

physician's comprehensive examination, and investigations, including audio evoked responses and visual evoked responses. These parameters are assessed by the physicians totally independent from the hyperbaric oxygen facility. After the course of treatment the same parameters are again measured. A full and frank explanation is given to the patients so as not to exaggerate their expectations, and they are asked to agree to the pre- and post-treatment measurements with the acceptance that this data is for research purposes.

### Teaching and Demonstration

These have proven useful for a number of resident doctors and medical students, police divers, senior scuba instructors and the Australian Antarctic Division personnel.

### Burns

I had to "knock back" the only patient with severe burns referred for treatment because he was too obese to fit through the door of the chamber.

I hope a larger facility will be available in the future as I feel that hyperbaric oxygen therapy has a role in modern medicine.

## ENVENOMATION

CJ Acott

Over the past three years 30 suspected cases of envenomation have been admitted to the Intensive Care Unit (ICU) at the Rockhampton Base Hospital. Nine of these have required anti-venom. After studying these admissions I can state that the best time for touring Central Queensland is between July and September, if one wants to avoid the nasties.

Anti-venom for snake bites is the main use of anti-venom in Rockhampton. A third of all our snake bite victims have required treatment. Four sea snake victims have been admitted over the past 5 years. One of these has required anti-venom. This was a two year old girl who was bitten, savaged would probably be a better description of the attack, on her left foot and ankle. Poor first aid measures were used, and the child required intubation 40 minutes after being bitten. The snake was identified as an *Astrotia Stokesii*.

Since then three other people have been bitten by sea snakes. One victim was snorkelling and thought the snake was a large piece of wood. I think he was rather surprised when the piece of wood turned around and bit him on the forearm and on the wrist. Another victim was walking in shallow water and felt something bite his foot. He lifted his leg out of the water, and there was a snake curled around it. Good first aid measures were applied immediately and he was brought into hospital.

One is always likely to see sea snakes off the central Queensland coast when diving and because of this and the four victims of sea snake bite I have developed an interest in sea snakes.

### **SEA SNAKES**

The Hydrophiliae (true sea snakes) are recognised by their flattened paddle-like tails. They grow to variable lengths, some can be more than 2 metres long. They are

mainly fish eaters, and are usually bottom feeders, however, the *Perlarmis Platurus* (Yellow Bellied Sea Snake) is a surface feeder. They are preyed upon by sea eagles, sharks and seals.

Lacking the ability to regulate their own body temperature, they are often found sunning themselves on the surface. This will only elevate their temperature slightly. They cannot breed or survive in water below 20°C, hence their distribution in tropical and sub-tropical waters throughout the Indian and Pacific Oceans.

The most widely distributed of all the species is the *Pel. Platurus*. Local distribution around any reef is patchy and is probably due to seasonal shifts which determine winds, currents and food supplies. They live in sea water, but captured ones have been kept alive in tap water. Some species of the *Enhydrina Schistosa* have been found in fresh water lakes of Cambodia and the Philippines.

There are strong evolutionary links between the Tiger snake and the Hydrophiliae. Baxter and Gallichio found that there was cross neutralization in vitro between some sea snake venoms and the Tiger Snake anti-venom. If no sea snake anti-venom is available, Tiger snake anti-venom can be used instead.

Sea snakes have one lung which extends into the abdominal cavity. This is divided into three sections, the two front sections are rich in blood vessels, while the posterior section acts as a gas storage organ, taking no part in gaseous exchange.

They are capable of diving to depths of 100 metres, and their maximum voluntary submergence time is two hours. Anaerobic metabolism is only used in an emergency. The sea snake's skin is unique. It has a respiratory function. Not only is a third of the snake's O<sub>2</sub> requirements taken up during a dive through the skin, but CO<sub>2</sub> and Na are eliminated.

Statistics of attacks and their subsequent outcome are difficult to obtain. There are probably thousands of attacks each year, the usual victim being fishermen in South East Asia.

Generally the species from Australian reefs are relatively inoffensive and only rarely will they attack when provoked. However catching, restraining or striking them may convert curious behaviour into an aggressive attack. Stay clear when they are feeding, or mating. If they are swimming in pairs, this usually indicates that they may be mating. Treat them with respect and handle them gently if you have to. Application of commonsense often prevents trauma both to you and to the snake.

The bite is usually painless, the victims hardly realizing that they have been bitten. Defensive bites rarely release venom. In the envenomating bite most venom seems to be released at the first bite. The *Astrotia Stokesii* (Stoke's Sea Snake) can inject large amounts of venom in each of seven successive bites. After their venom stores have been depleted it takes seven days for the supply to be replenished. The venoms of sea snakes are interesting. Fish and mice are susceptible, as well as man, but the reef eel is not. Broadly speaking they have either neurotoxic or myolytic properties or a combination of both.

Sea snakes can open their jaws wide enough to inflict a good bite. Their fangs are small and fragile and often break off and remain in the wound.

Reid pioneered the study of sea snake envenomation while working in Malaya in the 1950s and 60s. Fifty per cent of his patients died, while the remaining victims took up to two months to recover. All deaths were due to respiratory failure, renal failure (from myoglobinuria) and hyperkalaemia. Reid developed his "2 hour rule". This differentiated envenomated cases into 'serious' and 'non-serious'. Serious envenomation was indicated by myalgic pain (especially the neck muscles), ptosis, ophthalmoplegia, myoglobinuria and a leucocytosis of greater than 20,000 developing within two hours. Serious cases usually needed 3,000 units of anti-venom statim and up to 10,000 units in all. Non-serious cases usually required 1000 units statim and up to 3,000 units. Each ampoule of sea snake anti-venom contain 1,000 units.

## LAND SNAKE ENVENOMATION

### Case 1

A 74 year old man was bitten on his middle finger. The bite site was extremely hard to see. The medical registrar, an Englishwoman who had only just started work at the hospital, was summoned to Casualty. She took some blood, put in an IV line and then went to ring someone for advice. No first aid measures were applied.

I heard on the grapevine that there was a snake bite victim in Casualty, so I wandered down there. By the time I arrived the patient was drooling, dyspnoeic and had ptosis. His IV line site was bleeding profusely. A crepe bandage was quickly applied to his arm and the contents of one ampoule of polyvalent anti-venom was given.

The venom was identified as that of the Taipan. His coagulation profile was grossly abnormal and this was used as an indicator for our anti-venom therapy. He required two further ampoules of Taipan anti-venom. He returned to the ward after two days in ICU and went home three days later. He still had a residual ptosis at the time of discharge, which subsequently recovered.

### Case 2

A two and a half year old boy was bitten by a brown snake on his left foot. There was a large area of swelling and bruising around the site. The bruising and swelling became worse over the next 24 hours. He was also complaining of pain in his calf muscles. There were no signs or symptoms of systemic spread of the venom although local reaction to the bite was severe.

The brown snake is a very venomous snake, and after lengthy telephone conversations with Dr Struan Sutherland we decided not to give the child any anti-venom despite the severe local reaction. This was the correct decision as by the third day the local reaction had subsided.

It is of interest that after the child

had been bitten his mother applied a very firm crepe bandage. Perhaps the immediate application of the bandage and splint localised the venom and prevented its systemic spread.

### Case 3

A four year old girl was on a ventilator when I first saw her. She had been found, one morning, unrousable in her bed. On admission to hospital she was drooling, had ptosis, and a flaccid paralysis with rapid shallow respiration. There were two small fang marks on her left foot. She was afebrile. She had had a viral-type illness two weeks prior to admission. She had been well the day before.

A battery of various tests was sent off, including a venom assay on both blood and urine. However no swab was taken of the bite site. All the results were normal (including the venom detection), except for her liver function tests. All the liver enzymes were elevated, but she was not hypoglycaemic, nor did she have a raised blood ammonia level. Her respiratory status deteriorated and so she was intubated and put on a ventilator, when the epiglottis was seen to be normal. It was noted that she had a palpable liver after ventilation was commenced, this had not been noted before. A provisional diagnosis of Reye's Syndrome was made, and a liver biopsy contemplated, but thank God not done.

I first saw her two days later after admission. I was not very happy with the diagnosis. The fang marks on her leg worried me, as well as other aspects of the history and examination that had been overlooked. She had been noted to be passing dark brown urine, this was thought to be traumatic haematuria because it followed the insertion of a catheter. Her renal function had dramatically deteriorated over the 48 hours since admission (renal failure is not a feature of Reye's syndrome). The lack of hypoglycaemia and hyperammoniaemia did not support the diagnosis. I had CPK levels done on the blood samples taken on admission and I contacted Dr Struan Sutherland. He advised swabbing the bite site even at this late hour, because there might be some residual venom still present. The results were amazing. The bite site was positive for Taipan venom, the CPK levels were greater than 46,000 both on the day of admission and the day I first saw her (the normal in our laboratory is up to 200). I telephoned Dr Sutherland again and he advised giving 2 ampoules of Polyvalent anti-venom. The child was awake and responding six hours after the anti-venom had been given. She was off the ventilator within the next 48 hours. She went home 96 hours after the anti-venom had been given. A truly remarkable recovery from Reye's syndrome!

Hypoxia and hypercarbia were the probable causes of the raised liver enzymes. I cannot explain the negative result from the venom detection kit (VDK) on the blood and urine samples, except that I regard all results coming from our laboratory with a high degree of suspicion unless they correlate with what is happening clinically to the patient.

### Case 4

A 28 year old female was hanging out her washing and felt something bite her foot. She saw a tail disappearing into the scrub. No first aid measures were applied. She was brought into hospital, where no swab of the bite site was taken but a VDK test was done on her urine!

On admission she had severe abdominal

pain with palpable lymph nodes. She had also vomited and was extremely sweaty. I thought she had signs and symptoms of systemic envenomation so one ampoule of polyvalent anti-venom was given. This all occurred within 40 minutes of her being bitten. During the next 30 minutes all her signs and symptoms disappeared. All the investigations that were done were normal. She left hospital 48 hours later.

THE NATIONAL SAFETY COUNCIL OF AUSTRALIA, VICTORIAN DIVISION AND THE UNDERWATER TRAINING CENTRE

Ken Heynatz

The National Safety Council of Australia, Victorian Division, (NSCA) is the only organisation that I know of that offers both a retrieval service and hyperbaric treatment for patients. This is an overview of the operations of the NSCA, so that you may understand how we can offer this unique service. Those of you who have heard past presentations and read any recent writings, count this as an update, and please bear with us.

The National Safety Council of Australia, Victorian Division, is an independent, non-government, non-profit organisation, whose charge is to promote safety in all walks of life. To fulfil this charter, the NSCA, Victorian Division, provides vital services over a wide range of specialised areas at the highest possible professional standard at the lowest possible cost. The general membership of the Victorian Division, consists of public bodies, companies and private members. Some of these members are elected to the State Council, which is an honorary group of 31, who meet annually or as required. The State Council elects an executive committee, who, through the executive director and deputy director, pursue the goals of the Council with the various facilities at their disposal. The NSCA is a company limited by guarantee, with a turnover now exceeding \$16 million, generated almost exclusively through the fees for the services provided. The Victorian Government grant for safety and the membership fees, account for less than 2 per cent of the annual income.

The company employs over 180 people to cover the diverse range of services to industry, government and the community. The consultancy services offered from our Melbourne Head Office cover occupational health and safety in many industries. The consultants are highly qualified in occupational medicine, business administration, mechanical and civil engineering, ergonomics and fire prevention, etc. The staff are also trainers and educators. To assist in this area, video technology has been incorporated into the training services as well as on-site cameras for training. We have developed a sophisticated audio-visual production and post production centre at Morwell.

On the more active side, the Council is engaged in provision of industrial emergency services in the power stations of the LaTrobe Valley. We maintain a 24 hour a day, 365 day a year presence, to help with first aid, fire protection, fire prevention and emergency services. To maintain a call-out ability for the many varied emergencies that we are con-

fronted with, requires a large variety of support vehicles. These include rescue trucks, fire-fighting vehicles, personnel carriers for all sorts of terrains. We maintain and replenish various caches of stores and equipment throughout Victoria, which may be needed in times of emergency. Most of our ground support vehicles, support plants and equipment are fully maintained and serviced in our Morwell workshops.

The resources available within the Underwater Training (UTC) for use in training and emergencies, include a 52 foot Randal diving craft, currently being leased in conjunction with a sports diving organisation, for standby and rescue operations in Bass Strait, a 47 foot diving craft equipped with high pressure (HP) air banks, compressors, mixed gas banks, lifting arms, cages, and whatever is necessary for deep diving as well as numerous small craft, from a 24 foot aluminium jet boat down through semi-inflatable boats and zodiacs, the small "rubber duckies" that we use in diving operations as safety craft.

Training and diving includes the whole gambit of equipment. Air scuba used by the sports diver and the shallow commercial effort. Oxygen rebreathers used by our parascue unit. Kirby Morgan band masks and helmets which are used for surface supply diving. We have mixed gas helmets and rebreathers for bell diving as well. We carry a complete range of tools, both manual and hydraulic, which are used operationally and in the training realm. Underwater cutting and welding equipment, non-destructive testing inspection, underwater video, are just a few of the other sidelines. All diving is carried out to Australian standards, using Royal Navy tables and USN tables as appropriate and, so far, without any incidents. We safely train for, and work up to deep diving. We maintain an operational diving team, capable of diving to most depths using Drager FGG3 mixed gas equipment and Kirby Morgan with surface air supplies. We have two deck decompression chambers and a bell simulator. Again, all our equipment, whether for working dives or for training is maintained at our centre at Morwell.

We have a 10 metre diving tank for initial dives. This is also used with our ditched helicopter simulator for underwater helicopter escape training. This course, where trainees are strapped into the simulator and rolled over underwater, is designed to give confidence and understanding to those people who fly over water in a helicopter and who, one day may be unfortunate enough to be involved in a ditching and have to find their way to the surface. We also run survival courses for those who find themselves under the surface, regardless of how or why they got there.

To assure them that all these activities are medically sound, we have a highly skilled and well organised medical section, with three doctors, a fully trained nurse, one part-time psychiatrist and one full-time physiologist who cater for in-house medical needs, all training requirements and all forms of emergencies including hyperbaric treatments.

With all this equipment comes our mobile decompression chamber. This unit is totally self-sufficient and has a transfer-under-pressure (TUP) capability with our Drager DuoCom chambers. It consists of a prime mover, compressors, air banks, filtration banks, power generators, living quarters, supervisor's and operator's position in addition to the chamber itself. Currently this unit is located on a semi-permanent basis at the Royal Adelaide Hospital, together with one of our company operators and maintainers.

We have two Drager DuoComs in Morwell, one in Woollongong and one in Townsville. They allow for the transport of the patient and an attendant. For those who have not seen or used one before, and intend to in the fu-