Question: Dr Janene Mannerheim

What patients do you intend to treat at Prince Henry's Hospital?

Dr Charles Hackman

Basically, we intend to take people with no neurological deficit, who have not got a serious bend. We take people with niggles and pains. If someone who has got something more serious than that actually arrives on our doorstep, it is because of a communication problem. It may be that we will then decide to treat them anyway. If we do, we put them in our chamber. Partly because of the usually very long time between their coming out of the water and reaching our hospital we are fairly satisfied that they are not going to deteriorate so will not get worse while they are in our chamber. Therefore if we compress them and their symptoms are not largely relieved, we still have the option of contacting another facility and sending them on.

A comment from Dr Peter Laverick about oxygen toxicity, carbon dioxide retention and Royal Navy divers was also imperfectly recorded.

Dr Charles Hackman

I do not worry about pulmonary oxygen toxicity. For completely non-diving reasons, we have to put relatively sick people into hyperbaric oxygen at 2.5 ATA for, in one case, a total of 15 hours in two weeks. Knowing that we were going to do this, we did all sorts of wonderful tests of lung function before and after and found absolutely no change, so we are not really concerned about slight changes.

Central nervous system oxygen toxicity is certainly a problem. I understand that some years ago, one patient actually did fit in the chamber. We normally give them anti-epileptic medication before they go into our chamber. I have had two patients who did develop cerebral oxygen toxicity in the chamber. Certainly in these cases, and I believe in other cases, there were early signs. They do not abruptly go from being perfectly happy and reasonable to suddenly fitting. There is a time during which they either become restless or complain of nausea or of curious sensations and there is plenty of time, in that situation, to drop them down to below 2 ATA in which case you might see the symptoms resolve. We may have been lucky, but we have not had any problems from oxygen toxicity although we have had oxygen toxicity. We usually have one or two people watching them if they are at above 2 ATA. We have a completely transparent chamber so we can observe any restlessness or anything of that nature in which case we drop them back below 2 ATA. There is a very definite difference between someone who is lying completely at rest and someone who has been performing hard, physical exertion, which probably explains the lack of problems.

FIRST STEPS IN FIRST AID FOR DIVING ACCIDENTS

John Knight

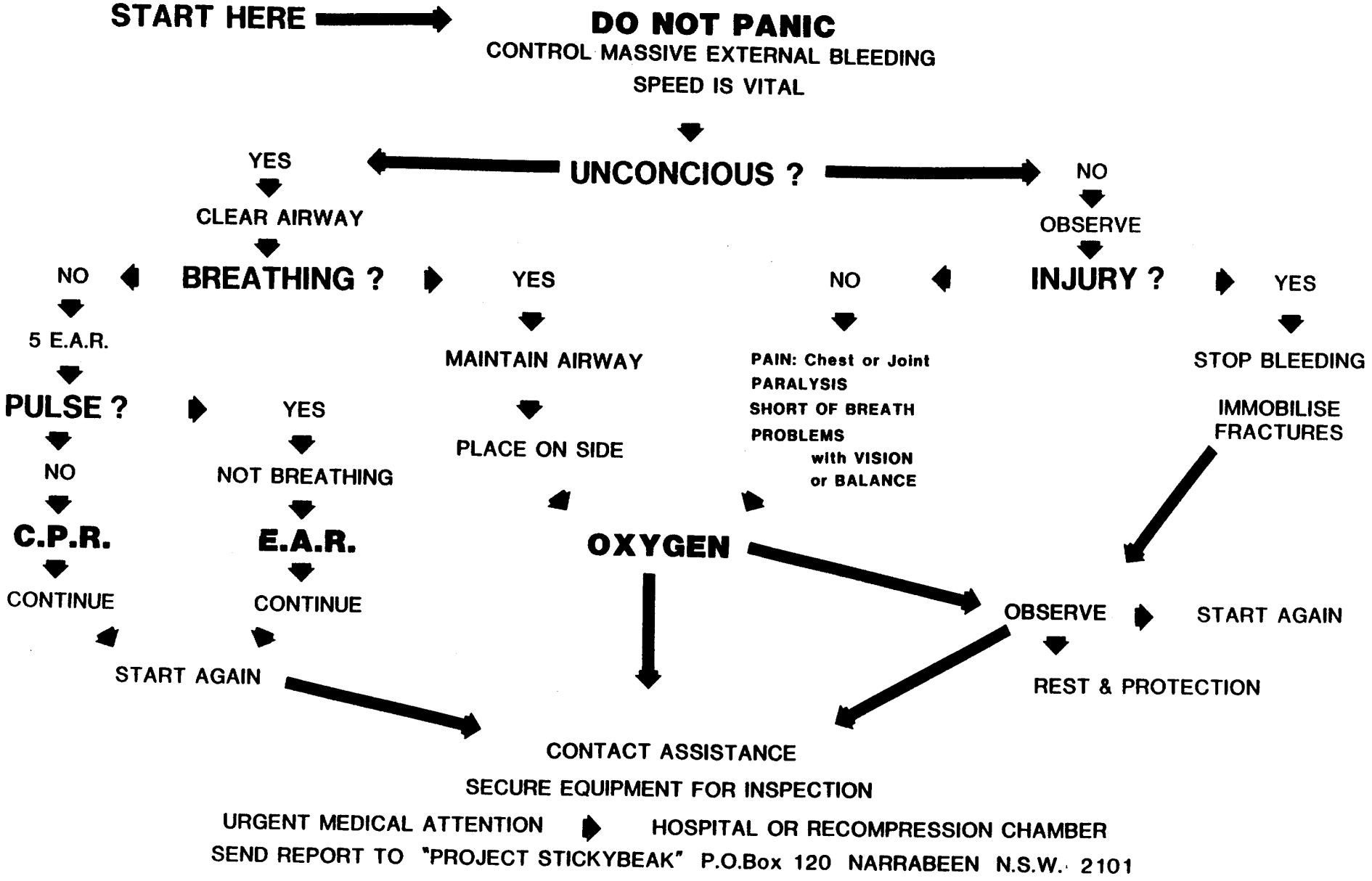
First steps in first aid for diving accidents is a message that we all ought to be taking to the divers we talk to so that the people who have diving accidents have a better chance of surviving, because most of the stories we have heard today were mishandled at the first point. A common error is that a doctor who does not know anything about diving accidents says they are hysterical or hyperventilating and that they do not need recompression. I was told quite firmly by the bloke who ran the boat that "everything was all right because we had a doctor on board, and he told us what to do", when he told me about Charles Hackman's air embolism patient. I replied that they story sounded like air embolism and that he should be recompressed if he had any symptoms. Later that evening the patient rang me and I added to the delay. Instead of getting straight onto Charles Hackman late at night I told the patient to see his GP in the morning and ask to be referred to Prince Henry's. I thought that as he had already waited over 48 hours, another 12 would not make much difference as he said that he was getting better. That diver has given up diving and sold his gear.

The chart (figure 1) is a modification of the flow chart Mike Davis presented in Singapore in 1980.(1) I have redrawn it for Australia on the assumption that we had to make it simpler for Australians than for New Zealanders. It is designed for divers to use in an emergency. SPUMS will be producing it on plastic so that it can be taken on a dive. All the diver has to do is find START and follow the arrows asking himself various questions on the way.

DO NOT PANIC is there because panic figures largely in diving accidents. It is no good having a panicking first aider as well as a panicking diver. And then CONTROL MASSIVE EXTERNAL BLEEDING because if a motor boat has run over someone or if a shark has taken a chunk out of him, he will be bleeding well, and he will not survive either affliction unless someone stops his bleeding. SPEED IS VITAL is there to remind the first aider to get on with the job of making sure that the victim has the best possible chance.

The first thing is to ask is "Is he conscious or unconscious?" So I put a question mark after UNCONSCIOUS. If he is unconscious, one must clear the airway and see if he is breathing (BREATHING?). If the victim is not breathing the next step is to give five breaths of expired air resuscitation (EAR) and then feel for the pulse (PULSE?). If he has not got a pulse he needs cardio-pulmonary resuscitation (CPR). Harpur has commented on the failures of CPR in Ontario.(2) I expect Australians have the same problems of failure to establish circulation and fractured ribs. Most doctors are not well trained in CPR nor are most divers. It is something that we ought to train ourselves in, and I brought Resusci Anne with me to remind us that the only way to learn, unless on is a particularly lethal sort of person, is by using a model to practice on.

FIRST STEPS IN FIRST AID FOR DIVING ACCIDENTS



If the victim has a pulse and is not breathing, EAR is required until he starts to breathe. If he is breathing, the first aider should MAINTAIN AIRWAY and put him on his side.

There are good theoretical reasons for using either side, so I have left out which side and put PLACE ON SIDE. What really matters is putting him on his side so that any vomit runs out of his mouth, and not where the bubbles are in the heart. And then one gives OXYGEN.

Going the other way, if they are conscious, one must look over him to see if he has any injuries. Of course, one can also ask questions and if he has an injury, the next step is to STOP BLEEDING and IMMOBILISE FRACTURES. If there is no injury ask if he has PAIN or PARALYSIS or is SHORT OF BREATH or has PROBLEMS WITH VISION OR BALANCE. If he has any of those he needs OXYGEN pretty urgently. The next step is to OBSERVE and from there arrows go to START AGAIN and REST AND PROTECTION as well as to CONTACT ASSISTANCE. Most Australian divers do not have any method of contacting assistance. A commercial dive boat operator will probably have a working two-way radio. So he may well be able to contact assistance. But not every boat has a two-way radio.

Between CONTACT ASSISTANCE and URGENT MEDICAL ATTENTION is SECURE EQUIPMENT FOR INSPECTION which enables one to come to some conclusions about gas supply, about the buoyancy compensator, whether there was an equipment malfunction, or what. The bottom line, a very important line, is SEND REPORT TO PROJECT STICKYBEAK.

All the things that can happen to you on shore, plus a few others, can happen when diving using compressed air. Among the others are drowning, marine animal injury, hypothermia and contaminated breathing gas which can occur at any stage of the dive. During descent, barotrauma can cause problems, while nitrogen narcosis has undoubtedly assisted people to get into trouble. One case has been presented today. Martini's Law "50 feet of sea water equals one double Martini" is fairly close to the truth, especially if the Martini is made the way that the American psychiatrist I met in Vietnam always made his. He filled the glass with gin and whispered vermouth across the top. On the way up there are the problems of barotrauma of ascent and of decompression sickness (DCS). In Western Australia pulmonary barotrauma of ascent outnumbers DCS.

Safe diving is the way to avoid the recompression chamber. It is becoming more obvious as years go by and more and more reliable statistics are gathered that doing a stop at five metres, or between five metres and ten feet, is an excellent safety precaution for non-stop dives as is shortening the no-stop times. Decompress for the next depth and time is another. For decompression dives, one should have extra air on the shot rope. Charlie Krebs and his friends did not do this and they did not have any oxygen in the boat either.

Air embolism and DCS can both result in central nervous system symptoms. The causation is quite different. In air embolism the lung bursts, giving arterial bubbles while in DCS there are bubbles throughout the body as gas comes out of solution because there is too much gas in solution because the ambient pressure was reduced too fast. Luckily the treatment, recompression, is the same for both which makes it easier for the first aider.

The problems and treatment of DCS are set out in Table 1. When one is out in a boat in the middle of Port Phillip Bay there is nothing one can do about reducing the size of the bubbles by compression. But one can do something about it by breathing oxygen. One can prevent platelet aggregation by taking aspirin. One can reduce haemoconcentration and dehydration by taking fluids. There is nothing magical about using an intravenous line to give fluids. The human gut absorbs fluids very nicely in normal health. Most people with early decompression sickness are in normal health. It takes them some to many minutes to develop their full-blown symptoms. In this time they can drink and absorb fluids. One can prevent some of that progression by giving fluids by mouth. Tissue anoxia is helped by oxygen.

TABLE ONE

DECOMPRESSION SICKNESS

PROBLEMS	TREATMENT
Bubbles	Reduce size by 1. Compression 2. Breathing Oxygen
Platelet Aggregation	Aspirin
Haemoconcentration	Fluids
Dehydration	Fluids
Tissue Anoxia	Breathe oxygen

That is why we put out the poster recommending oxygen, fluids, aspirin and getting expert advice.(3) There has been quite a reasonable response after that poster appeared in *Scuba Diver*. People have written from all over Australia asking for copies of the poster for their clubs and diving instructors have been asking for them for their shops.

The major cause of death in water associated accidents is not decompression sickness or marine animals or air embolism. It is drowning. It is panic and drowning. Therefore the most likely thing one is going to have to cope with is a panicky diver who may or may not be unconscious because he is half drowned.

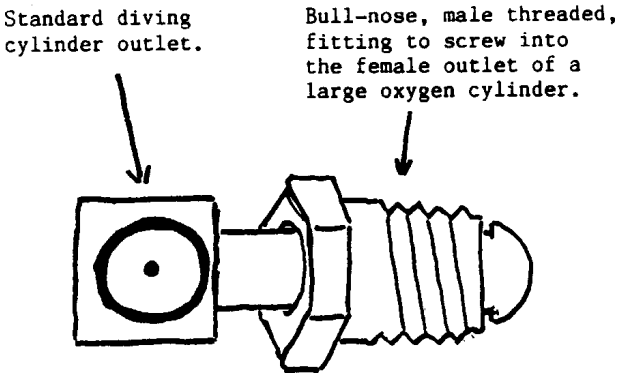
Mike Davis' chart (1) was designed to help the diver, not the doctor, cope with an accident. I have tried to make it a little easier to follow by making it clear that the rescuer asks himself questions about the state of consciousness, breathing, pulse and injury. Each time the answer starts him on a course of action. I mention the oxyviva with a RM head only to condemn it. It is an excellent method of ventilating the lungs. One does not have to get a seal on the face. It delivers oxygen at 60 psi and as long as it is pretty closely applied to the face, the chest will go up and down if the airway is open. But if one has a burst lung, 60 psi, even if it is oxygen, is not necessarily going to do the lung any good.

What I suggest for giving oxygen is a reducing valve and then a flow meter. For the unconscious, non-breathing patient, nasal catheters delivering 6 lpm into the nose of the victim during EAR have been shown (Komesaroff, unpublished observations) to result in normal oxygen saturation. The technique is to put the nasal cannulae into the patient's nose and pinch it shut, as in normal EAR. Anyone who knows how to do EAR and is interested in saving his buddy's life should consider taking-with him when he goes diving a D size oxygen cylinder, a reducing valve, a flow meter, a length of plastic tubing and a pair of nasal cannulae. This will allow him to give oxygen to an unconscious, non-breathing person. An even simpler alternative is to use the equipment outlined in the next paragraph to give the rescuer 100% oxygen to breathe and blow it into the victim.

For the breathing person there are two choices. Anaesthetists would like to use familiar equipment but this would be strange and difficult to handle correctly for ordinary divers. But divers have a special advantage. They have gone to a lot of trouble to learn to breathe through their mouths. The only other people who breathe regularly through their mouths are people who have so many nasal polyps that they can not breathe through their nose. Normal people have to train themselves to be happy breathing through the mouth. Mike Davis had the idea of using the diver's mouth breathing skill to give oxygen through a diving regulator. In Australia one cannot fill a diving cylinder with oxygen. But a simple adaptor (Figure 2) allows one to attach a diving regulator to a D size, or larger, oxygen cylinder. The adaptor consists of a standard, bull-nosed, male-threaded connector, which screws into the outlet of the oxygen cylinder, attached to a facsimile of the top, outlet, part of a diving tank pillar valve. One other piece of equipment is needed, a large adjustable spanner, which will tighten the adaptor into the oxygen outlet and then can be used to turn on the cylinder. All that has to be done is attach a regulator, and if one has been diving, it is highly likely that somebody in the boat has a functional regulator, and turn on the oxygen. The contents gauge, which of course is part of every sensible diver's regulator, allows one to monitor oxygen pressure. With the regulator in the patient's mouth, he is guaranteed 100% oxygen. If one is fussy, someone can sit beside him and hold his nose.

FIGURE 2

ADAPTOR TO FIT A DIVING CYLINDER TO A LARGE OXYGEN CYLINDER

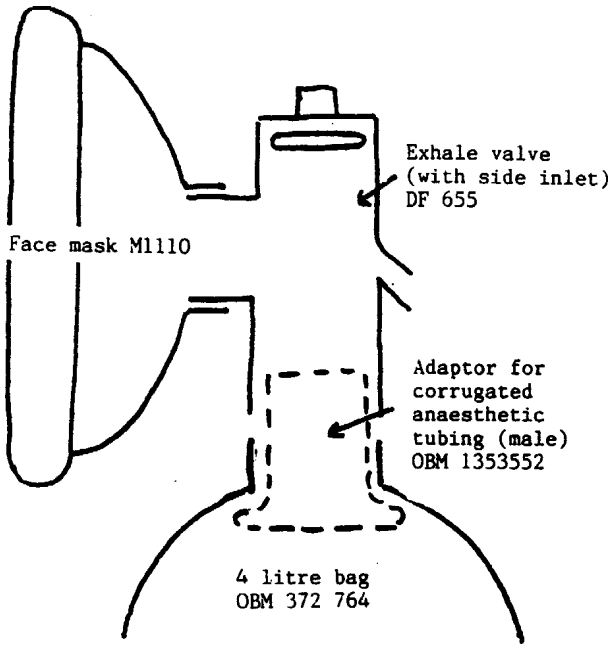


The equipment in Figure 3 is suitable for anaesthetists, intensive care and recovery room nurses and Mobile Intensive Care Ambulance (MICA) personnel, but few others, as it depends on getting a good seal between face and mask to deliver 100% oxygen. It has advantages as one can watch the bay moving and guesstimate the volume of ventilation. It requires a flow higher than the minute volume to guarantee no rebreathing, so I usually recommend 14 lpm, which, though wasteful, will allow a D cylinder to last 90 minutes. But unless the seal is effective the oxygen concentration will be less than 100%. How much less cannot be foretold. So, for ordinary divers, a better way is to use a diving regulator on an oxygen cylinder.

Of course, it is not suitable every time. Charles Hackman's patient was not conscious enough, so I was told, to hold the regulator in his mouth. Bill Bernhardt rescued a girl who, while unconscious, clenched her teeth and he was unable to get the regulator into her mouth. But there are problems with whatever first aid equipment is recommended. In my opinion, the important thing about first aid is to keep it simple. It is important in first aid that one uses familiar equipment so that the rescuers will not sit there scratching their heads and asking "What do I do with it?" One is dealing with a group of people who use what can be extremely unsafe gear if they go unconscious underwater. Bill Bernhardt rescued someone at the bottom of Portsea Hole who had gone unconscious during a night dive. He noticed that she had gone unconscious because she did not have her regulator in her mouth when he shone his light on her face. Going unconscious underwater is a good way to drown oneself if one goes on breathing.

We do have available at a reasonable price the equipment (Table 2) to make sure that we can do the best for the injured diver as soon as he gets to the surface. Also a logical set of priorities that one can go through. No training, other than having done a first aid course, is needed to get through the priorities. It is no great strain on cerebration to run a finger along a set of arrows. The way

FIGURE 3



that we are going to reduce the work load for people like Harry Oxer, Geoff Macfarlane, and Charles Hackman is by getting across to the divers that they have got an important part to play. Those at the scene of any diving problems should seek medical attention urgently. The sooner the victim gets to medical attention, the better chance there is of cure.

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1. Davis FM. First aid management of diving casualties. SPUMS J. 1981 Supplement; 11 (Supp): 63 - 67.

2. Harpur G. First aid priorities for divers: the Tobermory viewpoint. SPUMS J. Oct - Dec 1982; 12(4): 32 - 38.

3. First aid for decompression sickness and air embolism. SPUMS J. July - Sept 1981; 11(3): 11.

Question

What about the fire risk with oxygen and the grease used in diving regulators?

Dr John Knight

The greases that are used in maintaining regulators are the same ones that CIG use for maintaining their first stage regulators. They are silicone based and there can be no appreciable risk of fire or explosion because CIG use them on every regulator.

TABLE 2

EQUIPMENT NEEDED TO ADMINISTER 100% OXYGEN BY FACE MASK

(Prices correct on 14.1.83)

OXYGEN CYLINDER Size	Contents	Endurance *	Monthly Rental	Contents $ Price of Contents
D	1500 L	1 hr 40 min	$ 2.30	$ 9.90
E	3800 L	4 hr 10 min	$ 2.80	$16.00
F	7600 L	8 hr 20 min	$ 3.30	$24.70

** at 15 lpm*

MINI REG (518515)	$ 96.19
FLOW METER (TM 105)	50.90
Small bore flexible PVC tubing ID 4.8 mm (YR 62)	0.76 (per metre)
Exhale Valve (with side inlet) (DF 655)	84.25
Face Mask (M111O)	18.66
Adaptor for corrugated tubing male (OBM 1353552)	14.15
4 litre bag (OBM 372764)	10.00
Clausen Head Harness (OBM 301061)	10.39
Cylinder Key Wheel (511956)	7.74
Adjustable Spanner	

Question

What happens if the diver has serviced his regulator himself using ‘Vaseline’?

Dr John Knight

If you are mug enough to be diving like that, not using somebody safe to service your gear, you probably will not be diving with an oxygen cylinder in the boat.

Question

Victorian ambulances have Komesaroff closed circuit oxygen resuscitators which give 100% oxygen and are very economical. Should one recommend using them?

Dr John Knight

I do not think so as they need a good seal with the mask to guarantee 100% oxygen. Also if the diver has a high

nitrogen load he will out gas into the almost closed circuit and dilute the oxygen to a varying degree, so defeating the object of using 1OO% oxygen to give the highest possible gradient for getting rid of nitrogen.

NEWCASTLE UNDERWATER MEDICINE AND BAROTRAUMA SOCIETY (NUMBS) MEETING

Nelson Bay
Saturday 30 April 1983 and Sunday 1 May 1983

This meeting was an excellent balance, combining as it did stimulating, well presented papers and a couple of beach based scuba dives, plus a seafood meal unlikely to be equalled (let alone excelled) elsewhere. For this the credit belongs to both organisers and speakers.

The theme of the meeting was non-barotrauma diving accidents, which enabled discussion of the aetiology of hypothermia, the first aid flowchart approach to management of diving accidents, a glimpse at the various sites of action of toxins, and Neville Coleman's tour de force Recollections of a Pirate Life. He never explained how he survived his touch-it-and-photograph-the-damage approach to marine life, and nobody present seemed likely to seek to duplicate his dedicated approach to testing the defence/offence systems of marine life. But first we heard the Umbrella Man.

It would be unfair to detail Dr Frank Summer's talk on the value of the umbrella, a tool he claimed was mistakenly neglected by most scuba divers. Get him to attend some meeting you are running and listen to him for yourself, possibly giving as fee an Umbrella Perfecta, one which lasts through many dives without rusting. Perhaps there is a case for instituting an Australian Standard (Umbrellas, Underwater)?

Dr John Knight spoke on why divers develop hypothermia (they would not if they had had the sense to have different ancestors), with an example from Victoria of a near fatality from the incapacitating effect of very cold water. He noted the value of a wool vest worn under a wetsuit (thoroughly tested by Dr Janene Mannerheim), this reducing the rate of water flow over the skin, as an option with advantages over the use of extra thick neoprene material (with the buoyancy problems this will produce). This is an interesting throw back to the early days of Australian diving when tyre inner tubes were worn over shirt and woollies.

Neville Coleman commenced his presentation with a brief review of why and how he became involved in what developed into his life work - the discovery, photographic recording and observation of all types of marine life. His reputation, deservedly, is world wide. He is an excellent raconteur with a great collection of pictures of his wounds after testing the stings, bites and pricks of almost everything one should not touch. The exceptions are the Great White Shark, the blue-ringed octopus, and the Box Jelly. The last was not his fault, an unfortunate woman jumping into the sea onto the tentacles he was seeking. After carefully saving the box jelly he gave the victim the first aid care which greatly reduced her pain and disability, for he had carefully brought the necessary treatment with him on his quest. His is the tale of how determination can overcome "impossible" adverse circumstances, both environmental and academic, if you are an intelligent non-conformist in a new field of activity. His theme was that marine life was not there waiting for a chance to bite, sting or jab you, but you had to learn and obey the House Rules of the sea: ignorance is no protection. If you stand on a stone fish, it was not the fish's fault (a philosophical point to discuss as you lie in pain). His own survival in an excellent state of preservation after 10,000 dives over 20 years indicates his ability to perform dangerous things safely. Grab any chance to hear him talk.

The Flow chart for the management of diving accidents, well known to SPUMS members, was described by John Knight and a plea made that it be the check list used by those facing such an emergency. Basic to such management is the possession of a sound first aid knowledge by those present and the carrying by reputable dive boats of oxygen. Large oxygen cylinders with a fitting adapted to accept a scuba regulator attachment are a safe and cheap alternative to a proper anaesthetic mask kit, and therefore more likely to be adopted.

Prof. Tony Smith, from the Pharmacology Department, University of Newcastle gave an interesting paper describing the sites of action of various marine toxins which affect neuro-muscular function. It is hoped that this paper will be presented at a later date in these pages.

With such teachers, learning is a pleasure.

MEMBERSHIP OF SPUMS

Members pay $20.00 yearly and Associate Members $15.00. Associated Membership is available for those neither medically qualified nor engaged in hyperbaric or underwater related research. Membership entitles attendance at meetings and the Annual Scientific Conference and receipt of the Journal/Newsletter.

Anyone interested in joining SPUMS should write to:

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