no matter what dilution we employed. It took six weeks or so before we could determine an exact lethal dose 50% (LD50) of this venom. It is far more lethal than anything described in the literature.

Venom Detection

Venom detection kits are held in most hospitals now. The Flying Doctor can actually do this assay on a plane. It is about the only laboratory test that I think doctors can do without prior training. Doctors are pretty rotten technicians. Venom detection is very important because if one knows what venom is present at the site, then the correct antivenom can be given to the patient when he gets ill. If you do not know, in most parts of Australia, the first dose you have to give is polyvalent antivenom. It is a big volume, 50 ml of antivenom versus 4 ml say for Brown snake antivenom. It is very expensive. Antivenoms are free to the patient so that taxpayers are paying $300 or so per ampoule versus much less for the other antivenoms. Serum sickness is much more likely with delayed sickness a ten per cent possibility with polyvalent antivenom. So the less antivenom one gives the better.

The venom detection kit is very simple with six capillary tubes all joined together on a syringe. They are coated inside with a very special antivenom. It is 1 molecule thick and covalently bound to the glass. A swab from the bite site, or a little bit of clothing, are the ideal samples because of the high concentration of venom. Blood or urine can also be used. The samples are drawn through the capillary tubing, and left 10 minutes. If there is a particular venom then it will stick to its antibody or antivenom on the inside of the tube. If there is venom present in the sample there will be a colour change.

Venom Lethality

The maximum output when the Small-Scaled snake is milked is able to kill a quarter of a million mice. That is really quite phenomenal. The Taipan kills 150,000 mice. The average output from a Taipan is 120 mg. Now 120 mg of Taipan venom will kill 12,000 guinea pigs. Try imagining 12,000 dead guinea pigs. If it bites a rat, the Taipan does not hang on to it, it knows the rat is only going to go a few metres and it just cruises off. We have gone from about 15 deaths from snake bite a year down to about one every two years. The most tragic recent death was a small boy mauled by a Taipan. He got multiple bites around his buttocks and groin. I think he was probably dead within 10 minutes. He would not have had very much hope with a massive envenomating in an area not accessible to first aid.

The Indian Cobra is about tenth on the list. It is the first overseas snake that gets into the list. It kills about 10,000 people a year. The most dangerous American snake is

capable of killing 3000 mice. The potential killing power of Australian snakes leads the world.

First Aid

Until a few years ago we could not research first aid properly because we could not follow venom in the serum of patients or experimental animals. Then radioimmunoassay was developed. For the first time ever in patients, alive or dead, my colleagues and I could measure all the types of snake venom and also the neurotoxins. This meant that coroner's cases could be cleared up and also one could study first aid. When we put venom in little monkeys that were fully conscious and could move we could reproduce the syndromes seen in children two years old or so. We could see how the venom peaked and when paralysis started. Over a two hour period venom peaks in the plasma and after two hours it is getting into the nerve tissue and causing paralysis. We could give them antivenom and they would recover. This allowed us to put venom in monkeys and try out all sorts of first aid.

For a number of reasons arterial tourniquets are not a good thing for snake bite, or other envenomings. They are hard to put on and very painful. Most people cannot stand an arterial tourniquet for more than about five minutes unless they are under an anaesthetic.

An arterial tourniquet stops venom movement but when it is taken off after 30 minutes the venom surges away. It was an accidental finding that if you put firm pressure over the bitten area, and kept the limb still then the venom stayed within the tissues.

When venom is injected it has no blood supply. It is an avascular blob of liquid. If we can empty the lymphatics and capillaries around it, it will stay there. The limb must be kept still to prevent the venom moving.

This brings me to a very important point on first aid and that is when to take the first aid measures off. Take them off when the situation is under control, with antivenom available, the drugs that are going to have to be used and resuscitation equipment all ready and tested. Ideally one gets a venom detection kit, cuts away over the bitten area, takes a swab and puts the first aid measures back on until the correct antivenom is available. What should not be done is to leave them wrapped up like mummies for eight hours in the Intensive Care Unit while waiting for signs of envenomation to appear because the venom is just going to sit in that limb until unwrapped. The neurotoxins are not destroyed, they persist in the body.

It is a very unscientific method of first aid because everyone will put the pressure on at a different pressure. If there is no crepe bandage available pantyhose seems to be quite ideal. One does not have to bandage the whole of the limb. We like to start below and go upwards because that empties the vessels but only a little of the venom is pushed centrally. If the patient says the bandage is painful, the bandage is too tight. If you are going to get bitten by a snake it is best to get bitten on the hand because you can then walk back to civilization.

Signs and Symptoms

If someone has received a significant amount of venom and no first aid has been given they will be getting sick within about 5-10 minutes from the time of being bitten. Very rarely does one get a child with multiple bites. We had one in Melbourne a couple of weeks ago, with bites from a Tiger snake all over his calf. He was critically ill.

The time immediately after the bite is often the time of panic. We are trying to take panic out of snake bite. From one to three hours is when most snake bites are treated, and cured with antivenom. Some of the best cases are treated in a small country hospital by a country GP who treats three or four cases every summer. They are not written up because they are treated promptly and there is nothing special about them. We only hear of them on the antivenom reports.

After three hours an untreated case can be in real trouble with paralysis, coagulation problem and myoglobinuria. Over the past 100 years there are reports of patients who were not paralysed, and passed very dark urine or highly coloured urine and then went into renal failure. Everyone thought that was haemoglobinuria. But we now know that it was myoglobinuria.

Giving Antivenom

If one gives pre-medication before an anaesthetic to make the course smoother, why not give it before an antivenom? Antivenoms are improving all the time but a proportion of the population do have reactions to antivenoms. It has been established that with good pre-medication and only giving antivenom when it is indicated the reaction rate is acceptably low. If a person has no history of allergy a little non-sedative parenteral anti-histamine, not a big dose of Phenergan if you can avoid it as they might go to sleep from it and a touch of adrenaline. That is what we recommend for a person with a healthy cardio-vascular system. Steroids should also be given if the patient has a history of allergy.

Allergy is a strange thing. Often it is like what happens with bee stings, a person might have a severe anaphylactic reaction in childhood or several years ago but the allergy seems to have disappeared. We have a few snake handlers who have had severe reactions in the past, who when they are given pre-medication take the anti-venom without any reaction. Others will have had delayed serum sickness twice before and are given antivenom the third time and do not develop delayed serum sickness. It is all a bit of a mystery how allergy waxes and wanes. On the other hand snake handlers often become highly allergic to the venom. So when bitten by a small Tiger snake, say one foot long, and the person will have an anaphylactic reaction and die. That has explained a number of snake bite deaths.

Points to remember

Pressure bandage first aid immobilises venom. When the bandage is removed venom (if present) is absorbed. Only those patients who develop symptoms need antivenom. How much antivenom to give depends on the clinical response