SPUMS JOURNAL
South Pacific Underwater Medicine Society
No. 2, 1983 April to June

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Registered for posting as a publication (Category B).
Publication Number VBH 3527

Printed by: Universal Copy Service,
140 William Street, Melbourne 3000

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EDITORIAL

The present generation of divers is probably unaware of the extreme brevity of the ancestry of the diving syllabus, texts and equipment it uses. To anthropomorphise, Homo Sapiens (Aquaticus) burst forth, flush with hybrid strength, in the wake of World War II. It was the child of disreputable parents (native sponge and pearl diving) with a clandestine relationship with the "frogmen", whose provenance was wartime necessity. Homo sapien, the orthodox "Standard Diver", was soon left without the glamour of public acclaim, a useful workhorse tethered physically and psychologically in whatever small area of water he had been assigned. This dramatic change, the gift of mobility, was made possible by the introduction of the "Aqualung". The apparatus would probably have remained a minor curiosity of the diving world had it not been for a critical new factor, the intrusion into diving of the sport diving amateur. This group of divers was not obligated to take orders to work in a small area of nil visibility and was soon exploring the unexpected world of "inner space". Present day hose-supply, even deep diving, is developed from this rather than the Hard Hat philosophy. These newcomers to the sea's vastness were brave and ignorant, but not desirous of dying, and readily accepted innovations. The development of the eye-nose-face mask, quick-release weight belts, contents gauges, buoyancy vests and other innovations dates from this period of change. The influx of amateurs also led to people questioning accepted wisdom (which can nevertheless be correct!), sometimes with results such as the proof that helium could be used for breathing mixtures or the "invention" of Marine Biology.

It is a privilege to present some recollections of one of the small band who introduced this new diving to Australia, and salutary to consider the change in our understanding of the problems arising, associated with diving, which has occurred during the lifetime of many still active and contributing to diving. As the cartoon indicates, initially the inhabitants of the sea were feared (not altogether without reason) more than the sea itself. However the pioneers compensated for the absence of informative books by meeting and discussing experiences. The growth in numbers and distances involved has made such information dissemination no longer adequate and the task has been taken on by information ("Incident") collecting schemes such as that of the BS-AC (UK), the University of Rhode Island (USA) and Project Stickybeak here in Australia.

Medical Fitness for diving has only recently become a matter for heated discussion. While the armed forces, with their young, physically fit membership, could set whatever standards they wished for their own divers, nobody else made comment. Commando types obviously needed to be super fit. Discussion started when these standards were wished onto the rest of the diving population. Many felt, like Carl Edmonds in his paper, that a little bit of ill health might be permissible in oneself, however deplorable and disqualifying it had to be considered in others. In relation to professional divers, a special case because lawyers would "flay" any doctor using discretion in his client's favour in a past fitness check, standards are set to protect <u>everyone</u>, not solely the diver. But for sport divers the problem is different, and the papers by Drs Bove and Knight illustrate the differences of opinion which exist. In particular there is the question as to the purpose of the examination: what degree of certainty of medical guarantee is desired for a sport/occupation where training and correct dive practices are the critical safety factors. Is it morally correct to tell someone that they should not dive <u>but</u> is it for them to decide whether to follow the advice or ignore it? What is the poor diving instructor to do if faced with such a candidate?

DO NOT PANIC! is admirable advice, but only likely to be applied by those who have been efficiently trained. The Treatment Flow Sheet could save victims from disabling morbidity, particularly if the dive boat carries Oxygen. Afficionados of "The HitchHiker's Guide to the Galaxy" will now recognise the source of this compelling command, and that it is appropriate to both "inner" and "outer" space.

The Case Notes are of both interest and great value, in particular the further examples of the rule that one must NEVER ATTEMPT TO TREAT DCS BY IN-WATER AIR THERAPY. Even a $A 5,000,000 (reputed cost) treatment may not rid you of spinal symptoms. The remarkable tale (SPUMS J 1982 July-Sept) of Dick Alba's treatment illustrates human endurance, n<u>ot</u> correct management. But there are difficulties because the first, and possibly most difficult, step of management is the recognition and acceptance of the fact that the diver has a problem. The useful warning by Geoff MacFarlane places the obfuscatory factors on the record for the first time, alerting those faced with "diving problem?" to the extraneous factors which influence the information they receive.

It is not quite cradle-to-the-grave in this issue, but it is possible to claim it covers infancy (of sport diving) to maturity. Nobody is taking <u>seriously</u> of the geriatric stage yet.

SPUMS SCIENTIFIC CONFERENCE 1982

AN APPROACH TO MEDICAL EVALUATION OF THE SPORT DIVER

AA Bove

A thorough history and physical examination with attention to problems specific for diving should be adequate in 80-85% of candidates. The remainder require individual attention and laboratory studies tailored to the questions to be answered.

You can make the decision about diving in most candidates based only on the physical examination. With a benign history and normal lung examination, a chest X-ray will add little. But a chest X-ray is helpful if there is concern from either the history or the physical examination.

Long bone X-rays in sport divers are of no value since there are no reports of bone problems in scuba divers. Bone lesions from diving are associated only with some commercial diving exposures.

Divers in poor physical condition, and those over the age of 40 who do not exercise, should have a stress ECG done up to a level of 10 - 12 mets to be sure they can tolerate the expected exercise needs in diving, and to rule out occult coronary artery disease, or exercise induced arrhythmias.

You will rarely need a blood test in a normal person, and should do the tests indicated when an abnormality appears in history or physical examination.

Note that the above is directed to the sport scuba diver who can elect to dive in a suitable, safe environment. The physical standards for commercial diving are more stringent, and have been written into regulations in some countries.

I told you that US Navy divers are usually fit and are encouraged to maintain fitness throughout their careers. This is done at the expense of their work time. The fitness schedule is part of the working day. In the United States, a lot of corporations are doing this now too. They are providing fitness and maintenance times in the working day so that the people who work for them can take an hour off a day to go to a fitness centre and maintain fitness. There is some validity for doing this.

I do not think one has to do extensive evaluation of everybody. There has to be some flexible approach to the individuals that want to dive. When examining freshmen in college Phys Ed who are taking a scuba course as part of their aquatic programme, I do not think it is reasonable to ask for blood tests, audiograms, chest X-rays and electrocardiograms on all those kids. If some have a history of rheumatic fever, then they will have to be dealt with differently from the rest of the group. The majority of younger individuals who want to take a scuba programme can be dealt with by a thorough physical exam, with diving allowed if it is totally benign. If there is something in the history about asthma, or a heart problem, then they can be selected out for a possible further testing, tailored to the individual's problem. There is no evidence to date that sports divers get aseptic bone necrosis. I do not think that one can justify the expense or the radiation exposure of bone X-rays for sports divers.

We are going to continue for three more sessions on specific approaches to various and sundry kinds of medical problems to try and get some feel for who can be let do a diving programme and who cannot because of some underlying illness. This is only for sports divers. Commercial diving usually will not accept anybody who has serious underlying medical disorders, or a history of asthma or lung disease, or heart disease. They just will not accept them. They want healthy, fit individuals to train and put into commercial diving. We are sliding away from that hard, rigid rule in the sport diving community because it is a sport. It should be available to more than just the super people of the world who are fit, healthy and have no past illness. I hope, over the next couple of days, to pass on some guidelines where to draw the line where sport diving is not available to some people, and when you can allow people, who seem to have some abnormality, into the sport.

Dr Ian Unsworth

You said that there is no evidence to suggest that sports divers get dysbaric osteonecrosis. I have evidence that sports divers do get dysbaric osteonecrosis. There is no reason why they should not because they often dive deeper, more frequently, with less attention to tables than commercial divers who are far better monitored and regulated. The only difference between the sport diver and the commercial diver is the fact that one is paid. Bubbles do not know that.

Dr Fred Bove

There are millions of sport divers in this world, and the great percentage of them do not go to extremes. In fact, a lot of them do not dive. Of the ones that do dive, I would say that the majority of them do not go to extremes. The aberrant divers who disregard the rules, perhaps they will get aseptic bone necrosis but the diver that is diving in the normal fashion, the way he is trained to dive, should not get aseptic bone necrosis.

The second point is that if we take whatever the number is of sports divers, there is a finite incidence of bone necrosis in that population, regardless of what they do. One cannot statistically justify a statement that sports divers get aseptic bone necrosis because some sport divers have aseptic bone necrosis. One has to do a fairly complex statistical analysis that eliminates the normal incidence of the disease in the population first. As far as I know, that has not been done. There is really no firm evidence that sports divers are prone to, or get, aseptic bone necrosis. From that statement, I do not think it is justified to give all sports divers bone X-rays. It is the same argument for doing IVPs on all hypertensives.

The cost of the X-ray exposure does not warrant the benefits to be gained from X-raying all sports divers.

Dr Ian Unsworth

I accept that totally. I am not an avid advocate of bone X-rays for sports divers either. However, we do know that dives within the tables may produce some degree of venous gas emboli. If we accept that these may be the essential aetiology of bone change, then perhaps we ought to change our view, and say that sports divers may be susceptible to dysbaric osteonecrosis. The problem is that sports divers are not investigated for this. Perhaps we should be taking samples of sports divers and have a look at that bone.

Dr Fred Bove

I agree that we ought to do some study. The best way to know what you are doing is to get intelligent information and use it intelligently. It would be nice to have bone scans. We have learned in exercise physiology that when somebody has pain somewhere, the bone may look perfectly normal on X-ray, but when one does a scan, there is a stress fracture. The hyperaemia of the stress fracture may show up on scan, but an early fracture will not show up on X-ray. If the problem is under perfusion of a section of bone because of bubbles, then the chances are that we would find that on a scan and obviously not find it on an X-ray during the acute period. Denis Walder in England has done some work which shows that some divers who are bent have abnormal scans when studied soon after their exposure. It would be nice somewhere to generate some funds to do X-rays in some sports divers and to do bone scans in some sports divers, perhaps only in the ones that get bent, to find out what happens.

MEDICAL EVALUATION OF THE SPORTS DIVER

AA Bove

GENERAL REQUIREMENTS

The physician who evaluates candidates for sport diving should be familiar with diving physiology, the subsea environment in which the diver works, and the physiological responses of the body to cold, exercise and pressure. With this background, a diving candidate can be properly assessed and the correct decision made even in cases where a diving candidate may have a chronic disease. One way to determine how a diver will respond to diving with some chronic illness, is to consider how the illness will be affected by exercise, pressure, cold and emotional stress.

I have addressed exercise previously. A candidate with chronic illness should be able to meet the requirements of exercise that I outlined. If these requirements are not met, then either the candidate should not be approved, or should be considered a special problem requiring added support during diving. An example of the latter is a physically handicapped person (an amputee or a paraplegic, but not from DCS) who might dive with other handicapped divers in highly supervised programmes. Exercise capacity need not be guaranteed in all diver candidates. The individual between 16 and 35 years old who is physically fit, and by history has good exercise tolerance, usually poses no problem. Persons in this age group who are poorly conditioned, and most candidates over 40 years old, should have an exercise evaluation prior to diving. In addition, persons with chronic illness or history of chronic heart or lung disease can be exercise tested when there is doubt about their exercise capacity.

The effects of pressure which must be considered are chiefly those due to Boyle's Law (a good review of these pressure-volume relations in diving is worthwhile). Inability to equalize middle ear pressure, a chronically perforated ear drum, history of spontaneous pneumothorax and evidence of lung blebs on X-ray are all contraindications to diving. There is at present some controversy about diving after thoracic surgery. The great number of coronary bypass operations in the US have generated a group of divers who have had chest surgery. My personal experience with four or five of these patients is positive. They had no problem from the chest surgery per se. Their major problem is exercise capacity, and this can be adequately tested.

Another important and controversial area is allergic asthma. Patients with clinical evidence of airway obstruction at rest or with exposure to cold, or during exercise should be disqualified because of the high risk of pulmonary barotrauma. Patients requiring drugs for asthma control likewise should not dive. A history of asthma long past, with four or five symptom free years, no wheezing and no drug therapy, is probably not a contraindication to diving. However, one must examine carefully to be sure that no airway obstruction exists. Pulmonary function studies will help document the state of airway resistance. However their greatest use will be when you need objective data to support a disqualification. It is less common to need pulmonary function studies to document normality.

Although cold stress is not commonly considered in qualifications, there are several problems which need to be considered. Cold induced asthma was mentioned above. Breathing cold gas from a scuba bottle can have the same effect as breathing cold atmospheric air. If cold air induces asthma on land, it is likely to cause problems while diving. People with Raynaud's disease, ie. cold induced digital cyanosis, should not dive if the problem is uncontrolled since gangrenous fingers and toes may develop from the cold water exposure. Cold also induces a change in the circulation which adds a load to the heart. Persons with mild hypertension may have an excessive rise in blood

pressure in a cold water environment. Also note that drugs which block the autonomic system will reduce the body's ability to adapt to cold, and excess heat loss leading to hypothermia, may result.

Behavioural factors include chronic illness which may limit the diver's capacity to perform needed skills. Examples are severe arthritis, paralysis or amputation of an extremity (see above for exceptions).

Illness which renders the diver prone to sudden unconsciousness such as drug dependent epilepsy and insulin dependent diabetes mellitus. Occasionally severe migraine attacks will incapacitate a diver. Serious cardiac arrhythmias which result in reduced cerebral perfusion should also be included.

Finally the physician should assess the candidates emotional make-up. At present only the grossest of abnormalities would prohibit diving, nevertheless, the physician should make some judgement about the emotional stability of the candidate. Abuse of drugs or dependency on drugs or alcohol should disqualify a candidate.

SPECIAL CONSIDERATIONS

The following pot pourri comes from personal experience and interest, is not inclusive, but can serve as examples of how to apply the fundamental physiological information to specific cases.

Hypertension

Persons on large doses of anti-hypertensive drugs have reduced exercise tolerance, poor thermal balance and occasionally orthostatic hypotension. All of these must be considered. Patients on diuretics alone, small doses of beta blockers, etc., with good exercise tolerance and good blood pressure control can dive. Each case must be decided individually.

Coronary Artery Disease

Exercise induced ischaemia or arrhythmias at 10 - 12 mets or less is a contraindication to diving. The 35 year old man with a single vessel bypass whose heart is completely revascularised and has good exercise tolerance can dive. The evaluation is complex. I suggest you befriend a cardiologist, get him or her into diving and then maintain a continuous dialogue about this question, which is becoming more frequent each year.

Congenital Heart Disease

Patients with cyanotic heart disease have poor exercise tolerance and usually will not appear as candidates. Patients with asymptomatic atrial or ventricular septal defects should not dive because of the risk of paradoxical embolism reaching the brain from the venous circulation. We showed several years ago that these shunts change direction briefly during diastole and bubbles can pass from right to left even though the measured shunt is from left to right.

Lesions which obstruct blood flow in the central circulation reduce exercise tolerance, and contraindicate diving. These include aortic stenosis, coarctation of the aorta, severe pulmonary stenosis, hypertrophic subaortic stenosis, and mitral stenosis.

Pacemakers

New pacemakers are being used which sense the atrical rate and stimulate the atria and ventricles in sequence. These are not yet in common use, thus most pacemakers are fixed rate types, and do not produce adequate augmentation of cardiac output during exercise. A personal poll of manufacturers reveals that most pacemakers are tested to 130 feet equivalent pressure, and should function properly. Note that no clinical tests have been performed under pressure. However, the major concern is over exercise capacity, and newer pacemakers may overcome this problem.

Artificial Heart Valves

These pose several problems. First, the state of cardiac performance may be chronically reduced even with valve replacement and exercise tolerance will be low. Second, most valves do not function well with high cardiac outputs, so again during heavy exercise the patient may develop severe limitations. Third, most patients are on chronic anti-coagulation and run the risk of bleeding heavily from the minor trauma usually experienced while diving. The newer tissue valves may ultimately overcome these difficulties, but there is no data at present on which to base a diving approval in valve replaced patients.

Endocrine disorders

Most well controlled endocrine disorders do not contraindicate diving. Diabetes mellitus that is insulin dependant is the one obvious exception, as hypoglycaemia can progress to unconsciousness without warning.

Pregnancy

An Undersea Medical Society panel met on this topic several years ago and decided to recommend that a pregnant woman refrain from diving until delivery. This recommendation was based on some evidence that foetal and maternal tissues clear inert gas at different rates and one could not guarantee a bubble free foetus following a dive that was safe for the mother. We also felt that the higher oxygen partial pressure could be detrimental to foetal development. We assumed that the pregnant diver wished to deliver a healthy child, and felt that the sport would best be postponed in the interest of a healthy child.

PULMONARY DISORDERS AND DIVING

Dr Fred Bove

The conditions I have chosen to discuss are set out in Table 1.

TABLE 1

Asthma	
Pneumothorax	a. Traumatic b. Spontaneous
Chronic obstructive lung disease	
Chest surgery	

ASTHMA

We have already had some discussion on this. The main problem, and I think the only problem, with asthma is the inability to adequately and rapidly empty the lungs, because of a chronic airway obstruction, partial or complete as the case may be. That is not good for the asthmatic anyhow. But it is much worse underwater, because on ascent, when you have to have a clear airway to get the gases out of the lungs, the bronchospasm or airway obstruction present can delay the emptying of a small segment of lung and cause pulmonary barotrauma and cerebral air embolism.

I hold that if a person has asthma and they are wheezing, they absolutely cannot dive. These people have chronic airway obstruction and should not dive. Occasionally in the Caribbean there is someone on the diving boat squirting down Isuprel and all set to go, wheezing to beat the band, with a regulator in his mouth. Some how or other these people do sneak through the system and get onto diving boats. They claim that their asthma is better out on the ocean because there is no pollen there. I am not sure that is a good excuse for diving as an asthmatic. Anybody who is apparently wheezing should not dive.

I think that anybody who has to have medication to control their asthma should not dive. If an individual requires chronic medication, he still has an unstable airway. The instability is to some extent suppressed, but either exercise induced asthma, which is not an uncommon problem, or cold induced asthma can result from the diving environment. Either of those things happening under water is a really dangerous problem, because acute asthma clearly causes some airway obstruction. There are some very poorly emptying lung segments are there is a high risk of air embolism.

So the wheezing asthmatic should not be allowed to dive. In fact, most drug controlled asthmatics still wheeze a little bit. They say that they are fine, and that they do not have any problems, but if you get them to exhale rapidly, your stethoscope picks up scattered squeaks. That means that there is still some bronchospasm in some areas of the lung. It does not cause symptomatic problems, but it could certainly cause a problem while diving. Those two kinds of patients are not really a problem. Everybody agrees that you should not let them dive.

The patient who is a problem is the 22 year old male who tells you that he was an asthmatic up to the age of 12. From 12 years on the symptoms waned and by the time he was 15 he did not have asthma and was active in sports. He has never wheezed again, and is taking no drugs. Those patients are difficult, because some of these people do, in fact, get their asthma again. I would guess that they are all prone to it. We have had a run of very dry summers. During the second one I started to get a lot of athletes coming in with funny symptoms that they did not describe as asthma, but as a degradation of their performance that no one could explain. The history in these people was one of asthma as a child, which went away by mid teens. They then got active in sports in high school or college and did fine until this summer, when they began having trouble with their athletic ability. What they were getting was exercise induced asthma. But it was in a background of a high pollen count because of the very dry summer. A lot of these people have an underlying tendency to bronchial spasm with certain stimuli. The question is, will they get bronchial spasm while they are diving?

I do not have good answers to that question. There are a lot of these ex-asthmatics who do get cleared for diving. My approach is to ask the individual what he does for exercise and whether he has any limitations. Then make him breathe very hard, hyperventilate, and listen to his chest for any kind of wheezing. Also take a chest X-ray, to see if he has any hyperinflation. In these patients, it would be reasonable to get an exhalation chest X-ray too. By having a patient hyperventilate and then breathe out very rapidly I can often pick up a few scattered wheezes here and there, which suggest that there is still some bronchospasm.

If there are no wheezes and if I can convince myself that he can handle both cold and exercise without wheezing, I might approve diving. On the other hand, if one could demonstrate that there are clear cut tendencies to bronchospasm, under those circumstances then he should not dive.

A way out which seems to work with an asthmatic who one feels is going to be a problem, is to require a lung scan and pulmonary function studies. What one hopes to do is to demonstrate an abnormality. I do not think it is reasonable to do tests that one can predict will be normal. But if you are sure that the patient has an abnormality and you want to make sure that he or she understands that they should not be diving, then it is worthwhile having tests. I tell that person “I think you have asthma. I think you are going to have trouble diving. I think you have airway obstruction and I would like to demonstrate that by pulmonary function tests.” Since pulmonary function tests are expensive,

about half the asthmatics do not come back and do not dive because it would cost too much. The other half will spend the money. What I end up doing is proving that they have a limiting abnormality and I can disqualify them. Of course some will go to some other physician. Now that they know what not to tell, they would hold back that part of their history and get cleared for diving. But at least I feel that the obligation that I have to make a person dive safely is handled.

To sum up. The wheezing asthmatic and the asthmatic on drugs should not dive. The asthmatic with a history in the remote past can be told pulmonary function studies, and even pulmonary function studies with exercise, are needed to make sure that he does not develop a bronchospastic response. If the individual agrees to go ahead with that, then if they come out normal then I think he should probably he allowed to dive. If they are abnormal, there is clear cut evidence that he should not be diving.

PNEUMOTHORAX

As far as I am concerned, people can dive after a pneumothorax due to injury or surgery, if the lung is reinflated and there are no abnormal chest dynamics. With a traumatic pneumothorax there are usually a few adhesions, so the lung will not collapse completely. These individuals are not prone to spontaneous pneumothorax.

However, anybody with a spontaneous pneumothorax is prone to more of them. Most people do not understand the significance of that. They feel that a single spontaneous pneumothorax was something that just happened, and that it will not happen again. But it is very likely to happen again.

I remember having a long argument over the telephone with a dentist who had a physician friend who he got to sign off his medical. The dentist went to a diving instructor, a pretty astute guy, who looked at his medical form. He had written down 'spontaneous pneumothorax'. In fact that dentist had had three of them, two while playing tennis and one while working in his office. The diving instructor would not take him in the course. The dentist was ready to get a lawyer to force the instructor to take him in the course because his friend, the doctor, had said he was fit to dive. I often get these cases to referee. I talked to the dentist at length. I talked to his physician at length. His physician was totally ignorant of anything to do with diving medicine and in spite of this, had signed off the form, which is not an uncommon thing in the United States. I educated the doctor and sent him a xerox copy of a chapter in a diving medicine book. He then called the dentist and told him not to dive. He finally convinced him that if he was going to dive he was highly prone to another pneumothorax and so got the instructor off the hook.

I think spontaneous pneumothorax is an absolute contraindication to diving. However, during a diving medicine course in the Caribbean, some chest surgeons said that there is a treatment. Strip away the pleura and cause a total pleural adhesion between the lung and the chest wall. The claim is that there are no more spontaneous pneumothoraces after this. A thoracic surgeon, who was a diver, asked whether people who have total adhesion of both lungs to the chest wall could dive. My answer is that I do not think they should dive. I have not met such a patient yet. It is not a common operation. Most people do not have the operation unless they have had recurrent multiple episodes that are causing severe life threatening problems. Somebody who has that problem will not, most of the time, want to do anything that will run the risk of another pneumothorax.

The few people I know who have had spontaneous pneumothoraces really do not like it. It is very unpleasant because it hits them anytime without any way of predicting it. Most of them do not like getting into situations where a pneumothorax is almost guaranteed, so they will not dive. Spontaneous pneumothorax still is a contraindication to diving. I guarantee that anyone who meets somebody like that who wants to dive is going to have a real argument on their hands. So one has to be ready with a nice, clear, logical argument to point out why it is dangerous to dive with a history of spontaneous pneumothorax.

If there is no history of spontaneous pneumothorax, is an X-ray necessary? I believe that a chest X-ray is only required if one needs to make certain decisions based on a chest X-ray. Then one has to make sure that the chest X-ray will provide the information to make those decisions. A plain chest X-ray is unlikely to show small blebs on the pleural surface, so that is not a good reason to take a chest X-ray. If one wants a chest X-ray to show big blebs, that is fine. Usually a patient with a big bleb, a great big hunk of the lung missing, has other chronic lung problems which one can pick up in a physical examination. Then a chest X-ray will verify the clinical impressions. I think the need for a chest X-ray ought to be decided by what is found on the history and physical examination. With a late teenager, adolescent or young adult college student, who is in good physical condition and who has a perfectly normal history and perfectly normal physical examination, it is highly unlikely that a chest X-ray will give any more information. I think doing a chest X-ray on all these people is a significant excess of both cost and radiation exposure. But with a good history and physical examination, one ought to be able to pick the individuals who need a chest X-ray.

CHRONIC OBSTRUCTIVE LUNG DISEASE

Obstructive lung disease is an absolute contraindication to diving. These patients have a combination of things like airway obstruction, and emphysema with blebs through the lungs. They have very unstable lungs. They are also prone to pneumothoraces, so should not be allowed to dive. Most of them are so sick that they rarely want to do anything like diving anyway. There are some people with

early chronic obstructive lung disease with bronchitis and emphysema who might want to get into diving. If one is convinced that the patient has some degree of chronic lung disease, then the studies that are needed, the chest X-ray and the pulmonary function studies, are going to be done to prove to that individual that he should not be diving.

Studies should be done to demonstrate things that one expects to be there rather than as a blind screen to try and pick up things which are unexpected. That attitude will cut studies down to those that are going to be most useful.

CHEST SURGERY

I have seen any number of people after all kinds of chest surgery who are diving. They were divers before they had the operation and they are still divers. They do not seem to have any major problems. Sometimes I see people long after the operation, or I go diving, see the big scar on their chest, and find out that they had some kind of chest surgery. It is well 'after the fact' when they say "Do you think it is alright to dive?" "I had an operation 22 years ago and I have been diving for 20 years".

I am not too concerned about people who have had chest surgery. Obviously, if somebody has a massive deformity of the chest from surgery, then one might have to worry. I think a thoracotomy for a subsegmental resection of a lung, or some kind of cardiac surgery, or a patent ductus ligated of an ASD repaired 15 or 20 years before, is not going to cause trouble with diving. Chest surgery per se is not an absolute contraindication. One has to look at what was done and what was resected or repaired before one can make a decision.

PULMONARY PHYSIOLOGY

The normal response to exercise is an increase in ventilation with a slight drop in PCO_2, a stable arterial oxygen content, and a tiny rise in alveolar oxygen, which takes the place of the CO2 that has gone down. Somebody mentioned CO_2 retention with exercise. That is not usually the case but if one is breathing through a snorkel, a long airway, or a regulator, where one has an extra piece of breathing apparatus that can limit ventilation, there will not be this normal response with exercise. If there is some restriction in the airway then there will be CO_2 retention. That does happen if one has a regulator that resists inspiration. I had one and I never realised it was bad. It was an old double hose, single phase regulator. The tank valve was getting gunked up and over several months the regulator became a little harder to breathe with each dive. I was getting dyspnoea when I dived and I did not quite understand what the problem was. I worked out that I had to draw so hard on the regulator that I was using an extra amount of energy for my respiratory muscles and yet limiting ventilation, so that CO_2 was building up. This can happen, but it is not a normal physiological response. That is just poor care of equipment.

If we look at chronic obstructive lung disease in the same context the first thing we notice is that these people can not ventilate as much as normals. They can not reach levels of exercise that the normal person gets to. They are limited by inadequate ventilation. Tidal volume does not go up much. One of the problems with the chronic obstructive lung disease patients is that they lose their capacity to expand their lungs. Their lungs are chronically expanded with high dead spaces. Aterial CO_2 goes up and arterial oxygen comes down. It starts low and does not change very much with the small amount of exercise that they are capable of. It will in fact go if one can get these patients to exercise enough. These patients retain CO_2 and get severely dyspnoeic with small amounts of exercise.

There is another reason besides the mechanical aspects of the possibility of the rupture of a bleb or embolism because of airway occlusion, why these patients should not dive. They would have a terrible time with the exercise needed to do the normal things you have to do for diving, as they will retain CO_2 and get severely dyspnoeic.

Another kind of lung disease that can be a problem is the diffusion abnormality. In the United States the most common diffusion abnormality in a young person who might want to dive is sarcoidosis. It is not a common disease, but on the other hand it occurs in the population of young people who might want to take up diving. They get interstitial infiltrate in the lungs, which causes diffusion changes. Their ventilation is not affected because the airways and alveoli are normal. The tidal volume may be reduced by some stiffening of the lungs. Remember with diffusion abnormalities it is oxygen that is a problem. CO_2 diffusion is usually unaffected, so CO_2 will go down as there is excess ventilation. The arterial oxygen content will be low at rest, so these patients get hypoxic when they exercise because they do not get enough oxygen into the bloodstream. A patient with a diffuse interstitial process in the lung, who seems to have a normal airway function is still going to have trouble, at least with the exercise aspect of diving. They can run into problems with acute oxygen deficits. It is unreasonable to argue that since one can provide oxygen at higher partial pressures, diving ought to be the sport for these people. I do not think that argument is valid. We should not put these people in the water in the hope that the higher PO2 that they inspire underwater will help their diffusion of oxygen. They will probably still be limited. It is not worth taking anyone with an interstitial process in the lung diving, even if their mechanical function looks good. They are going to have trouble in the water.

INVESTIGATIONS

One of the advantages of a chest X-ray is that sometimes it shows something that is unexpected. One such thing was a cancer in the right upper lobe. I suppose that the one argument for screening chest X-rays is to find things that one does not expect. One would not expect to get much out of screening chest X-rays in the average population. For

diving candidates over the age of forty or fifty, a routine chest X-ray may be worth while. But for the younger population, late teenager and young adult, it is not reasonable to do a screening chest X-ray.

It used to be that there was a fairly high incidence in the United States of tuberculosis infection. Not the disease per se, but a healed infection. Until the 1960s it was said that one third of the population had evidence on the chest X-ray of old tubercular infection, a Ghon complex with a nodule. So screening chest X-rays were considered useful to pick those people up. But the incidence of a TB infection in the population is low now, probably ten percent or less, that is, asymptomatic infection leading to chest X-ray changes. So even screening for TB with a chest X-ray is being dropped. If there is any concern, people are now using tuberculin rests for screening rather than using a chest X-ray.

Screening chest X-rays are to pick up some underlying process in the lung. One may want to do them in the older population, because they are more likely to have something like a nodule show up in the chest X-ray.

One of the ways that one can find out the extent of a bulla is to do a lung scan. Unfortunately the sensitivity of a scan is even worse than the X-ray to pick up small pleural blebs. So neither is going to be very useful.

A problem that comes up once in a while is old tuberculosis. Active TB with a cavity is obviously a contraindication to diving. Is somebody who had had an old infection leaving a little scarring of the apex, especially a large number of adults who have tiny flecks of scar at the apices, going to have a problem with diving? I do not think so. These people do not usually have problems with their chest function and a small amount of reticulated density at the apex should not really be a reason to keep these people out of diving.

CONCLUSIONS

I think that when there are gross abnormalities of the lung one should not allow diving. That would include anything that looked like a cancer or tuberculous gland because they cause some airway obstruction. Obvious pulmonary disease is not a problem.

The problem with spontaneous pneumothorax is going to be around for a long time and the way to detect those sub-pleural blebs is always going to be a problem.

The ex-asthmatic who is asymptomatic and who has not taken drugs for years is going to be a problem because they seem to show up every now and again, for no good reason, with an asthma attack that would have been unpredictable based on their past experience. I guess we are stuck with not knowing when these people will get an asthma attack associated with diving. Other than that I think one has to make individual judgements. I would opt for studies when one thinks a study is going to prove an abnormality present, rather than the other way around. I am against using studies to prove normalcy, because what one is doing there is trying to prove the absence of disease. Usually one can do that by careful evaluation of the history and the physiological examination. If somebody has no history of asthma then I do not think one has to prove that person does not have asthma. On the other hand, if somebody says he had asthma, one would like to prove that he had airway obstruction, then a pulmonary function test would be useful and likewise a chest X-ray. If there is something in the patient's history or physical examination that could be verified by chest X-ray, then I think one ought to get a chest X-ray. I do not recommend a chest on everybody with the idea that one might find something that proves normalcy. It is just a big screening effort that is relatively unproductive.

Question:

What about diving after chest wall injury?

Dr Fred Bove

Generally, I would say yes to that. I have known at least three people who have had some traumatic problem with the lung. A commercial diver had an empyema which needed a partial rib resection with a big drain. That all healed up. He now has an area of pleural thickening at the left base. He dives without any problems. I think such a lesion would not produce any bleb on the lung. If anything, the result is to produce adhesions in the pleural space which would prevent a total lung collapse. After a stab wound, or some other traumatic injury, when the lung has reinflated, the chest dynamics are normal and if there is no severe anatomic derangement inside the chest, then that person could probably dive.

Dr Bruce Bassett

In the USAF some flyers who have had a spontaneous pneumothorax have returned to flying after surgery to strip the pleura.

Dr Fred Bove

Thoracic surgeons are really hot on that. They feel that if they strip away the entire pleura then there ought not be any problems in the thorax. Say a patient had four recurrent spontaneous pneumothoraces on the left side, so the surgeon goes in and strips away the left pleura. What about the right pleura? Remember that the lesions are usually bilateral. Should one clear him to dive, if he has not had his right pleura stripped? I suppose that if a commercial diver had a spontaneous pneumothorax and wanted to get back to diving, he could argue that stripping the pleura would make him eligible for diving. I think he would have a hard time arguing with the company, but the Air Force and the rest of the military are flexible and may let you do that.

Question:

What about cigarette smoking and diving?

Dr Fred Bove

When somebody comes into me who smokes, I rip the cigarettes out of their pockets, throw them in the trash can and stomp on them a couple of times. That is just an attitude that I have. I think the more violent you are against cigarettes, the more your patient thinks you mean it. Cigarette smoking can cause bronchospasm. Invariably with a heavy smoker one can hear their lungs wheezing. There are often little scattered areas of atelectasis that cause a few rales and crackles and snorts in the lungs. A chronic heavy cigarette smoker has terrible sounding lungs. If I hear wheezing, I say "I am sorry, you just cannot dive. Come back in 3 months after you have stopped smoking and we will see what you are like then." If a heavy smoker is demonstrating problems with airways on physical exertion then I would not clear him. That is another situation where chest X-ray will not tell you very much. Small changes in the airways just will not show up on a chest X-ray. A smoker with enough changes in his lungs to show up on a chest X-ray is a symptomatic chronic lung patient.

Dr Ian Unsworth

You say that you are not very concerned with pleural adhesions and pleural thickening because there might be less likelihood of a pneumothorax. I got the impression that you were very concerned about the onset of pneumothorax underwater. I wonder whether a very stiff lung, or a lung that has areas of thickened pleura and areas of normal lung parenchyma, might not in fact be more prone to something far worse than pneumothorax, in other words, an air embolism. It seems to me where the pleura is adherent to the chest wall in certain spots, then if that lung was put to any overpressure then the pleura is not going to slide properly and therefore the risk of lung tearing and air embolism is increased. Could you please comment on that? I am not concerned about pneumothorax underwater, but I am concerned about differential stretch in the lung tissue and therefore small tears.

Dr Fred Bove

I am not aware of adhesions to the lung causing a problem like that. It is theoretically possible, but the experience I have had with those kinds of problems are relatively limited, about ten people. I do not have an answer. It is a good theoretical consideration.

Dr John Knight

Professor Colebatch, in Sydney, studied a number of people who had burst their lungs and his paper suggested that they had areas of extra stiffness in their lungs which explained why they got their pulmonary barotrauma better than anything else. But he has only published one paper on about eight or nine divers.

Dr Carl Edmonds, who referred these RAN and other divers to Professor Colebatch, elaborated on the concept of regional variation in lung compliance being responsible for pulmonary barotrauma. Unfortunately the recording was too faint to allow transcription.

Dr Janene Mannerheim

Some people occasionally wheeze when they have hay fever. I have had long arguments with these people about their suitability for diving. Should one test them before and after bronchodilators and exercise? Would you say that they can dive when they do not have hay fever?

Dr Fred Bove

One gets into enormous battles with these people. They only wheeze during the worst hay fever season. When the season is over, they do not wheeze any more. One decides they can not dive. One does pulmonary function tests because one is convinced that they are going to have abnormalities. Do the tests in the fall, instead of the spring, and they have perfectly normal pulmonary function under all circumstances. Now what should one do? I do not know. I suppose that one could say that in the fall when there is no hay fever, diving is alright. It seems to me that one has to test them every year, to prove they are normal in the fall, then let them dive for three months, and stop when the hay fever starts in spring.

A lot of these people ultimately develop asthma. They have recurrent hay fever, then all of a sudden they have asthma along with it. I do not like to have these people in the water because they get a little allergic stimulus when they are off on a trip somewhere and then they start diving with some bronchospasm. Maybe the answer to that is to tell them "I will clear you for one year and you have to come back for pulmonary function tests very year". That is going to chase half of them away, because pulmonary function tests are expensive.

Dr Janene Mannerheim

We have been doing both expiratory and inspiratory X-rays. We have picked up sarcoidosis and hyperinflation and medium sized bullae and TB in Argentinians, Greeks and Indo-Chinese. I feel that it is worthwhile continuing to do X-rays, even if there is only one positive in two hundred.

Dr Fred Bove

I guess it is the population. If one is picking up significant pathology in a certain population, you have to be flexible.

The population I was talking about is the teenager or the young adult, who has been in the local community all his life. I do not think one is going to find one in two hundred in that population. It is more likely to be one in five or six hundred. In the transient population, if you know they come from an area where some kind of pulmonary problem is endemic, then I think it is worth while.

Dr Janine Mannerheim

If someone has fragments of bullets throughout his lungs, with scarring around them, what would you say to that?

Dr Fred Bove

I would say that they would probably have some airway obstruction somewhere. It does not take much to cause pulmonary barotrauma. The US Navy experience in submarine escape is that they can not predict who is going to get an air embolism. All the submariners had pulmonary function tests and inspiratory chest X-rays. Anybody who had an abnormality was taken out of the programme. Everyone who was doing submarine escape had passed all their screening tests. They trained them thoroughly so that they were exhaling during ascent yet they could not predict who was going to get an air embolism after this thorough screening. What they said was that there was probably some local, small airway that was obstructed enough to put some air into the arterial system and cause a cerebral lesion. It can be a very small obstructed airway or segment of the lung that you cannot pick up.

In submarine escape training they still do all these screening tests, but they still expect a small incidence of air embolism in spite of these tests and the fact that all the trainees are going to do their rapid ascent in a perfectly normal way.

Dr Janene Mannerheim

If a person has a history of sarcoidosis and they have been on steroids and finally they have a normal chest X-ray, can they dive then or will they have areas of scarring that one cannot see?

Dr Fred Bove

The first thing to do is thorough pulmonary function studies to make sure that they have no sort of obstruction. After that, I do not know what to say. The chronic sarcoid patient usually does have some damage to the lung interstitium with some airway obstruction. It can be detectable or it can be below the level of detection by normal pulmonary function studies. So it is a hard question. With somebody who had significant sarcoid lung disease and required steroids, I would probably not let them dive. Because although they have a normal looking chest X-ray, they still end up with permanent parenchymal damage to the lungs, some scarring here and there and probably somewhere some airway is going to be obstructed. It only takes one little obstructed airway to cause trouble.

Dr Mike Page

In doing diving medicals there seems to be a small proportion of people who have no history of asthma, nor history of allergy, who on physical examination on forced expiration had a wheeze, usually in the right upper zone. They have normal pulmonary function tests and normal expiratory chest X-rays. Is there any reason for this or is it just my ears?

Dr Fred Bove

You are right. Everybody has a type of wheeze in the right upper zone. It is one of the major right upper lobe airways, which is near the chest wall and it is easy to hear. It is not really a classic, high pitched wheeze. In is a little lower pitched. We also have to be careful about calling normal findings “abnormal”. It is a fairly characteristic finding with rapid expiration in the right upper lobe.

Question:

Why will the submarine service not take people with abnormalities on their chest X-rays?

Dr Fred Bove

The crew will be underwater for three months or more and because of their operations they do not want to come to the surface. So they are very careful about the health of the submariners. Part of the screening process for submarine escape fits into this. They do not want anybody who is going to have the risk of anything happening to him in the submarine service. They figure that if they put men with abnormal chest X-rays on board, they may lose them if they ever had to do a submarine escape. Submariners, enlisted sailors and officers, are all very carefully screened medically and psychologically.

Question:

People who have fairly low FEV_1/VC ratios, have lungs that are more at risk than normal. Why not recommend a slower ascent rate?

Dr Fred Bove

I guess it is the same old thing. In sport diving if you say that a person is fit for diving and he gets a certificate, there is not organisation in the United States that puts a limit on the card. All it says is “Certified Diver” not “Certified Diver who must ascend at no faster than 25 feet per minute”. It does not say “Certified Diver, but not to dive deeper than 33 feet”. There are no limitations put on it. As far as I am concerned, it is unwise to assume that a person is going to always remember, including under stress, to ascend at a slow rate because he has problems with his lungs. I would much rather just not let him dive.

OTHER MEDICAL DISORDERS AND DIVING

Dr Fred Bove

Various disorders come up frequently enough that we need to spend a few minutes on each to try to decide what to do when somebody walks into the office with such a problem.

The first two are highly controversial subjects in the United States. They have generated a tremendous amount of disenchantment with the diving medical community and an awful lot of hostility amongst the people who want to dive and have either epilepsy or diabetes.

EPILEPSY

There is a population of young epileptics who are well controlled and who were told by their physicians or neurologists that they really should consider themselves normal and capable of anything that anyone else can do. So they get involved in certain kinds of sport. They are not supposed to play contact sports like football or hockey or anything like that, but they can get involved in some sports and do reasonably well.

The usual problem is the college student who has been well controlled for a number of years and wants to get into physical education programmes as part of his training. He finds available on the college curriculum, a scuba diving course. He has never been stopped from doing things, except playing football or hockey. There is enough forewarning about that.

When an epileptic wants to dive, the approach that is taken is that an epileptic who requires drugs to maintain control is not allowed to dive. That is the standard approach in the United States because of the problems of stimulating seizures with either hyperventilation or hyperbaric oxygen. We will not let a person who is taking drugs for a seizure disorder dive. These people are not a problem.

The problem comes with the person who has had a seizure disorder as a child and perhaps requires drugs for three or four years. The fits stopped as he grew older. When he is seen, he might have gone for five or six years without any seizures or drugs. The question is, how to deal with that person?

John Hallenbeck, who is a neurologist, would opt for not letting those people dive. He is a navy doctor who by occupation is conservative in the diving business, and would not clear that individual. If the person really insists on diving, then he would do an EEG, with the usual hyperventilation stimuli and so on. If the EEG is perfectly normal, and there has been a long interval of no seizure disorder, then that person might be able to dive. Again, we do not know if there is an added risk for that person in diving. There is not enough experience with such people.

If one were to take a totally conservative approach to an epileptic who was clearly an epileptic as a child and required drugs, who slowly got off drugs and has not had a seizure, one would say no to diving. If he came back and insisted on diving, then I would do the test with the idea of demonstrating abnormal function when there is a good case to keep that person out of diving. I will not clear these people unless the EEG is totally normal with the various stimuli. One could even opt for an EEG with hyperbaric oxygen, which is not a common or standard procedure.

If the individual has been asymptomatic for five years or more, is completely off the drugs and the EEG is totally normal with the various seizure stimuli, then I might approve that person for diving with some depth limitations so that he is not exposed to high pressures of oxygen.

Another problem is the person who has a history of an occasional febrile seizure in childhood and who has never had a fit since then. Those fits are not precursors of chronic epilepsy in most cases.

Dealing with a 20 year old who has never had a seizure since he was three or four and all of which were associated with high fevers, I would not be concerned at all.

So the spectrum goes from no diving whatsoever in a drug dependant epileptic to a hesitant contraindication to diving in an epileptic who is off the drugs but who had a history of epilepsy for a long time, even if five or six years have gone by since stopping drugs. If he comes back, I would get an EEG with hyperventilation and other stimuli. If that is perfectly normal and shows no evidence of a focus developing with the various stimuli, then I would probably allow diving with some limitations, mainly hyperbaric oxygen limitations.

DIABETES

Diabetes is becoming more and more of a problem in the United States. There is a large population of insulin dependent juvenile diabetics who are in their late teens, early twenties and beyond who have been told by their physicians that the insulin gives them good control and they should not regard themselves as handicapped in any way. They play sports and do almost anything that they want to do. This generates a problem when they come to take a scuba course. Obviously these people would not even get through the front door of a commercial diving firm. But in the sport diving world we have to deal with the diabetic on insulin.

The diabetic who is not on insulin, who wants to dive, such as the forty-five year old man who is overweight and has a family history of diabetes is no problem. If he wants to

dive he must first lose 50 lbs. Chase them out of the office with a diet and exercise programme. I tell them to come back in six months, 50 lbs lighter for a repeat blood sugar test. Often after the exercise and the weight loss the blood sugar will be normal and the glucose tolerance test will be normal. Then he is not a diabetic any longer and no longer a problem. I have had to do that with some US Navy divers. They are just as inclined to get heavy as anybody else. Occasionally there is one who gets obese enough, and who has a family history of diabetes, that his sugar goes out of control. That scares a navy diver, because they first got into diving because of the extra money. It is easy to motivate a navy diver. The first thing one says is "Your diving career is over unless you can come back in a few months with your blood sugar under control." They get their weight down. Weight loss is a simple solution which is thrown right back to the diving candidate. If he wants to dive he has to lose weight and get his sugar under control. Inevitably an obesity onset adult diabetic will get his sugar under control by losing weight and getting exercise.

The juvenile diabetic is not so easy. This is the diabetic who basically has his islet cells destroyed and fibrosed over a time for whatever reason. These people do not have the opportunity to regain control of their blood sugar by diet or weight loss. They have no, or very few, islet cells, and cannot secrete insulin so they have to have it replaced. Oral agents will not do it, or may do it for a brief period early on, but the long term treatment for these people is daily injections of insulin. The problem with both insulin dependent diabetes and drug dependent epilepsy, is sudden, unexpected and unpredictable unconsciousness underwater which is almost 100% likely to produce a drowning.

Some diabetics argue that they will be alright because "I am diving with a buddy, and I have a syringe of glucagon my bag, and I have a hard candy and orange juice". If the diver had trouble at 70 or 80 feet underwater, it is very difficult for a buddy to give intramuscular glucagon at that depth, even if he has a syringe with him. Things need to be done very quickly to somebody who goes unconscious at depth or that person drowns. What if a diver carries a syringe of glucagon strapped to his leg while he is diving? Who is going to give it to him? All his buddies have to be trained to pull the syringe out, find a bit of bare muscle somewhere and inject the glucagon.

As far as I am concerned the insulin dependent diabetic should not be diving. It generates a tremendous amount of discussion. In the United States there are insulin dependent diabetics who are diving. I have been getting letters in Skin Diver like "My husband is a diabetic (insulin dependent) and the best thing he has done in years is to take up a scuba course. We have written a long disclaimer to NAUI, PADI, or whatever it is and disclaimed any responsibility for the diving organisation, the doctor and anyone else."

In the United States any disclaimer is worthless if they get a bunch of lawyers who are willing to fight the case. They can always find a hole. They will ask "Did you explain in fine detail that the diabetic might not be able to get glucagon at 77 feet because his buddy was not trained to give the syringe through a wetsuit?" If one has not explained that the disclaimer is no good. One must explain everything properly.

I also get these kinds of letters. "My husband is an excellent diver. He loves his course. He loves diving. Whenever he comes up and gets the shakes we give him some hard candy and in half an hour he is OK." That is an admission that the guy is having trouble. The last letter I got like that was the story about having the syringe of glucagon in the dive bag, with hard candy and orange juice, and if anything happens we will be ready to take care of it. I wrote back and asked what would happen if the problem occurs at 100 feet? What are you going to do? Have you trained the people you are diving with to take care of the sudden unconsciousness in the water? Do you have someone who know how to give glucagon intramuscularly? If you become a little flaky, do they know that it is a hypoglycaemic reaction which they are going to have to give you something for?

Worse than that, some of these diabetics go off on their own on a vacation and end up on a dive boat with a bunch of other people who do not know anything about their medical history. I can imagine the scenario of an accountant sitting in a dive boat and the guy next to him says "Here is this syringe and needle. What I would like you to do if I get a little funny ..." The accountant just screams and runs away.

I have not yet been able to find an argument to remove the absolute contraindication for diving for an insulin dependent diabetic, so I do not think they should dive. I have talked to a number of diabetic specialists in the States, who are involved with sport and athletics, and they all agree that this is the one sport where sudden unconsciousness cannot be tolerated. If a swimmer suddenly becomes unconscious in a pool there is someone to pick him up. But unconsciousness cannot be tolerated underwater.

There are insulin pumps which give a continuous dose of insulin. It is regular insulin, the short acting kind that one gets from one's pancreas. The pumps are programmed to increase the insulin dose at meal times. These diabetics are under fantastically good control. Their whole metabolism changes back to normal. They have a very low incidence of hypoglycaemia reactions. There are even pumps designed to sense the glucose level and respond to it appropriately. The problem of deciding whether a pump supplied diabetic can dive is at least five years away, so we can think about it and be ready for it when it comes along. I think that these people should not be diving even though they have better control than we have now. We do not know about the effects of pressure on insulin pumps. At the moment the insulin dependent diabetic should not dive.

BLOOD DISORDERS

Factor VIII Deficiency

I have had one person with a factor VIII deficiency who was under good control with plasma transfusions who wanted to dive. These people usually have a terrible time. They bleed all the time. They develop terrible arthritis and a lot of tissue scarring from haemorrhage. Nowadays they are well controlled with plasma transfusions. A diving instructor called me and said "I have a haemophiliac who wants to dive. He looks pretty good and claims that he is under good control. What do I do with him?" I discussed this with a haematologist and decided that he should not dive because their ability to clot varies a lot. When they are near the point where they need a plasma infusion they start to have bleeding problems. These people do not just bleed from a cut. They get subdurals or massive haemarthroses and scarring of the joints and things like that. Patients with bleeding disorders and that includes patients on anticoagulants, should not dive. It is a rare dive that one does not come back with blood leaking out of the body. Those minor traumas would be magnified. Also the blood trauma that one gets from diving, that we can disregard most of the time, can be lethal to someone with a bleeding disorder. So those people should not dive.

Abnormal Haemoglobins

There are patients with anaemia. I do not mean the guy who just lost three litres of blood from an ulcer, but the chronic anaemias from abnormal haemoglobins. We have a reasonable population of sickle cell disease in the United States. People with sickle cell trait will be cleared for diving in the military, as long as their haemoglobin is acceptable. Their haemoglobin is usually between 11g% and 13g%, compared with 13g% to 15g% in the normal population. The decision made by the military was in fact a political decision, not a biological decision, because it was claimed that there was racial discrimination against the people with sickle trait in both aviation and diving. So the powers that be decreed that people with sickle trait would be allowed to dive. Now there are people in the United States Navy diving with sickle trait and they seem to have no problems.

The problem is if they become hypoxic, they may sickle and have a crisis or renal failure. So far that has not happened in diving. I think there was one aviator who had a sickle crisis at high altitude in an aircraft, in spite of the politicians, who claimed that there would be no problem with sickling at high altitudes.

What does one do with a budding sport diver who has a haemoglobin abnormality? He maintains a haemoglobin of perhaps 11g% or 10g% and wants to dive. We have seen a number of people like that. Sickle trait people do quite well diving. Most of them do not have problems with sickle cell disease.

With any of the variants that have small amounts of abnormal haemoglobin with a majority of A type haemoglobin, when the haemoglobin levels are quite reasonable, there does not seem to be any reason not to dive. There are people who have a haemoglobin of about 11.5g% to 12g%, which is about 1.5g% below normal, who dive and do not seem to have any problems. I recently cleared a Navy diver with spherocytosis which produced a haemoglobin level of about 11.5% to 12g%. Ha has had his spleen out and has mild chronic anaemia. He was a vigorous young man who was one of the champion athletes of his area, and he did fine in diving.

One can make judgements in terms of the haemoglobin abnormalities based on what the haemoglobin is and what the person's exercise capacity is. The military were more or less forced to approve sickle trait people for flying and diving. As there have been no problems, I think it is quite reasonable to let such people go sport diving. However, if the haemoglobin is low, 7g% or 8g%, I would not allow diving. I think the cut off should be around 11g% of haemoglobin. Below that one starts to get incapacity from limitations to exercise.

RENAL DISEASE

The next problem would be the renal hypertensive patient and the renal disease patient. They are problems because there are occasional persons with mild chronic pyelonephritis, or chronic glomerulonephritis with mild abnormalities of renal function. Most of these people are doing quite nicely. They are going through college, playing sport, and all the rest of it. Then they hear about scuba diving and want to do it. My renal friends tell me there is no real reason to worry about diving in somebody who has got mild renal disease whose blood urea nitrogen (BUN) or creatinine is not elevated, or is minimally elevated, that is, the BUN is below 20. As long as there is reasonably good renal function, the renal folks tell me one can let these people exercise and dive. There is no reason why diving, per se, would affect the kidneys.

HYPERTENSION

The hypertensive patient is a different problem. The uncontrolled hypertensive can get massive blood pressure responses to exercise. These people can get some degree of heart failure because of the high pressures that occur during exercise. A person with a blood pressure of 130 or 140 over 95 at rest might be untreated because the local physician will tolerate small elevations in blood pressure. When he exercises he may push both systolic and dystolic pressure very high, to a systolic of 220 or 230 over 140. That person runs the risk of exhaustion and in fact, of heart failure, as the blood pressure goes extremely high during excitement and exercise. So anybody who has uncontrolled hypertension ought to have their hypertension treated. They should not be diving unless their blood pressure is under control.

How do you get their blood pressure under control? If the entire autonomic system is suppressed with blood pressure

medicines so that the person has to get up out of bed over a six or eight minute period to avoid a faint because he cannot respond to exercise with a tachycardia because of high doses of beta blockers and his vasoconstrictor capacity has been wiped out from a few muscle relaxants, or other alpha adrenergic blockers, he cannot tolerate two things. He cannot tolerate significant fluid shifts in the vascular space, for example sudden head up position, as he will pool blood in the lower extremities and faint. He cannot tolerate exercise because the entire autonomic system is more or less paralysed to keep his blood pressure down. These people will faint sometimes because it is not as easy to remember to do things slowly when one is in a diving environment as it is when one is sitting at home.

So to the hypertensive who is uncontrolled should be controlled. If they require massive amounts of autonomic blocking drugs they should not dive because they can handle neither the exercise nor the sudden positional changes.

The question is, then, where to draw the line in drug therapy? It is a tough line to draw but we have to come up with some guidelines. The first thing I would do would be to take the person off salt, give him an exercise programme and tell him to lose weight, if he is overweight. A small percentage of mild hypertensives, probably 10%, will get good control from that. When a person is under control, then one can clear him for diving.

The next step is still a diuretic, although the consensus is now moving towards beta blockers as an initial drug. To the no salt, exercise and weight reduction one adds a diuretic once a day. If that is all that is needed to get blood pressure control that patient is probably fit for diving, because that does not affect autonomic control very much. All it does is reduce the blood volume a little bit. It does something to the smooth muscle of the arterioles that has something to do with the sodium and potassium balance. One has to watch potassium levels and make sure they have a proper potassium intake. If the person only requires a diuretic and the other non-drug measures to control his hypertension, he can have a good exercise tolerance and can dive.

What is done next is to use a drug that blocks some component of the autonomic system. Usually in younger people we would use the beta blockers. That is probably the next most benign thing we can do for hypertension. Use a diuretic, weight control, salt restriction and exercise plus beta blockers. The beta blocker is an interesting drug because in small doses it will control blood pressure and will not completely inhibit the autonomic system. Somebody on small doses of Propranolol will be able to play tennis or take whatever exercise they want to do and they are not inhibited. The only things that are inhibited are their heart rate response and their blood pressure response. In this case we have a few people diving who are on diuretics and small amounts of beta blockers who have a good exercise tolerance. I usually insist that someone like that get on a treadmill and have their exercise tolerance quantitated if they want to dive. Again the motivation is to prove that the individual can handle it. For the hypertensive who is on anything more than a diuretic, I do an exercise test to find out what his capacity for exercise is. Anybody who is on massive amounts of anti-hypertensive drugs should not be diving because they do not have good autonomic control.

There are a lot of people who suffer from hypertension because they consume too much alcohol. I advise all patients to reduce salt and to cut out alcohol for a while. Them, oftentimes, the hypertension will go away. With uncontrolled hypertension there should be no diving until it is under control. If massive amounts of any hypertensive drugs, with significant inhibition of the autonomic system are needed, then they should not be diving. With the non-drug therapy and a diuretic, diving is allowed. Those on non-drug therapy plus a diuretic, plus small amounts of beta blockers, should be tested on a treadmill for exercise tolerance. If they have a good exercise tolerance then they can be cleared for diving.

PHYSICAL HANDICAPS

There is a move afoot in the United States to start incorporating diving as a sport modality and therapeutic modality for the physically handicapped. By physically handicapped I mean the paraplegic from a traumatic injury of the spinal cord and the amputee with part of an extremity missing, usually a leg. These people are getting into diving all the time. There are some efforts to organise diving for these people so that they can use it as therapy. They claim that it is one of the times that they can feel the freedom that they otherwise do not feel, being confined to a wheelchair.

Paraplegics

What can one do with these people? Obviously they cannot do any type of certification because most of them are wheelchair bound. One would have to have three or four assistants to help him out of his wheelchair, into the boat, dress him and throw him overboard and help him back in.

Obviously they cannot just dive with everybody else. These people are being trained to dive in a very constrained and controlled environment, in a pool, with instructors who are combined instructors and physical therapists. In the pool they swim around and gain some freedom. I have already seen some efforts at divers going into the water in a wheelchair, and then just floating up out of the wheelchair and swimming away. But they cannot do this on their own. One cannot wheel a chair down the beach and keep on rolling into the water and swim away.

This kind of diving is being done and is getting to be a very well accepted therapeutic modality for these people. One may be asked to clear a group of these people. All the things that would inhibit the normal person hoping to dive still count. I consider that paraplegics should limit their diving to a very controlled environment with people helping them.

Amputees

Amputees are a different category. A lot of amputees who dive have either below the knee or below the hip amputation from trauma and they do quite well. They walk onto the boat with their wooden leg, slip a flipper on their good leg, and they swim safely. They have to learn slightly different swimming skills. Many can outswim others because they seem to put more punch into it. An amputee has to be physically fit because there is more exercise involved in walking and swimming with only one leg. I do not think that they could do the kind of climbing that one might need to get to certain dive sites. But the limitations would be physical limitation on the location. Once they are in the water they do very well. If an amputee has no other problems, there seems to be no reason to disqualify him from diving.

PREGNANCY

Pregnancy is not a medical disorder but it is a contraindication :o diving. A workshop was held by the Undersea Medical Society about a year and a half ago, on diving and pregnancy. It was made up of a number of people who were either interested in the basic physiological aspects of pregnancy or the clinical problems. They concluded, both from some cursory, but reasonable, clinical observations and some research on gas exchange in the foetus compared with the mother, that a woman who is pregnant should not dive. There seems to be differences between gas exchange in the foetus and the mother such that the foetus might bend when the mother had a safe dive. Also hyperbaric oxygen is known to cause damage to foetal tissue and even though one could not prove that a woman diving to 200 feet would damage the foetus, it is not reasonable to find out by sport diving exposures. The advice to women who dive, is that they should not dive until the pregnancy is over.

Question:

Have any divers died from insulin caused hypoglycaemia? Do diabetics have a higher chance of developing decompression sickness?

Dr Fred Bove

We had a death in the Atlantic five years ago from an insulin reaction during a dive. That is still the most important reason for debarring diabetics from diving. It is reasonable to expect that the long standing diabetic who is known to have microvascular disease is going to have problems with gas elimination because they do not have the tissue perfusion that the normal person has. Their vascular system is much different. So one would expect that they would be more prone to decompression sickness.

Question: Dr Janene Mannerheim

Should someone who has almost completely recovered from a traumatic spinal injury dive?

Dr Fred Bove

That is a good question. A diver, commercial or sport, who develops a spinal cord bend and ends up with residual neurological damage, is taken out of diving for good because there is a high risk of a recurrence of neurological injury and permanent, severe spinal damage, with further diving. I think that a person with traumatic injuries to the cord with partial recovery so that there is reasonable motor function and some sensory abnormalities is in the same position as the diver who has been bent and has a partial spinal cord lesion. It seems to me that person ought not to dive because of the risk of further injury to the cord.

If you have residual neurological signs of cord injury there is an enormous amount of pathology in that cord, much more than we would suspect looking at the clinical picture. If you add more damage to that pathology, presumably the compensatory mechanisms that are functioning can be wiped out and one gets a catastrophic change of function by a small addition to the injury to the cord. My colleague John Hallenbeck, who is a neurologist, thinks that way. The other person who is doing a lot of work on that is Tommy Palmer in England who is a neuropathologist. He is convinced that whenever there is a cord bend, even though there is a full recovery, there is a fair amount of residual permanent pathology that is not detectable clinically. When these people have a post mortem, later on, one finds scars in the cord which represent permanent damage to the cord which has been compensated for.

People argue that once the cord has been hit it is prone to be hit again and if it is hit again then you are not going to get a small change in function you are going to get a large change in function.

My advice to that person who has had a traumatic spinal injury and still has neurological symptoms is that he should not dive.

And that is basically the same statement I would make to someone who has had a neurological bend who has residual neurological abnormalities.

A commercial diver or a military diver who gets neurological decompression sickness and is treated with full recovery goes back to diving in a month. We are beginning to understand that there is permanent residual pathology in the cord. If there is a neurological deficit after treatment that person is out of diving for good. I think the same concept probably holds for traumatic spinal injury.

Dr Ian Unsworth

Would you agree that patients who are on high doses of steroids, for example, following successful renal transplantation, should be advised not to dive?

Dr Fred Bove

Yes, I think they should not dive.

Dr Ian Unsworth

Do you think there is a danger of synergism between venous gas emboli and steroids increasing the risk of femoral head necrosis?

Dr Fred Bove

These people have a reasonably high incidence of aseptic bone necrosis because of steroids. I had an interesting diver come to me who had a seminoma which had metastasised to his lungs. He was a 45 year old millionaire. As a young guy he had made a lot of money in real estate. He came in with no hair, greyish, with burns on his chest. He had been treated for a fairly bad seminoma. The lesions in his lungs were smaller than they had been and he was on chemotherapy and steroids. He wanted to come down here on a trip around the world and he had been told that he had about a 5% chance of surviving. I just said do whatever you want to do and he did. He wrote me a letter and said it was the nicest trip he had had in his life. He was writing from the Sloane Kettering in New York where he was because of pulmonary metastases. I do not think he is alive today.

Dr Bob Paddock

You did not comment on hearing problems. I recently examined an 18 year old who had a total hearing loss in one ear and a perforated drum in the other with a 20% loss. I rejected him for diving. He went to another doctor, an otologist, but not a diver, and he was passed by the otologist.

Dr Fred Bove

It is amazing that anyone would clear somebody for diving with a chronic perforation. Even non-diving ear, nose and throat specialists know that one should not let somebody submerge their head in water when they have a chronic perforation. That otologist is malpracticing in the United States. Anybody with a chronic perforation should not dive because they will always get water in the middle ear and infection often follows.

Joe Farmer at Duke University tells me that chronic perforations are not because of poor healing in the drum but because of inadequate Eustachian tube function. The perforation is chronic because the person cannot ventilate the middle ear normally. There are ways to treat that. Anyone with a total neurological deficit of hearing in one ear is not fit to dive because if anything happens to the hearing in the other they are 100% deaf, and that is a real problem. Those are two important ENT considerations that do not come up very often in the States because everybody agrees with them, except for an occasional otologist.

Question:

Should people who have had prosthesis placed in the middle ear dive?

Dr Fred Bove

There are people who have tympanoplasties and artificial bones placed in the middle ear. To me that is the ultimate in microsurgery, for someone to grind up a couple of pieces of plastic, shape them like middle ear bones, put them in place, put a new tympanic membrane on and restore some hearing. It only takes one little ear squeeze to wipe the whole thing out. In the States the ENT people tell their patients that the insurance will only pay for the first operation (about $1,800 an operation) so if you want to go diving, put 1,800 bucks in your piggy bank, because when that ear is damaged, nobody else will pay for the repair. They can dive, but they run a high risk of wiping out all that nice surgery. It is not going to hurt the surgery if the person has good Eustachian tube function and knows enough to keep his ears properly cleared.

WHAT SHOULD WE ASK FOR IN A SPORTS DIVER MEDICAL?

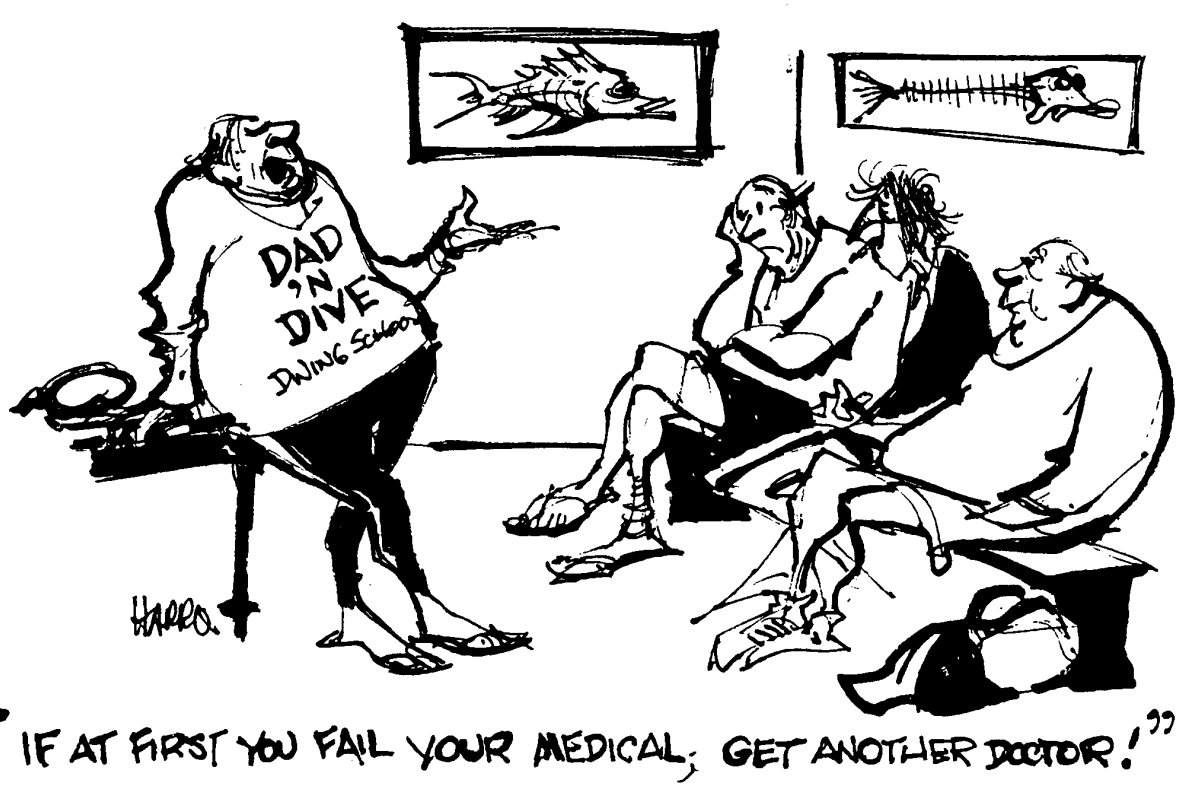
John Knight

The cartoon (Fig 1) which appeared on the front of the SPUMS Journal (July-September 1981) is horrifyingly true. Often somebody who has a physical defect not compatible with safe diving goes to a knowledgeable diving doctor and is knocked back. He then goes to another doctor and suppresses the information about asthma or angina. He cannot suppress being overweight or hypertensive but he can find some doctor who does not know anything about diving. I think everybody would agree that sports divers do not necessarily have to meet the same high standards of physical fitness required for military and commercial divers. For one thing, many of us are very much older than the working commercial or military diver and we do not seem to have more than our fair share of accidents. I approached the idea of producing a diving medical suitable for sports divers by making a list of what I thought were absolute contraindications to diving. (Table 1)

ABSOLUTE CONTRAINDICATIONS

I decided that conditions that were likely to cause you to go unconscious underwater were a complete bar to sensible people going diving.

Conditions likely to cause pulmonary barotrauma make it extremely unwise to go diving, and conditions that cause breathlessness on exertion make it stupid to go diving. Then there are various ear conditions that make diving impossible without risking hurting oneself.



I take the attitude that the doctor is not God, he is just an advisor. So the most one can do with a budding sports diver is to say to him, "Well, I think you should not dive and these are the reasons". Then if he insists on learning to dive it is up to him to find somebody who will teach him. The doctor tells him about his limitations.

Conditions Likely to Cause Unconsciousness

The only medical conditions that will give you sudden unconsciousness are epilepsy and diabetes treated with insulin. Many diabetics do not recognise their hypoglycaemia coming on. There are diabetics who say "I know when I am getting hypoglycaemic and I can take my barley sugar and be right". I ask them, "Are you going to be able to find the pocket in your wetsuit where you keep your barley sugar, unwrap it, take your regulator out of your mouth, pop the barley sugar in, put your regulator back, all while you are feeling rather queer?" Most of them agree that it is asking a bit too much.

As far as I know none of the diabetics who I have told that they should not dive have gone off and found another doctor and got the certificate.

I saw one university student who was an epileptic, not quite controlled, who also had asthma. He wanted to learn to dive, but he listened to me and took up parachuting instead. Hang-gliding is probably safer than diving if you have all the conditions in Table 1.

Conditions Likely to Cause Barotrauma

A previous spontaneous pneumothorax has shown that the person's lung is liable to burst. There is no point in

TABLE 1

ABSOLUTE CONTRAINDICATIONS TO DIVING

CONDITIONS LIKELY TO CAUSE

UNCONSCIOUSNESS

- Epilepsy
- Diabetics on insulin

PULMONARY BAROTRAUMA

- Previous spontaneous pneumothorax
- Obstructive airway disease
- Lung cysts
- Previous thoracotomy
- Asthma

BREATHLESSNESS ON EXERTION

- Asthma
- Obstructive lung disease
- Poor effort tolerance
- Angina
- Coronary artery disease

EAR PROBLEMS

- Inability to clear ears
- Perforated ear drum
- Previous middle ear surgery with the insertion of a prosthesis
- Previous rupture of an inner ear window

exposing him to pressure changes. If there is a cystic area in the lung it usually has a narrower entrance than would be expected for the volume. Some of them do not empty properly. One does not know which are going to empty properly and which are not. I think anyone whose X-rays show lungs cysts should not dive.

Obstructive lung disease has the same problem, the air comes out slowly. If someone with this problem bobs smartly up to the surface, part or all of the lung is going to be overdistended. Professor Colebatch's work in Sydney suggests that some people have lungs that stretch at unequal rates. This causes stresses at the junctions between the unequal rates. The slowly expanding bit holds back and the rapidly expanding bit tears itself off. The result is an air embolism.

I have always thought that a previous thoracotomy could cause problems if bits of the lung are tethered. The lung could tear at the junction between the normal and tethered bits.

Everyone says that asthmatics should not dive, because they are prone to pulmonary barotrauma. David Clinton-Baker's case is the first one I have heard of where an asthmatic has had a pulmonary barotrauma. I have heard of a number of asthmatics who have had respiratory problems diving, but they were breathlessness problems, not pulmonary barotrauma problems.

Conditions Causing Breathlessness

I put asthma first because many asthmatics want to be active chaps doing this and that and the next thing. Give them cold, dry air to breathe, with a little cold water coming in through the regulator and they get the salt water aspiration syndrome. They also get their asthma, and the two together make breathing extremely difficult. Especially if they are using a diving school regulator which do not always function very smoothly. Panic on top of all this gives them real trouble.

Obstructive lung disease makes you breathless on exertion as does poor effort tolerance. That is what the older ones among us have, because we do not stress ourselves very often. I am quite certain that somebody who has angina should not go diving. So far, in seven years doing diving medicals, I have not seen anyone with angina who wanted to learn to dive. People with coronary artery disease should not go diving, for all the reasons that Fred Bove gave.

Ear Conditions

Inability to clear the ears will cause aural barotrauma.

A perforated ear drum will let water into the middle ear. Oddly enough, salt water is not as bad for the middle ear as fresh water. In fresh water practically every time infection follows, while only a relatively small proportion of perforations in salt water get infected. Perforation also puts cold water against the inner ear. This causes vertigo which is not a good idea when underwater.

Previous middle ear surgery with the insertion of a prosthesis means that any failure to equalise can wreck the surgical result. The real problem is that the second time the chances of a good result are much reduced. One is very much better to hang on to the hearing that has been restored. George Gray tells people who he knows are scuba divers that they should give up diving and explains why when he does a stapedectomy.

I think anyone who has ruptured an inner ear window, whether it is diving or lifting heavy weights, or straining of any sort, has demonstrated that he has a weak inner ear window and that it is quite possible that it will go again. One diver I know ruptured an inner ear window, and had it mended. He got his hearing back, which was lucky. He did it again, and got his hearing back a second time after the second repair. I have pictures of drops of fluid coming out of his round window membrane. It really was amazing to see those drops of fluid coming out. We eventually persuaded him to sell his gear. He was lucky to have got his hearing back twice.

I think all these are real contraindications to diving.

RELATIVE CONTRAINDICATIONS

Then there is a group of relative contraindications to diving. Those with a forced respiratory volume in I second (FEV) to forced vital capacity (FVC) ratio below 75% figure in the burst lung statistics more often than they should. They are more likely than normal to burst their lung during an emergency ascent. But by coming up slowly and never running out of air underwater, and not holding their breath when being bounced up and down by the waves, such a person will probably get by safely. I know a lot of divers who have FEV/VC ratios of less than 75% who dive quite happily. One is an abalone diver whose ratio is 55%. He certainly has obstructive lung disease. But he earns $80,000 a year for about 100 days work. There is no other way he can possible earn the same money, so he goes on diving.

TABLE 2

RELATIVE CONTRAINDICATIONS TO DIVING

FEV1/VC ratio less than 75%

Poor physical fitness

Previous myocardial infarction

Pregnancy

Another relative contraindication to diving is poor physical fitness, and that, if we are truthful, applies to a lot of us.

Someone who has had a myocardial infarction or coronary artery surgery should not go diving until he has exercised on a treadmill and proved that he can really turn on the energy.

Pregnancy is a contraindication to diving, but there are very few pregnancies, that go on for more than nine months, so it is a temporary one.

DIVING MEDICAL EXAMINATIONS

How are we going to avoid Fig 1? Diving instructors have an economic incentive to put as many students through as possible. Because more people in their fifties retire now, instead of in their late 60's, there are many older people who feel well enough to go out and learn to dive. We have to try to educate the rest of the medical fraternity. We have got to try to persuade the diving instructor organisations that using doctors who know what they are talking about is a good idea. We have to give some guidelines to ourselves.

The national qualifications scheme for divers in Australia sends out a blue medical examination form reprinted from the previous Australian standard of 1972. It includes various disqualifying conditions such as varicose veins, which is not in the present standard, but VD still is. I can see that syphilis is a drawback to being a fit person, but I do not think that NSU or gonorrhoea, or any of the other venereal diseases really influences one's fitness for diving. I do not think it is necessary for a diving medical to ask that question, so I have left it off my modification of the form (Figs 2 and 3). The medical examination forms from the present standard 2299 (1979) have been printed in the SPUMS Journal.(1)

Specific Tests

I do not think that there is any point in doing ECG's on people who are asymptomatic. That is an anaesthetist's viewpoint. I watch an awful lot of arrythmias come and go during anaesthesia. I never give any drugs, except perhaps some atropine and the arrythmias that have come on during the anaesthetic always go away. Mind you, I have only given some 20,000 anaesthetics, so maybe in the next twenty will be the one that does not go away. But I believe, from my own experience and from the experience of people who have done 24 hour monitoring of asymptomatic people living their ordinary lives, many of whom developed gross abnormalities on the ECG record for short periods without any problems, that most abnormalities do not matter two tuppenny hoots. That is if one is healthy. If there are symptoms it is a different matter. If one has no symptoms, ECG's are not awfully helpful

The paper in the SPUMS Journal (2) by Peter Wilkins tells that the United States Air Force has given up doing stress ECGs on asymptomatic people. What I have read about ECGs as prognosticators of having a coronary, suggests that they are not a good one. There are false positives and false negatives.

Exercise tests are also not good prognosticators. The USAF had one in 20 with an abnormal exercise ECG, but after cardiac catheterisation and selective angiograms, only one in three hundred was grounded. Presumably, the other 14 who were investigated were not in fact positives. I do not believe that a test which gives you that number of false positives, which costs a lot of money to do and which should be done in a proper cardiac laboratory with full resuscitation facilities, and a physician standing by, is good value for money. It is not acceptable to put a person on an exercise bike, put on ECG leads and tell him to pedal away, because there is no way of knowing which one is going to say "I've got a terrible pain in my chest" and collapse.

Chest X-rays I feel are quite helpful because lung cysts are quite undetectable except by X-ray. If somebody is passed on the basis of his history and he happens to have a lung cyst and dies sometime in his early dives, you might feel that you had let him down by not doing a relatively cheap examination.

Audiograms are another thing that people have doubts about. I think they should be done because the man who has damaged his round window twice, had only a mild hearing loss, but we had his previous record, which was an absolutely normal audiogram. There he was with a high tone loss and a bit of loss over the lower tones, and over the next four days it got very much worse. He had done it in fresh water and developed a middle ear infection. Had it not been for the fact that we had a normal baseline in would have been very difficult to persuade the ENT surgeon into the operating theatre. We live in a very noisy society. People go out and do noisy things like shooting clay pigeons or targets, without ear protection. People earn their living driving bulldozers which are very, very noisy. It is interesting that Australian country children have worse hearing than city children, because they travel on tractors from an early age. These are some reasons why I think that audiograms should be done to establish a baseline.

Specific questions

I have added some questions on exercise because that seems to me to be the easiest way of checking up whether a bloke is reasonably fit. If he is playing Australian rules football every Saturday afternoon, the coach will make sure that he takes some exercise between Saturdays. If you are playing a game that goes on for 90 minutes of constant running you are reasonably fit. Recently I have been doing the step test that was recommended for the UK commercial divers (3) on all my diving candidates. That is, they step up and down onto a 17 inch chair, at 30 steps a minute for 5 minutes. They sweat. Then counting for 30 seconds three times, you first take the pulse a minute after they stop stepping, then at two minutes and three minutes. Add the three 30 second pulse counts together and the answer should be less than 190 if they are fit. About 80% of those I have tested pass, most of them quite comfortably. I would not have expected some of those to pass. But they were stepping up and down at the right rate. I do not know if it is a good test of fitness, but it is a lot easier to organise than

FIGURE 2

Diving Medical Centre

MEDICAL HISTORY QUESTIONNAIRE

Please fill in pages 1 and 2

1	SURNAME OTHER NAMES	2	DATE OF BIRTH
3	ADDRESS	4	SINGLE MARRIED OTHER
5	OCCUPATION	6	TELEPHONE (WORK)
8	NEXT OF KIN	7	TELEPHONE (HOME)
9	ADDRESS OF NEXT OF KIN	10	RELATIONSHIP
		11	TELEPHONE

12 DO YOU TAKE PHYSICAL EXERCISE? YES NO

13 DESCRIPTION OF ACTIVITY

14 FREQUENCY

15	ARE YOU EASILY TIRED AFTER EXERCISE?	YES	NO
16	DO YOU GET A PAIN IN YOUR CHEST AFTER EXERTION?	YES	NO
17	DOES SHORTNESS OF BREATH LIMIT YOUR ACTIVITIES?	YES	NO
18	DO YOU HAVE ANY DISEASE OR DISABILITY AT PRESENT? NAME OF CONDITION	YES	NO

19 ARE YOU TAKING ANY TABLETS, MEDICINES, OR DRUGS? YES NO
NAMES

	HAVE YOU EVER SUFFERED FROM OR DO YOU NOW SUFFER FROM ANY OF THE FOLLOWING DISORDERS?	YES	NO	NOTES
20	RHEUMATIC FEVER			
21	SWOLLEN OR PAINFUL JOINTS			
22	HEART DISEASE			
23	HIGH BLOOD PRESSURE			
24	ABNORMAL SHORTNESS OF BREATH			
25	PLEURISY OR CHEST PAIN			
26	PNEUMONIA			
27	BRONCHITIS			
28	COUGHING UP BLOOD			
29	TB			
30	CHRONIC OR PERSISTENT COUGH			
31	PNEUMOTHORAX (COLLAPSED LUNG)			
32	ASTHMA OR WHEEZING			
33	ANY CHEST INJURY OR OPERATION			
34	HAY FEVER			
35	SINUSITIS			
36	ANY OTHER NOSE OR THROAT TROUBLE			
37	DEAFNESS OR RINGING IN THE EARS			
38	GIDDINESS			
39	DISCHARGING OR INFECTED EARS			
40	OPERATION ON THE EARS			
41	WEAR GLASSES OR CONTACT LENSES			
42	KIDNEY OR BLADDER DISEASE			
43	DIABETES			
44	INDIGESTION OR PEPTIC ULCER			
45	VOMITING BLOOD			
46	BLEEDING FROM BACK PASSAGE			
47	JAUNDICE OR HEPATITIS			
48	GLANDULAR FEVER			
49	MALARIA OR OTHER TROPICAL DISEASE			
50	SEVERE LOSS OF WEIGHT			
51	HERNIA (RUPTURE)			
52	ANY SKIN DISEASE			
53	ANY REACTION TO DRUGS OR MEDICINES			
54	ANY ALLERGIES			
55	FAINTING OR BLACKOUTS			
56	FITS OR EPILEPSY			
57	MIGRAINE			
58	SEVERE HEADACHES			
59	SEVERE DEPRESSION			

FIGURE 3

		YES	NO	NOTES
60	CLAUSTROPHOBIA			
61	ADMISSION TO A MENTAL HOSPITAL			
62	OTHER MENTAL ILLNESS			
63	UNCONSCIOUSNESS			
64	CONCUSSION OR HEAD INJURY			
65	ANY BROKEN BONES			
66	ANY INJURY TO JOINTS			
67	ANY BACK INJURY			
68	ANY PARALYSIS OR MUSCULAR WEAKNESS			
69	HAVE YOU BEEN IN HOSPITAL			
70	HAVE YOU HAD ANY OPERATIONS			
71	HAVE YOU EVER BEEN REJECTED FOR INSURANCE			
72	HAVE YOU EVER BEEN UNABLE TO WORK FOR MEDICAL REASONS			
73	HAVE YOU EVER BEEN ON A PENSION			
74	DENTURES			
75	DO YOU SMOKE			
76	APPROXIMATE NUMBER OF CIGARETTES PER DAY			
77	DO YOU DRINK ALCOHOL			
78	APPROXIMATE DAILY CONSUMPTION			
79	MOTION SICKNESS (CAR, SEA OR PLANE)			
80	DO HAVE ANY DISABILITY RELATED TO FLYING			
81	ANY OTHER ILLNESS OR INJURY			
82	HAVE YOU EVER LIVED IN THE SAME HOUSE AS A PERSON WITH TB			
83	HAS ANY MEMBER OF YOUR FAMILY HAD TB			
	FEMALES ONLY			
84	DO YOU HAVE ANY DISABILITY DURING OR BEFORE PERIODS?			
85	ARE YOU PREGNANT?			

DIVING HISTORY

1	APPROXIMATE DATE OF FIRST SNORKEL DIVE
2	APPROXIMATE DATE OF FIRST COMPRESSED AIR DIVE
3	APPROXIMATE NUMBER OF COMPRESSED AIR DIVES SINCE
4	GREATEST DEPTH OF ANY DIVE
5	LONGEST DURATION OF ANY DIVE
6	APPROXIMATE DATE OF FIRST DIVE ON MIXED GASES (PRO DIVERS ONLY)
7	APPROXIMATE NUMBER OF DIVES ON MIXED GASES (PRO DIVERS ONLY)

	HAVE YOU EVER SUFFERED, OR DO YOU NOW SUFFER FROM ANY OF THE FOLLOWING DISORDERS RELATED TO DIVING?	YES	NO
8	EAR SQUEEZE		
9	RUPTURE OF EAR DRUM		
10	DEAFNESS		
11	GIDDINESS OR DIZZINESS		
12	SINUS SQUEEZE		
13	LUNG SQUEEZE		
14	RUPTURED LUNG (BURST LUNG)		
15	EMPHYSEMA		
16	PNEUMOTHORAX		
17	AIR EMBOLISM		
18	NITROGEN NARCOSIS		
19	DECOMPRESSION SICKNESS (BENDS)		
20	NEAR DROWNING		
21	MARINE ANIMAL INJURY		
22	OXYGEN TOXICITY		
23	CARBON DIOXIDE TOXICITY		
24	CARBON MONOXIDE TOXICITY		
25	DYSBARIC OSTEONECROSIS (BONES)		
26	ANY OTHER DIVING INCIDENT		

I CERTIFY THAT THE ABOVE INFORMATION IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

SIGNED

DATE

a 12 minute run and you can repeat it as often as you like.

Hypertension

One worrying thing in Australia is that an awful lot of young men, the 19 year olds, have a blood pressure of 160 to 190 over 70. I put that down to anxiety, excitement etc., and so I do not knock them back if the diastolic is around 70. I think that the stress of "Am I going to pass this medical or not?" puts up their blood pressure, and so I ignore the high systolic. It is a rather pragmatic attitude, adopted because otherwise I would by trying to explain to very healthy young men why they should not dive, when I can not think of an adequate reason. With people who have a raised diastolic. I take a different approach.

FITNESS TO DIVE

I think that only those with my absolute contraindication to dive should be told "No, you should not dive". They must be given the reasons. Everyone else can be told, "You probably should not dive, but this is a way around your problem". One can educate people who have trouble with their ears to clear them more easily. Pregnant women can be told to stop diving while pregnant.

I have given you a Knight's eye view of diving medicals. The floor (and the correspondence column of the SPUMS Journal) is open for everybody else's views on diving medicals.

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Dr Ian Unsworth

I would agree with almost all of what you have said, particularly about audiograms. Aural barotrauma is very common with people who are trying to dive. They are the ones who have not been taught to clear their ears, or they have stuffed up Eustachian tubes. It is helpful to have a baseline audiogram, if as one hopes, these people come back to you and do not go to their General Practitioners. Doctors without diving medical knowledge often diagnose ear infection and put them on antibiotics, not recognising that the eardrum has been stretched and that is what the pain and infection is due to.

Dr Fred Bove

When I was working on the east coast in the US, the university ran a scuba course. We did audiograms for all the students as a medico-legal device just in case the student came back and said that he lost his hearing during the scuba course. It was a curriculum course and there could have been a problem with them suing the school. I wonder how useful the baseline audiogram is in a random population that might turn up in a dive shop for a scuba course and then disperse themselves all over the countryside. That baseline audiogram is unobtainable when they are in a totally different area. In the US we would not do an audiogram on a normal candidate for a scuba course, except when there is a medico-legal problem, such as an institution that would worry about lawsuits. It does not seem to be a major problem in follow up. If somebody comes in with an ear squeeze and says "I cannot hear well" then one can diagnose for the decrease in hearing and treat him and see how he goes. We do audiograms in selected populations rather than in everybody, except for the military and professionals.

It is my understanding that small subpleural blebs are very hard to detect on a $30.00 X-ray and that radiologists would not be able to rule out the presence of blebs on an X-ray unless they took special views. I still wonder whether the ability of an X-ray to pick up a small sub-pleural cyst is worth the irradiation and cost, or whether we should be more selective about whom we X-ray.

I personally am a little more liberal in doing stress ECGs in the older population. In the individual who is asymptomatic one must be careful to make sure that he is not asymptomatic because he never does anything. A person can be asymptomatic because he has been sitting behind a desk for 25 years and has never walked fast in that time. I would be careful when taking the history to make sure, when a person said that he has never had any symptoms, that he had had the opportunity to elicit symptoms in the past.

I agree about the young person with the high systolic pressure. I feel that they get a little excited and their systolic pressure goes up. However, in the younger population, the beginnings of hypertension are based on a high cardiac output, so I have those people come back after a couple of months, when the diving physical is not of concern, just to have their blood pressure taken.

The Harvard Step Test was used for a while in the late forties and fifties to test fitness. I cannot tell you precisely what level of conditioning it tests for. People were not so meticulous about relating VO_2 max to the exercise level when the Harvard Step Test was designed. In 1967, or 1968, we did some work using a Harvard Step Test on divers, which was published in the Archives of Environmental Medicine in the United States. We found that about half the divers in a scuba club did not pass the test. So we gave them a swimming programme. When they came back after three months they did pass the step test. It is a bit antiquated, but it is still useful for looking

at somebody's fitness level. It is easy to do, a watch and an old chair are all you need. However, there are problems with very tall and very short people.

Dr Ian Unsworth

Is it a dangerous test, like running somebody around the block?

Dr Fred Bove

This problem comes up all the time. We used to do a Masters test supervised by a nurse. A physician was not used because we did not have an ECG during exercise so there was no way to make judgement of ischaemia. I think one had to be careful doing an exercise test on an individual. One can be pretty certain by history. The US Airforce study looked at risk factors. They found that if the person had a certain number of risk factors, then they would be more likely to have positive stress tests that would point to coronary disease. In the older population, the over 40's, ask about diabetes or diabetes in the family, about high cholesterol, look at the person's weight, height and blood pressure and level of fitness and family history of coronary disease. If they have a lot of risks, or a history suggestive of cardiac ischaemia, I would not do any kind of exercise tests without ECG monitoring. On the other hand, if you get somebody who is relatively active, maybe plays golf twice a week and does some swimming, then I think you can go ahead with something like the Harvard Step Test which is reasonably easy to conduct. In fact, we do not do Harvard Step Tests, and I would only do a stress test if I thought it was needed.

Question

Should the physician attempt any sort of psychiatric evaluation, or should that be left to the diving instructor?

Dr Fred Bove

One of the most important things one can do is to find out if the candidate is taking drugs. Especially if they are young. There are a lot of kids on drugs who think scuba diving is another kick. There are a lot of kids who are on drugs and want to scuba dive for a sport. I will not clear anyone who is using marijuana or anything worse. These people will take the drugs when they are diving, which will cause them to do strange things. That I think, that one thing, is the most important psychiatric component. I agree that most doctors do not do a psychiatric assessment. I guess a diving psychiatrist does not listen to the heart.

Dr Ian Unsworth

I agree with you about drugs. That was the point of my presentation about the chap who got bent while taking drugs. I am sure many of you have seen people who wanted to take up diving and had been on the hard drugs. Has anyone admitted to anyone that they have been on heroin? I know that a lot of them drink, but in Australia we do not, as yet, classify alcohol as a drug. I have seen two who admitted to having had heroin. There was a third, a girl who started to be very ill while I was seeing her. She went over to the sink and vomited and vomited and vomited. She was really crook. Her boyfriend had forced her to have the heroin before she came. We have to look out more and more for this. A lot of divers are getting away with drugs but for how much longer?

Question:

What age do you think people should start diving? I think in New South Wales 15 is the age, and some schools will take them at 14 if the parents dive. Do you think there are any contraindications to diving earlier than 14?

Dr Janene Mannerheim

I think they have to be sensible enough to understand the theory and large enough to be able to carry a tank.

Dr Fred Bove

I recently wrote an article in Skindiver about age and diving. In the United States the instructor organisations set 15 as a limit for certification. However they will train younger children that they feel are trainable. Say a 12 year old who is big enough to carry a tank around and who can learn. But they will not certify them. They give them an interim certificate that they have to dive with an adult. Then at age 15 they will automatically give them certification. I have a friend in the East, a very active Scuba Instructor, who trained his son to dive at age nine. He had his son diving with him in the Atlantic at age nine, in full wetsuit. Before I wrote that article I went to talk to his son, who is now 30 and assistant manager of his father's dive shop. He has continued to dive all the time and has never had any problems. So you can go below 12 or 13 with special circumstances and a lot of supervision.

Question

How can you persuade the instructors to get their pupils to go to diving doctors or to take notice of the advice given?

Bob Cumberland (Diving Instructor, Melbourne)

We give our students a list of recognized diving doctors. We consult with those people we know in the diving medical field before we issue such a list. We very strongly advise them to go along and have a proper diving medical. Some people do get knocked back and that only reinforces what we are already saying to our students, and reinforce in their minds the importance of the medical.

Dr Fred Bove

In the United States, all instructor organisations have medical directors. They all have a doctor as an official member who represents the medical interests of the instructor organisation. In my experience, the instructors have always wanted to have information about fitness for diving, in addition to better information on diving medicine.

In the United States, for the most part, the doctors that know about diving medicine try to relate with the instructors in their community and get together in seminars and consult over the phone. If you can establish that kind of environment, you will not run into this kind of problem.

Dr Ian Unsworth

The situation in Sydney is not so good as in Melbourne. I am aware that one or two of the bigger dive shops are only too happy to ask the students to go to see their own general practitioner. I think they do this because they are going to get fewer knockbacks because diving instructors are aware that general practitioners may not be so on the ball. I think the conscientious diving instructors are happy to have weak students weeded out before problems occur.

Dr Fred Bove

Has anyone tried to inject diving medicine into the medical schools? We have tried and it seems almost impossible. Occasionally we can squeeze an hour of diving medicine into the medical course.

Dr Ian Unsworth

I think we must get things in proportion. The course costs $200 and the medical about $60 and lasts for quite a long time. Not a bad comparison really.

Unidentified Speaker

When I did the course in Sydney I was told "You can go along to the Diving Medical Centre, but it is inconvenient to go over there, and it is not rebatable. Go and see your local GP as you are a young, fit character, and you should not have any trouble." It is really up to us to liaise with instructors and to get into the dive shop scene.

Dr Ian Unsworth

I think that in Sydney there are sufficient diving doctors for there to be no problems.

Dr Janene Mannerheim

The important thing is to educate the diving schools and instructors to get people to have their diving medicals before they start. I have people turning up for diving medicals the night before their check out dive. I fail up to three out of ten. The need is for education of instructors.

Dr David Clinton-Baker

Diving doctors have got to show that they can offer something more than the ordinary doctor can give in that they are not just there to turn down people, but are also there to give sympathetic and recent advice in a specialized topic. Look at the effect that Tony Slark has had in New Zealand. He permeates the whole diving world. I often feel sorry for Tony, because he gets pestered so much. He always has been willing to give advice at any time.

Unidentified Speaker

We have been talking about instructors and divers being accredited. The other side is dive groups and dive clubs. Reaching these people depends on the initiative of the diving doctors in that community. The differences between Melbourne and Sydney could be partly attributed to this. Just a visit to a dive club meeting and a short talk about decompression sickness to people who did the course 15 years ago is quite valuable and really does change their attitude towards diving and towards safety aspects.

Bob Cumberland

We are finding problems with a number of older, over 45's, who are passed as being medically fit. They pass their swim tests without any problems. Some of them have played a lot of water polo in their youth. But when they are placed under any sort of stress, they become very, very anxious about the skill they are trying to perform. They invariably fail the course because they just do not seem to have the stamina. But I do not think that is quite accurate. I think they are so anxious about what they are doing that they cannot really adjust to the underwater environment. Even though we handle them with kid gloves, we have a lot of difficulty getting them through. Men or woman who learnt to dive in their 20's, 30's or 40's are not a problem generally speaking. It is the older person wanting to learn to dive who seems to me to find it very, very difficult. They are trying to learn to dive with a group that is 20 odd years younger than them. I would be interested to hear some comments.

Dr Fred Bove

That is an extremely important problem. I have suggested that in our university courses that we do not make the older adults (50's and 60's) learn with the college students. The younger kids can learn skills much more rapidly. Unfortunately as we get older our ability to learn dexterity skills goes down. I think the answer to that is to have courses for older adults that are not run at the same pace as a course for the younger kids. One may have to charge more for it. One may have to run it for an extra four or five weeks. The answer is to change the pace of the course, and not have middle aged adults trying to keep up to the pace of late teenagers or young adults. One must tailor the course to the people.

Dr Harvey Chesterfield-Evans

I did exactly what you have described five years ago when I was 55. I did a course at Heron Island, but did not have enough underwater time, so I did another course in New South Wales. The senior diver may be slower with dexterity skills, but one feels that as you have been around a while you will let yourself down if you cannot keep up with the others. So you tend to rush yourself, because you want to make sure that you can keep up with these people who are the same age as your children. There is some pride involved, quite apart from physiology.

As far as a two tiered type of training is concerned, I believe that if you cannot do the course as it is laid down, you should either get fitter, or take up squash or something.

Dr Fred Bove

It is not a matter of "cannot do it". The skills take a little longer to learn. They have to be repeated three or four times instead of two or three times which are enough when one is a little younger. I am not suggesting compromising the training. What has to be done is to slow it down a little, repeating things a little more so that the person who does not have the ability to pick things up rapidly can pick them up over an extra week or so. At the university we ran a continuing education course, which was mostly adults, at that pace. The undergraduate course usually finished four weeks sooner. We ran a fourteen week course, but the undergraduates were done in ten weeks. They were all just as well qualified.

Dr Ian Unsworth

Does anyone think there is any alternative to a person who is judged 'not fit to dive' and a person who is judged 'fit to dive, unlimited'? Dr Bove was talking about this earlier on, and stated 'you are either fit to dive or you are not'. There is no qualification there. Is there a general consensus about putting restrictions on a person's diving?

Dr Fred Bove

I think it is a very good idea to have restrictions, but how can you enforce them? In the States we do not really have much to do with the candidate. He turns up in your office with a form. It has a very cursory physical examination sheet that has to be filled in. All you have to do is tick in a couple of boxes and sign it. That can be done by any physician. There are instruction paragraphs about ears and asthma and things like that on the form so that the physician knows what to ask.

In the United States one gets a card that says 'certified scuba diver'. There is no statement about how deep or where they can dive, when they can dive, or who they have to dive with. The card says 'scuba diver'. Now there are some cards that are more advanced. You can do advanced diving, wreck diving, photography, cave diving, and so on. The fundamental card basically says 'certified scuba diver' and that is all. If an individual is interested enough to come to somebody who knows about diving medicine, then one can advise that person about what to do, one can give him a written statement. But there is no legal or official way that one can enforce it.

Dr John Knight

I think this idea owes a lot to Tony Slark. He says that the doctor is there to advise the diver about any limitations that the diver should place on his diving in order to be safe. For some no limitations. For others you think it would be wise to restrict their ascent rate to 20 feet a minute. For somebody who is not awfully fit, it could be dangerous because he would get very breathless, and be unable to cope, if he goes diving on a day when he might be caught in a current. If you feel that someone is not very safe or happy in the water, a sensible restriction would be "If the weather is rough, forget about the dive, do not go into the water, even if you have driven 80 miles, because you are not very happy in the water, you may get into difficulties on the surface". Most of the fatalities occur on the surface.

I put "Ascent rate limited to 20 feet a minute" on the certificate when a person has a history of asthma but has not has asthma for 20 years. I also put it if he has a low Vital Capacity/FEV ratio. I explain why I have put it and hopefully he will look at his watch and depth gauge and come up somewhere around 30 to 40 feet per minute instead of around 60 or 80. Very few people come up at 60 feet per minute.

I am all in favour of explaining to the candidate anything that would be dangerous for him and how to try and avoid trouble. If he does not want to avoid trouble, it is his life he is playing with. I think our job is to give advice. I think that telling anybody that he should never dive, except for that row of absolute contraindications, is very difficult to justify because I how people who do dive quite safely with all those conditions. I would like to ask Bob Cumberland if he is happy to have students upon who a diving doctor (not a GP) has put restrictions?

Bob Cumberland

Obviously, we are not as happy as if the person was completely cleared to dive. There is a danger of buddying up someone who can ascend at a normal rate or 50 to 60 feet per minute, with a person who knows that he should not ascend at that rate. Something may occur. If you are aware of it, during the course you can probably do something to control his ascent rate. But after they leave our care, no one knows what will happen. A lot of people become disorientated under water, particularly inexperienced divers. People have little idea of their ascent rate. Often with buoyancy vests they come up like missiles.

Unidentified Speaker

I think a problem with your restrictions is that you are examining the patients before they start diving. They really have no background to understand what you are trying to put across.

Dr John Knight

Hopefully, your explanation is something that they will remember. You give them two pieces of paper saying they are fit to dive under the following conditions. One is to give to the dive shop, and one is for them to keep, in the hope that they will perhaps look at it once or twice. People do forget things, and we cannot control their actions at all. All we can do is offer advice.

Dr Peter McCartney

For whose benefit are you writing the conditions?

Dr John Knight

They are an attempt to do what is best for the patient.

Dr Ian Unsworth

There are other restrictions besides ascent rates. The number of dives per day, repetitive dives, depth, decompression or no decompression, all can be mentioned. One is trying to get them to dive safely. We are trying to get them into the water, but not at the expense of their lives or a buddy or two.

Restrictions do not have to be bad. Somebody who is not terribly fit may well be very pleased to have this backup because they can say to their buddy "I am recommended to only do one dive a day", and that is probably all he feels like doing anyway. These recommendations are to me the best argument why these people should be seeing a diving doctor.

Dr John Knight

The happiest bloke I have ever seen after a diving medical was a man of 60 who I told that he really should not dive. His sons (18 and 20) were both doing diving courses and they wanted Dad to go along. Dad did not mind being in the boat waiting for them to come back, but he did not like being in the water. He was only too thankful, when he had blown into the vitalograph and produced an almost flat curve, to be told that he should not dive.

Unidentified Speaker

One of the areas you have not touched on is the transport of a very sick or injured diver. Transport of a bent diver presents some problems.

Dr Ian Unsworth

There are only two ways to transport someone, by air or land. To move a patient from Wollongong to Sydney it is probably quicker by helicopter if you have a helicopter immediately on standby. I am prepared to accept that helicopter vibration is acceptable until proven otherwise. So, if you have a helicopter immediately available, that would be the method of transport. But if you have to call a helicopter down from Sydney, and you have a road ambulance available, the ambulance may be preferable because it will save time. The road between Wollongong and Sydney is quite good now. It is not speed, but a really steady drive that is more important than speed. Under those circumstances, use an ambulance, with intravenous fluids and 100% oxygen.

Dr Fred Bove

One has to get the patient relatively stable, and get him to definitive medical support as soon as one can. The commercial diving industry follows the basic rule that if you have a sick diver, you can put him in helicopter and fly him to a chamber if you do not have one. Most of them have a chamber on site. If they have to recompress a bent diver who is having seizures and there is no doctor there, the best thing they can do is to get the diving supervisor to put up an IV and give the drugs that they have got and wait for a physician to arrive. In the North Sea they have one man compression chambers that can be transported by helicopter and mated onto bigger chambers so they can transport under pressure.

The problem with any remote site accident or injury is that you are pretty well stuck with having to arrange transportation. You would not want to wait for a physician to arrive on the boat before starting treatment. I do not think it is possible to be ready for every contingency that one could consider needing treatment in a remote place. At some point you would have to decide which ones you are willing to take care of on site and which ones you are going to have to transport the patient. The ideal solution would be to have a fully equipped small hospital with a rotor on top of it to go anywhere you wanted it to, taking a doctor, two nurses and a paramedic in it. Short of that you will have to transport the patient sometimes.

Dr John Doncaster

We must make allowances for people's practice and also for the conditions under which they dive. In Victoria, where I go diving once, twice or three times a month throughout the year, it is certainly hard work. It is always cold, even in summer. One really does need to be moderately fit to cope with that. The kind of stuff I do often involves a surface swim, and there is a big difference between that and dropping over the side of a boat and hopefully, not encountering any wild currents, but knowing that, even if one does, one could come to the surface and be picked up. There is a huge difference between the sort of diving we are doing in Madang and diving in the cold waters of southern Victoria. I expect that Bob Cumberland would say that everyone should be trained to cope with Victorian conditions and Madang is just a luxury. But there are a lot of people who only dive in calm, warm waters. What should we do about them?

Dr Ian Unsworth

I think they would elect not to dive in Victorian water. Some people dive once a year.

Dr John Doncaster

Are they safe to be let loose once a year?

Dr Ian Unsworth

I think we can stand by our record, as politicians say. We have yet to lose a member of SPUMS.

Dr John Doncaster

Is that good enough? I feel that for our next meeting we should have an incident report form to be filled in anonymously. It would be interesting to see how often people have close shaves, including such things as dropping

a weight belt and ascending inadvertently.

Dr Mace Ramsay

I think that might well prove a point we have missed. We talk about fitness, but the whole psychological approach comes into this as well. It seems we have a fairly intelligent, probably rational group of divers. I think the incidents have been a lot fewer than one would have expected in an ordinary group of divers of similar experience and physical condition over a period of a week. However we have been lucky. What would have happened if a rain shower had come across while we were in the current? We would be easier to spot if people stopped wearing all blue and black. The British Sub-Aqua Club put that out years ago. I wonder if diving with such large groups is not asking for trouble.

Dr Fred Bove

Several of us who run physical training courses and diving together, have found that there are certain things that are worthwhile. It is sometimes worthwhile to hold a group meeting daily, or at the end of the course to find out what little things have happened. From that you can get some recommendations for the next year on how to avoid ear squeeze, or how to avoid external otitis. Just keeping a record of what ear squeezes occur and things like that is worthwhile so that one can advise the next course how to avoid it.

Diving in a group like this we, in a sense, pressure each other to dive well. For example in the Caribbean, the local dive shop runs a boat that takes on all comers. They sit there until thirty divers appear on that boat from anywhere. The diving off the boat is horrendous. Some divers jump off the boat and disappear into the blue and nobody knows where they went. Some diver jumps off the boat and all his gear comes off, and he flounders around. It really is a disaster to watch them. A group like this, who are basically committed to training each other and watching each other all the time, and putting on a little bit of peer pressure to dive properly and who have all the gear right is one of the best ways to dive. I have had comments from people who come to our course that, they would not want to go on another diving holiday or diving expedition because they did not feel secure enough. When everybody has the same level of knowledge and the same level of concern the diving is done much better.

Dr Bruce Bassett

I would endorse from my own experience what Fred has said. With each group the first lecture is on diving safety, which is what you do. I think it is worthwhile before starting the diving to re-emphasise some safety tips. A lot of people are uncomfortable diving with large groups. In the Caribbean we have 18 to 20 people on a boat, but the diving is superbly organised. Weight belts are taken, tanks are taken, so that we are diving as easy and safe as anywhere. In spite of the numbers it is still good diving, because we are spread out. If one gets into current or drift diving, that has got to be super-organised.

Dr John Knight

SPUMS has come a long way since we went to Truk, which was the first time that we insisted that people had buoyancy compensators. On the first dive people disappeared as their nine weights, without a wetsuit, took them remorselessly towards the bottom. Somebody turned on his Fenzy when this happened to him. He blew up his Fenzy very nicely, but he unfortunately did not turn it off nor let the air out of it. Those things no longer happen. The people who have come back time and time again have improved their level of skills.

There was an appalling series of people running out of air underwater in Truk. Five in ten days were brought to the surface on octopuses. When this was discussed in the meeting one doctor said "But every diver runs out of air at least once a year". That attitude, mercifully, has died and gone away.

I think SPUMS is, for a large group, remarkable safe divers. But we do take chances. Not every boat had a safety line when we were diving in that current. They should have been behind every boat. They were not there because there was no rope in some boats. If rain had come there would have been some very worried people. But we can all float in our compensators, put our snorkels in our mouths, and make sure that we get air to breathe.

This is the sort of thing that is being taught in the diving schools now. What to do when you lose contact with the boat, whereas five years ago that was not done. It was assumed that one would not lose contact with the boat so there was no need to tell the pupils. We are developing a more intelligent attitude. We have not been as safety conscious as we should have been.

Bob Cumberland

In Victoria we do a lot of current diving, which is very exciting diving. What we could have done was to drop a group at a time in the current, with a surface marker buoy attached to one of the divers. They would have flown along that face and it would have been a very exciting and very easy dive. It is a simple matter for everyone to ascend on the line to be picked up by the bat. Most of us have never dived this area before so we are not quite sure what to expect. It is a valid comment, and perhaps we could bear it in mind for the future. As a dive guide here I have been very pleased with the attitude of everyone and the way in which they have conducted their diving. Apart from tanks falling through backpacks, I cannot think of any problem except for sorting our tank straps.

Quentin Bennett

The comment has been made that we should be diving with orange compensators, etc. That is another part of the education of divers.

I have done some work on this, and the colours must be fluorescent. The clearer and bluer the water the redder the

colour of the fluorescent material must be. If you are working in very greenwater, you would be best wearing white luminous tape that shows up pretty well in the water.

Bob Cumberland

I spend a lot of time looking out for divers bobbing up here, there and everywhere. Invariably, because of the reflection of light on the surface of the water, all divers, no matter what they are wearing, appear, at any distance, as black blobs. You cannot distinguish any colour, even if they are wearing a brightly coloured wetsuit, until you are close. In my experience divers are little black blobs when they surface, hopefully not too far away.

Dr Ray Leitch

We have a check list at the end of every dive that includes depth and time. It would be simple to add "Did you have any problems, if so give a report". I find I tend to forget things by the next day.

MIGRAINE, HEADACHES AND DIVING

Rosalind Lloyd-Williams

I have had migraines since I was about 16 and I think I am qualified to discuss it from a patient's point of view, as well as the doctor's.

Migraine has been defined as a unilateral episodic headache.

Many migraine patients often have a prodromal period lasting for 24 to 48 hours before the onset of the headache. Mood changes, appetite changes, urinary or bowel symptoms allow some people to predict when they are about to have an attack. Symptoms associated with migraines are unilateral, thumping headaches, unilateral nasal stuffiness, runny eyes, scalp tenderness, neck pain, nausea, vomiting, diarrhoea and for some, diuresis. Migraines occur in about 10% of the population, but are more common in females by about 3 to 1. However, they are more common in boys than in girls until puberty. Migraine starts early in life. Even a two year old child can have a headache of the migraine type. Children often have abdominal migraine, which then goes on to be the adult common migraine. The point is that 5% to 10% of fit young people who may present to you for diving medicals can be migraine sufferers.

The cause still remains unknown despite wide research. It is terribly difficult to bring on attacks experimentally. In divers it has been found that in deep diving, platelet counts fall, clumping increases and there is an increase in certain enzymes suggesting an increase in metabolic activity, similar to that in the post-traumatic condition, as the diver is coming up. It is the same sort of general inflammatory type of reaction that Fred Bove discussed in relation to the treatment of decompression sickness (see SPUMS Journal, July to September 1982). It is postulated that the divers have some altered vascular chemistry in the frontal area and that these changes are most likely to occur there first. Possibly air bubble formation is a factor.

There are various factors which can trigger a migraine in a susceptible patient. They can differ from time to time in each individual. Changes in blood sugar, either up or down, can cause it. So can changes in sleep, either too much or too little, also dietary factors such as red wine, chocolate, oranges and so on. Tyramine has been postulated to be a factor. Migraine sufferers are very susceptible to glare. Excitement, especially in children, effort and exercise, noise and smells have all provoked migraine. There was a case of a man who only got a migraine when he smelled a certain food. Hormonal factors, especially premenstrual factors in women, precipitate migraine. However, it very rarely occurs in pregnancy.

Cold has been postulated as a factor, but there is no real evidence for this. Migraine suffers are often told to wear wetsuits with hoods to prevent cold. However, during an attack, cold packs to the head can be a great help. Stress can cause it, but migraine occurs after a stress not during it. There is classic 'weekend' or 'relaxation' migraine. I suppose it depends whether one looks at diving as a relaxation or a stress, whether migraine is likely to be precipitated for that particular individual. A fall in atmospheric pressure has been shown to precipitate migraine.

There are very few references to migraine sufferers and diving. However, in 1965 Anderson in "Neurology" published a paper about when migraine sufferers were decompressed from a hyperbaric environment or subjected to a fall in barometric pressure during high altitude flying. They frequently got attacks of headache and visual disturbance. Migraine patients are more likely than others to get headaches when they undergo barometric pressure changes. In the study of four people in a chamber which went down from 66 feet to 135 feet all these patients had headache and an abnormal EEG. Two were 'classical' migraine sufferers, and one 'common' migraine sufferer.

When you are presented with a diver with a headache, there are quite a few things to help you. You have the history of attacks, the recurrent nature of the attacks, and the family history quite often. There is a simple test that has been published in "Headache" in 1981, which tests for vascular dilatation headaches. Vascular dilatation headache improves during a Valsalva manoeuvre and then worsens within two to five seconds afterwards, and is back to the normal level of headache in 15 to 30 seconds. The second part of the test is the Valsalva manoeuvre plus compression of the superficial temporal artery. The pain improves during straining and increases at the end of the strain in external carotid system dilatation which is what happens with migraine.

The differential diagnosis is important with divers. The main thing we have to worry about is confusion with decompression sickness which normally responds to recompression. Migraine does not. Delirium and confusion are not connected with migraine. Other headaches are hangovers, trigeminal neuralgia, cold induced headaches and CO_2 induced headaches which are usually fairly easily diagnosed.

Back to deciding fitness to dive. Migraine patients are barred from professional and decompression diving in the United States and I presume also in Australia. The hazards of migraine underwater are that a large proportion of migraine patients have impaired vestibular function and quite often there is a benign recurrence of vertigo during the attack. There is likely to be vomiting with migraine.

There are hazards associated with vomiting underwater. Migraine can lead to errors in judgement. Very rare complications which may occur are stroke, a monocular visual defect, and transient amnesia, but these are extraordinarily rare, about one case recorded every six years or so.

I feel there is quite a large safety factor with migraine patients. Migraine is not of sudden onset. One has a fair idea of when it is coming. It is very rare for a patient to have a first attack underwater. Patients have a knowledge of their own headache type. One can always stop the dive if one starts to get a headache, or one is feeling sick, or one gets benign prodromal symptoms. If one gets the aura underwater one has at least ten minutes in which to get to the surface, so there is no great hurry. If you have a headache you can assess your responses to analgesics before the dive. Incidentally the increase in CO which you get with the diving environment is helpful.

I shall only mention drugs briefly to alert people to the fact that migraine sufferers are often on such things as beta blockers or clonidine.

I feel that patients normally should be allowed to dive with migraine unless they are known to have really severe neurological symptoms every time they get it. I have never had migraine underwater and have had no problems with diving over the past five years. I should be interested to hear of anybody who has had trouble with migraine underwater.

Dr Bill Douglas

In my experience unilateral headaches following diving are not uncommon.

Dr Rosalind Lloyd-Williams

This is quite possible. Postural changes can start a migraine. An abnormal position can trigger an attack. The main danger is getting the full blown headache underwater. When you are on the surface, headache and the other symptoms are not particularly important.

Unilateral headaches and neck problems can occur with the weight of the tank. The headache often starts first and the neck pain follows from muscle tension in response to the headache, rather than the neck pain first with the headache afterwards.

Question:

Suggestions have been made that post diving headaches could possibly be caused by CO_2 retention following skip breathing. Yesterday we heard that with exercise there is no increase in PCO_2. Is CO_2 retention believed to be a factor in causing migraine?

Dr Rosalind Lloyd-Williams

The CO_2 retention type of headache is totally different from migraine. It is all over the head, a very severe, thumping headache, often accompanied by nausea. Migraine is typically a unilateral headache. Migraine patients who have had both headaches are quite able to distinguish between them. I feel that CO_2 retention does occur during a strenuous dive, due to the resistance of the regulator.

ROCKHAMPTON MEETING
QUEENSLAND REGIONAL COMMITTEE
AUSTRALIAN AND NEW ZEALAND INTENSIVE CARE SOCIETY
29th and 30th October 1983

ALL SPUMS MEMBERS WELCOME

Draft Programme

SATURDAY 29th OCTOBER

9.00 am	Registration	
10.00 am	Morning Tea	
10.25 am	Introduction and Welcome	I Airey
10.30 am	Envenomation (Chairman)	C Acott
10.30 am	Taipan Snake Bite - Case Presentations	J Orton
10.45 am	Management of Snake Bite in Australia	S Sutherland
11.15 am	Anaphylaxis complicating Snake Bite and its Treatment	I Airey
11.30 am	Clinical Sequelae of Snake Bite	A McKillop
11.45 am	Panel Discussion	
12.00 md	LUNCH	
1.30 pm	Underwater Medicine (Chairman)	I Airey
1.30 pm	Hypothermia	J Knight
1.55 pm	Drowning - The Initial Insult	A Holloway
2.10 pm	The Drowned Lung	V Callanan
2.25 pm	Salt Water Aspiration Syndrome	B McKenzie
2.35 pm	The Cerebral Sequelae of Drowning	P DeBuge
2.50 pm	Panel Discussion	
3.00 pm	Afternoon Tea	
3.30 pm	Envenomation (Chairman)	K McLeod
3.30 pm	Management of Spider Bite	S Sutherland
4.00 pm	Sea Snake Envenomation Case Presentation	H Mercer
4.15 pm	The Box Jelly Fish Sting	J Williamson

4.30 pm	Blue Ringed Octopus - Case Presentation	H Stephens
4.45 pm	Panel Discussion	

SUNDAY 30th OCTOBER

9.00 am	Underwater Medicine (Chairman)	M Culwick
9.00 am	Decompression Sickness Case Presentation	J Orton
9.15 am	Decompression Sickness An Overview	B McKenzie
9.40 am	Oxygen Therapy in the Water	J Knight
10.00 am	Transportation of the Bends Patient	C Acott
10.15 am	Panel Discussion	
10.30 am	Morning Tea	
11.00 am	Free Papers (Chairman)	H Stephens
11.00 am	Patient Selection for the ICU	A Holloway
11.15 am	Faciomaxillary Problems in the ICU	R Jones
11.25 am	Discussion	
11.30 am	Problems of the Country ICU	M McDonald
11.40 am	Discussion	
11.45 am	TPN in the Private ICU	R Galley
11.55 am	Discussion	
12.00 md	The ICU Ambulance	K McLeod
12.10 pm	Discussion	
12.15 pm	Data Processing in the ICU	M Culiwick
12.25 pm	Discussion	
12.30 pm	Close of the Academic Meeting	
12.35 pm	LUNCH	
2.00 pm	AGM Queensland Regional Committee ANZICS	
3.30 pm	Afternoon Tea	

EUBS BARCELONA

The European Undersea Biomedical Society will be holding its 9th congress at the Hotel Ritz, Barcelona from 23rd to 25th September 1983.

The official languages will be English, Catalan, Spanish and French. Simultaneous translation in all these languages will be provided.

The invited lecturers and their papers are:

Prof AA Castane (Spain)
"Positional balance in relation to the underwater environment"

Dr X Fructus (France)
"New concepts on diagnosis and treatment of decompression sickness"

Prof RI McCallum (United Kingdom)
"Bone necrosis in divers: A review"

Dr DJ Bakker (Holland)
"Clinical application of hyperbaric oxygen: Past, present and future indications"

Dr DF Gorman (Royal Australian Navy)
Dr TG Shields (United Kingdom)
"Review of arterial gas embolism as a consequence of pulmonary barotrauma"

For further details contact:

Secretariat
IX CONGRES DE LA SOCIETAT EUROPEA DE BIOMEDICINA SUBAQUATICA
Sepulveda, 45-47
Barcelona 15, SPAIN

SPUMS ANNUAL SCIENTIFIC MEETING 1984

Next year's ASM will be held in three parts.

April 7th to 14th
at Phuket Island Resort, Thailand.
April 14th to 17th
at Bangkok, including a combined Conference with the Royal Thai Navy.
April 18th
At Hong Kong, where there will be a meeting with local and SPUMS speakers.

The guest speaker will be Surgeon Captain RR Pearson, who is the Royal Navy's senior diving medical officer. He will be speaking at all three meetings. His topics will be:

Oxygen, the diver's friend or foe?

The problems of caring for sick or injured divers in compression chambers.

Medical screening of professional and recreation divers.

Dysbaric osteonecrosis, is it a major problem for divers?

Saturation diving, a review of military experience and associated research.

The management of divers with audiovestibular problems.

Presentation and diagnosis of decompression illnesses.

Arterial gas embolism in diving and in clinical practice.

The deep trial unit and the Admiralty Marine Technical Establishment (Physiological Laboratory) (AMTE PL).

The Institute of Naval Medicine and controlled atmosphere research.

A brochure will be posted to all members during the next month.

EXECUTIVE COMMITTEE OF SPUMS

By the closing date for nominations (30.4.83) only the following nominations had reached the Secretary:

President	Dr Chris Lourey
Secretary	Dr Chris Acott
Treasurer	Dr John Doncaster
Editor	Dr Douglas Walker
Committee Members	Dr David Davies
	Dr John Knight
	Dr Janene Mannerheim

Consequently there is no requirement for a ballot. These members will form the Committee after the 1983 AGM.

JE MANNERHEIM
Secretary SPUMS

LETTERS TO THE EDITOR

A copy of this letter was sent to the Secretary of SPUMS.

Bass Strait Medical Services
Main Street Medical Centre
281 Main Street
BAIRNSDALE VIC 3875

2nd May 1983

The Hon Mr T Roper,
Minister for Health,
Treasury Place,
MELBOURNE VIC 3000

Dear Mr Roper,

HYPERBARIC OXYGEN TREATMENT AND MULTIPLE SCLEROSIS

Research work in recent years (1,2,3) has shown the value of hyperbaric oxygen (HBO) in the Management of Multiple Sclerosis.

I wish to submit that instituting such a programme in Victoria is both urgent and timely.

The following factors I believe are cogent:

a) the illness is crippling and widespread and its unresponsiveness to treatment in the past has generated a highly emotional response in the general public;

b) general knowledge of the research work cannot be far away. An article has already appeared in the mass media some months ago;

c) the treatments as used by Fischer and Neubauer, are simple and effective but require expensive facilities with a modest labour input, and small maintenance costs.

However initial cost benefit analysis on the basis of Fischer's work suggests that HBO treatment would be effective in reducing hospitalisation, drug costs, etc., as well as immensely improving the quality of life and the productivity of the patients.

Medical supervision expertise (for treatment) would be at the level of a competent general practitioner-anaesthetist, who understands the use of an intercostal catheter, and recognises the possibility of air embolism, although this is extremely unlikely with an established protocol;

d) although both authors disclaim their work as a general recommendation, the evidence, even at present, is sufficiently strong to warrant early utilisation as a matter of urgency (Appendix 1);

e) the lead-up time to establish-such a programme with an appropriate purpose-built facility, is of the order of two years.

It would therefore seem advisable for the Health Department to appoint a committee to report urgently on the earliest means of establishing a suitable facility in Victoria.

Two walk-in, low pressure facilities do exist already. They are the MMBW chamber at Carrum and the RAAF chamber at Point Cook. Both would need some modifications. However this and many other matters require investigation; and in the light of points (a) to (c) above, I believe the matter to be humanely, medically and even politically, urgent.

If I can be of any assistance in furthering this matter please let me know.

Yours faithfully,
CG McFarlane
B Agr Sc, MBBS, FACOM

Dr McFarlane, who is a member of SPUMS, is the AMA Representative on the Standards Association of Australia, Committee SF17, "Work in Compressed Air". He is also Diving Medical Officer, Diving Division, National Safety Council of Australia, and Diving Medical Officer for Esso Australia, Oceaneering Australia Pty Ltd and Comex Australia Pty Ltd.

REFERENCES

1. Fischer, Boguslav H, Marks M, and Reich T. Hyperbaric-oxygen Treatment of Multiple Sclerosis. A Randomised, Placebo Controlled, Double-blind Study. *N Eng J Med*. 1983; 308: 181-186

2. Neubauer RA. Treatment of Multiple Sclerosis with Monoplace Hyperbaric Oxygenation. J *Fla Med Assoc*. 1978; 65: 101.

3. Neubauer RA. Exposure of Multiple Sclerosis Patients to Hyperbaric Oxygen at 1.5 to 2 ATA: a Preliminary Report. J *Fla Med Assoc*. 1980; 67: 498-504.

APPENDIX 1

Dr Phillip James is Lecturer in Occupational Medicine at Dundee. He is a member of the executive of the European Undersea Biomedical Society and enjoys very senior consultant status throughout the world in hyperbaric and diving medicine. He has published widely in the field and has made many original contributions.

15th April 1983

The position with regard to the HBO treatment of Multiple Sclerosis has changed considerably since my Lancet article. The Fischer trial has now been published in the New England Journal of Medicine (1) and in my opinion, probably represents the best controlled trial in the history of medicine. This should end the speculation because it confirms the results in uncontrolled studies, totally well over 1,000 patients.

We have now completed the treatment of over 160 patients in Dundee and find the same levels of benefit. I have no doubt that this treatment should be offered to all multiple sclerosis sufferers as a matter of some urgency.

Yours sincerely,

PB James
Senior Lecturer in Occupational Medicine
University of Dundee

NATIONAL SAFETY COUNCIL OF AUSTRALIA

VICTORIAN DIVISION HYPERBARIC EMERGENCY UNIT

On 11 March 1983 the Underwater Training Centre in Sydney became a Department of the National Safety Council of Australia, Victorian Division, and has been relocated into new facilities at Morwell, Victoria.

With it, the National Safety Council of Australia has established essential hyperbaric facilities normally used for training which are ideally suited for emergency treatment of decompression sickness of divers, etc.

Hyperbaric Chambers

The National Safety Council of Australia has four decompression chambers.

A 20 BAR 1800mm internal diameter, twin lock, chamber with capacity for up to ten persons, linked to a COMEX bell simulator with a wet chamber for training dives up to 200 ft. Oxygen bibs, environment control system, ECG connector, suction, are fitted to the chamber.

A twin lock, 1800mm internal diameter, chamber with oxygen bibs, with capacity for up to 8 persons with a working pressure up to 12 BAR. These two chambers can be linked together for saturation purposes.

A mobile, twin lock, 1800 mm internal diameter chamber with oxygen bibs, video control system, capacity for up to 8 persons, mounted on a semi trailer. It is complete with independent power, air and mixed gas supplies, and has a working pressure up to 12 BAR.

A transportable 2 man Drager Duocom chamber rated to 6 BAR, complete with CO_2 scrubber, oxygen and life support system with a duration of up to 8 hours.

The hyperbaric facilities are run and maintained by the National Safety Council of Australia, Victorian Division, in conjunction with the Bass Strait Medical Services and with the co-operation of the Latrobe Valley District Ambulance Service, as a hyperbaric emergency unit.

The Drager transportable chamber can readily be transported in a National Safety Council Bell 212 helicopter or King Air fixed-wing turbo-prop 200C aircraft. The chamber can be locked to the National Safety Council stationary chamber system, or the National Safety Council mobile large decompression chamber. This is done by means of an international bayonet flange which we hope will ultimately become common at decompression chambers throughout the country. This system permits transfer from the small transportable chamber to the larger units which contain all the necessary treatment facilities such as suction, oxygen bibs, ECG connections, video monitoring and environment control system.

Arrangements

The service will utilise existing National Safety Council/ Ambulance infrastructure for alert purposes which will ensure that the facilities are available 24 hours per day, 7 days per week throughout the year. The emergency hyperbaric unit telephone number is 051 - 34 4666 at anytime.

Costs for transport and medical treatment are expected to be covered by health insurance or alternatively transport will be charged at cost to the patient. In cases of hardship, the National Safety Council of Australia maintains a non-enforcement policy. It is expected that medical practitioners will submit their own accounts to the patients.

The National Safety Council of Australia is well experienced in such operations and has been running ambulance helicopters for the Latrobe Valley District Ambulance Service and a number of other emergency transport systems for some years. Our King Air aircraft has excellent endurance and can travel from Morwell (Victoria) to Sydney (New South Wales) in 1 hour, 40 minutes and from Morwell (Victoria) to Brisbane (Queensland) in 2 hours, 45 minutes.

The system will be operational from mid April 1983.

For technical details contact:

John Friedrich
National Safety Council of Australia
Victorian Division
051 - 34 1726
34 5212

For medical details contact:

Dr Peter Laverick
Dr Geoff Macfarlane
Bass Strait Medical Services
051 - 52 3055

COVER STORY

HISTORY OF AUSTRALIAN SPORT DIVING
MIGHTY MEN IN DYED SANDSHOES

Edward du Cros

In the 1920's "Goff" Gapp and Denzil Wells, as schoolboys, were among the first spearfishermen in Sydney Harbour. The former later became a doctor and served in Vietnam with a civilian relief unit, while the latter continued to be active as a diver and invented a number of devices which became important in Australian skin diving. Even in 1947-48 there were possibly no more than two dozen skin divers in the whole country. They were regarded by the general public as lunatics, for who else would swim out there with all those sharks? Some of the pioneers were men who had served in World War II with New Guinea or Torres Strait Islanders, who had been pearl shell or trochus divers, but most would have been novices who had heard or read about the wartime "frogmen" or the sport divers of France, California or Florida.

There were only two books available on skindiving at this time. One was in French and described underwater hunting, the other was Guy Gilpatric's "Compleat Goggler". In addition to the belief that large packs of hungry sharks would eat anyone who ventured more that 20-30 metres from the shore there was a groundswell of antagonism from both amateur and professional fishermen who feared that the activities of this handful of spearfishermen would scare the fish even from their offshore locations of longstanding. Nobody thought of them as heroes.

The first spearfishermen wore sandshoes stained green to avoid attracting sharks. They had neither snorkels nor fins, unless they imported them privately from overseas. Skin diving items first started appearing in shops after about 1947. If you needed it, you made it. There were no wet, or dry, suits to protect you from the cold so gradually divers started to wear a wrap-around tunic of rubber inner tube over their woolly jumpers. Weight belts were relatively heavy, 6-12 lbs being common, and survival might depend on dropping the weights quickly. The spears used were often without lines and, like the belts, often required recovering after loss. There is a story that one spear fisherman took down a small hydraulic jack to move rocks to reclaim a lost spear! The technique was to enter the white water from the rocks and hope to meet one of the large fish to be found there. One imitated a large bag of garbage on the bottom and then surprised the fish! A popular method of coming ashore was to be taken to the rocks and dumped by a large wave. This looked harzardous and it was. The basic technique was to allow the surge to take one from place to place rather than to try to propel oneself.

These pioneers included a number of eccentrics. Their retirement and the introduction of commercially manufactured equipment, gradually resulted in the less colourful (and much less dangerous) spear fishing methods practiced today. The introduction of fins and snorkels led to a change to the cruising techniques used overseas and a reduction in weights carried. Discontinuation of the climbing about on rocks underneath huge waves was one of the factors associated with a great increase in the popularity of the sport. Another factor was the realisation that there were alternatives to hunting fish. These included diving to locate wrecks, underwater photography (both still and movie) and marine research to assist museums and universities. Yet another new element was the number of very attractive girl skin divers being added to the scene! In the early days of only spearing fish, the sport had been almost totally a masculine affair.

Not all the pioneers were resolute, brave, rash or stupid. One individual I remember was a rich young man who bought the latest model Studebaker every year. He was equipped himself with gear imported from France. It was his habit to load his equipment into his impressive car and to proceed to a place where there was sheltered water. Before entering the water he would take a measurement of its temperature. If the result was below his expectations he would reload his gear into the car and return home.

Another eccentric of the late 1940's was a successful and experienced spear fisherman with a strong dislike for the masks and snorkels available. He had a cast made of his face in a light alloy and he strapped this to his head. There

were two tubes from the mask. One was a short hose with a one-way valve, for the exhaled air. The other was 5 metres of hose which ended with a funnel air intake mounted on a six metre long alloy raft/float. He used to float for his fish, thus keeping any hungry sharks well away from his position. It could also serve as a lifesaving float if he became washed away, though he usually fished in calm waters for flathead so this emergency was unlikely to occur. Naturally he could only breathe if at less than 5 inches depth. He was a man of massive build and used this strange device for over seven years without any trouble.

Prior to about 1949 skin diving items were not available from stores. The early masks were made from army surplus shaving mirrors: The silvering was scraped off and the glass was mounted, using the mirror's frame, in a piece of truck inner tube. Hints on making such equipment, also spearguns and quick releases were published in the magazine produced by the Sydney divers' group, the Underwater Spearfishermen's Association of NSW. (The name was later changed to Underwater Skindivers and Fishermen's Association of NSW). "The Association" was founded in Sydney and by 1953 had over 400 members, which made it the largest skindiving club in the world at that time. In 1953 two clubs were started for users and owners of scuba gear, which had now become a part of the diving scene. Members of these clubs were also members of the USFA, though the Underwater Explorers Club (which was active for about four years) was not itself affiliated. The Underwater Research Group, which survived, was soon involved in running courses of instruction in the use of scuba and several of the shops which catered for divers began to offer instruction to their customers. At one time a Sydney dive shop dropped the course charge from 5 pounds to nil, but this innovation did not last for long! Meanwhile, the district clubs in NSW, not specifically scuba clubs, became sub-units of the USFA of NSW and the USFA of Australia. These were the predecessors of the Australian Underwater Federation. The AUF is itself the parent body of the Federation of Australian Underwater Instructors. The complicated evolution of the present day diving groups is mirrored overseas, and certainly not to Australia's discredit.

Early speakers to the Association members included Siebe-Gorman staff, hard-hat divers and Lt Cmdr Baterham, the senior "frogman" officer of the RAN. Those who attended these meetings soon became aware of the fact that several members had purchased oxygen rebreather diving units, ex-armed forces, from disposal stores in Sydney. The name used was "Salvus Gear" or "Salvus Suit" although it was an appliance and did not include any piece of clothing. It is a pity that this short phase of our (amateur) diving history is not documented and it is hoped that anyone with any information of any kind will come forward. It would be of great interest to know what decided each owner to give up using oxygen and what became of the sets. Were they taken to the tip, given away to poor relations or sold to unwary later buyers?

The early users of oxygen sets soon realised that they could be lethal, through oxygen poisoning, especially if used deeper than 33 feet. This was particularly so because the users were untrained, unsupervised and often used poorly maintained sets. One set was known to have been sold containing damp, used soda lime, with the suggestion that all that was needed to regenerate it was to leave it in the sun on a rock for a time. One successful user of such equipment was Don Linklater, a diving pioneer still with an active interest in diving matters.

Until the introduction of scuba, there were few women divers, but thereafter their numbers began to increase rapidly. Some, like Valerie Taylor, achieved an international status later.

The first divers, whether as spear fishermen, users of oxygen units or home-made hookah apparatus, were mighty men. It is hoped that people with knowledge of this important period of discovery of ways to enter the underwater world will make their information available to this and future generations. They deserve such a memorial.

(EDITOR: An article by Don Linklater will appear in the next issue.)

HISTORY OF AUSTRALIAN DIVING
THE DICK CHARLES SAFETY BELT

An important instrument in distributing information about divers, their problems, and their equipment was the Australian Skindiving and Spearfishing Digest (ASSD) (under various titles). From the first it contained advice on ways to improve safety. In October 1953 its readers were informed that one of the best known divers of the time, Dick Charles, was starting to manufacture a safety belt capable of supporting a 15 stone man wearing 15 lbs of lead. It was inflated either orally or through activating a CO_2 sparkler bulb. The first advertisement seems to have been published in February 1954 and by April it was claimed to have saved two lives. The last advertisement traced was in September 1961, by which time 21 lives were claimed saved as notified by grateful users to the originator of the belt. Nobody else seems to have produced an alternative belt, though an inflatable bag, the Aqua Pak, was advertised once (January 1958). It is probable that the market was small and interest in safety belts minimal because there were no belts visible on divers pictured in the magazine's pages over the succeeding years. Healthways started to advertise their halter type vest, also an oral or CO_2 inflator mode in October 1964. There was no advertising of vests by other sports shops however, even then.

It is possibly worth a passing mention that by May 1954 the appropriate Government department had started to apply a 12.5% Sales Tax on the belt!

Dick Charles always encouraged users to report their findings and one user had his case reported in the ASSD

(April 1954). The Editor of the day made comments on the safety infringements of the user. It seems that 'diving editors' rode their hobby horses even then: Plus ca change, plus c'est la meme chose! The report reads:

"I have had occasion to put the belt to the test and am happy to report that it performs its function as a life preserver remarkably well.

"I was using an aqua-lung and had pumped air to 750 psi into the cylinder and equalised the cylinder with an oxygen bottle to 1500 psi (commercial oxygen). For about twenty minutes it worked satisfactorily and then I experienced a pain in the chest accompanied by a sensation of total exhaustion. I released the sparkler into the belt and relaxed on my back on the surface for about ten minutes before feeling well enough to climb up the ladder on the jetty.

"I was wearing the lung and about 4 lbs of lead, a sealskin and three jumpers, and carried a Lyle Davis speargun. The belt supported me with my head well clear of the water, even though a heavy swell was running. Since this episode I got cramps in both legs together, and again had to resort to the belt, so, altogether, it has been a Godsend and worth its weight in gold.

"It is debatable whether my hide was worth saving, but my wife seems to think so, and you have hers as well as my heartfelt thanks for a very worthwhile product."

Editor's (warning) note: When Ray mixed oxygen with air he added a couple of dozen hazards, most of them not fully understood, to those already existing. Mixed-Gas diving is OUT. It is highly dangerous. Anything can happen and usually does. (Further discussion followed).

This report indicated that our predecessors as Australian divers set a high standard, and we can only reach a similar standard through conscious effort. We can truly say of the "dream time" of diving that mighty Men strove with the mysterious forces of the underwater world.

REPRINTING OF ARTICLES

Permission to reprint articles from this journal will be granted on application to the Editor in the case of original contributions. Papers that are here reprinted from another (stated) source require direct application to the original publisher, this being the condition of publication in the SPUMS Journal.

IDLE TALK

UNCONSIDERED TRIFLES JUSTIFY "JUST BROWSING"?

Newspaper readers often come across interesting pieces of information with offbeat resonances. A few are here recounted, none of which have been spoilt by research into their truth or examination of the factual basis they claim. For instance, there is the extremely bizarre suggestion that women who have received silicone breast implants are flying into trouble. The basis of this remarkable Public Health warning is the belief that high altitudes and sudden changes of pressure could cause the implants to explode, a warning supposed to have originated in the American Medical Association. *"Theoretically it seems that the silicone implant might expand like a balloon to two or three times its nodal size with sudden change of pressure"* runs the article in "Arielle", the magazine of the Hostesses Association. *"We haven't had any reports of it happening in Australia. The US report was run because we thought it might interest our members" said the Assoc*iation's Safety Officer. This apparent extension of Boyle's Law to cover the performance of fluids has obvious significance to divers. No, the news report was not dated 1st April.

In another breakthrough of American medicine a report records the finding by lecturers at the New York State University of a better method for getting at least the basic medical techniques remembered by students. Graffiti! They wrote out a step-by-step guide to heart lung resuscitation methods next to graffiti on the university's toilet walls and found that their students knowledge and performance of the technique was greatly improved. They have decided to continue the practice and have encouraged other universities to adopt it. Their success in propagating this pedagogical break-through may, just possibly, be indicated by another press story. Apparently, some long-haul airliner was about to be ordered to make a diversion to the nearest airfield because of the crew's failure to identify the cause of a worrying vibration. Fortunately the problem was identified in time. It was a jogger doing an hour's running-on-the-spot in one of the lavatories. You will notice there are no Healthy Lifestyle posters in aeroplane toilets now. This is one more example of the unpredicted flow-on effects which follow advances in knowledge.

In Australia we have become somewhat blasé about sharks, the sighting of a fin off-shore having only a local and short lived effect on swimmers and surfers. Not so the Dutch. When two policemen sighted a 6 metre long Killer Whale cruising off Wassenaar, an elite diplomatic suburb of The Hague, the response was to ban bathing off the North Sea beaches. No reports of whales attacking North Sea swimmers, or divers, have been made public.

On a more serious note, there has been mention of the use of hyperbaric oxygen to ameliorate, or reverse, the course of Multiple Sclerosis, a treatment based on the theory that multiple fat emboli cause the focal damage found in the spinal cord and that oxygen protects the resultant hypoxic

areas. The true value of this therapy is still undecided. Press "leaks" have been given credit for getting a medical journal to publish work on this subject. There have also been some articles on the possibility of finding new pharmaceuticals of value from urine sources, and about the study of Weddell Seals on Ross Island. This is because their dive reflex is believed to offer clues to the Cot Death Syndrome, where death occurs following failure of the baby's respiratory centre to function adequately during sleep. The seals will have their metabolic and cardiac responses monitored by a computer back-pack as they dive to the floor of McMurdo Sound, a depth of 600 metres. Deep diving, remarkably, is thought to hold clues to the switch-off of the respiratory centre in certain groups of babies. There is interest also in whether the dive reflex of pregnant seals includes the uterus in its "vital organs" category.

The Press, of course, latches chiefly onto the dramatic and the tragic. We are all attracted to such stories. As a sad footnote to the above story there is a follow-up on the Australian baby born underwater in a home-made spa pool "*in order to recreate the atmosphere of the womb and ease the child into the outside world"*. Nine months later this careful forethought was negated totally by a moment of prosaic risk-taking on a public road. Even an idle browser may think there is a message here. It is no good being careful part of the time. Divers (of course) are aware of this.

SAGA - THE SUBAQUATIC GERIATRIC ASSOCIATION

Carl Edmonds

Earlier this year I attended a meeting of the South Pacific Underwater Medicine Society in New Guinea. It was my first such meeting for over 5 years, even though I was one of the founders, and the first president. While casting a paternal and benevolent eye (one only) over the milling throng, I was appalled to notice the incidence of bald heads, rotund tummies and other signs of age. Could this be the same group of sophisticated and debonair adventurers I knew only a decade ago? And were they really fit to dive?

The answer to both questions had to be "yes". These are my contemporaries, and if they are unfit to dive, then surely so am I. I therefore have to think of some way to ensure they continue to be classified as fit.

Chris Lowry and Bob Thomas carried out an extensive survey some years ago on the medical examinations required for amateur divers. They found that even in the candidates between the ages of 20 and 30, 20% of them would fail to qualify if the standards for professional divers were strictly applied. In those candidates over the age of 40, 45% failed to qualify.

This group of diving physicians, who presumably would be the more knowledgeable diving physicians of Australia, would have averaged over 45 years of age. They all obtained a great deal of pleasure from their diving activities and in many cases it was now part of their leisure and life style. There is also a tendency for older folk, especially those associated with yachting and the sea, to take up diving as part of their marine life style. It then often becomes a valuable contribution to the quality of life amongst these middle-aged drop outs.

What approach should we take to such a group? I am reminded of two quite different concepts. The first is that of the Sub-Aquatic Geriatric Association (SAGA) and the second is one that could be described (and has been described) as the conventional medical approach. Both Fred Bove and I have, independently, prescribed the requirements for proclaiming older folk as "fit to dive" and the standards are very similar. Fred certainly practices what he preaches, being a very fit and competent diver, whereas I must admit to having experienced many of the New Guinea dives through a slight hangover haze, overindulging also in food and noticing a definite tendency for my clothing to shrink in the humid environment of the tropics. Nevertheless my preaching, as depicted in the latest Diving and Subaquatic Medicine text, paralleled very much the practice as described by Fred Bove in the Diving Medical Update series.

The conventional approach is to prove that all us oldies are really as young in body as we are in spirit. To verify this beyond any doubt we require better than average medicals, and reasonably standardised stress tests, eg. maximal exercise tolerance tests with electrocardiograph monitoring, and assessing both rhythm and ST depression changes as well as blood pressure responses. Even then, we commonly apply restrictions to the diving profiles allowed, to reduce the incidence of decompression sickness in this very important age group.

The approach of SAGA is refreshingly different. Their attitude is that diving should change for clientele at risk. SAGA was initially developed by a dive instructor, Mike Ball, in Townsville, Queensland. There are now many breakaway groups with their own aims, privileges and Articles of Association, but all are based on the same egocentric principles.

The criteria of membership is that one must be over the age of 40 and older than the two members who are proposing him. One would be forgiven for believing that this would result in an ever diminishing number in the society. No so, due to the continuing reduction in the age of each individual member.

The following rules apply to SAGA members:

1. Depth and duration of each dive must be doubled for calculating the decompression requirement and for all apres-dive discussions. Any diving depth stated by the member is fixed, and no discussion or correspondence shall be tolerated.

2. Members shall be helped on and off the boat with their diving gear, and no members shall draw attention to, or poke fun the condition of another member.

3. SCUBA tanks must be carried to and from the site by non-members.

4. Any member too exhausted at the end of the day to open up his own stubby (bottle of beer), may sip from half empty bottles of non-members.

5. Members may take liberties with young female divers, without causing offence.

6. Apart from observing the sun's position relative to the yard arm, members shall be exonerated from all boating activities and especially from those related to the retrieval of anchors.

7. Any member who is also a physician is exonerated from undergoing annual diving medical examinations, but shall remain perfectly fit.

8. Non-members must treat members with the greatest respect. They are to listen intently, as if they are hearing the SAGA's stories for the first time. They are to express admiration and respect for the member's continued youthfulness and courage and the degree of awe shown must directly relate to the age and improbability of the story. There must be no comment made about apparent discrepancies within the story, or between it and previous versions.

9. Members shall be encouraged to partake of medicinal beverages, before and after any diving activity.

10. Non-members must campaign for more genteel and comfortable diving facilities, and for roll-on/roll-off systems for all diving vessels. Soft bunks and hot showers are to be available on all diving vessels used by members, so that the aforesaid member can then indulge in reminiscences of the bad old days when the diving was presumably done under much more adverse circumstances.

It does need to be explained that the author is only an honorary member of this society, and has been so for many years.

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BEWARE THE FOOTED METRE!

(An Incident Report from Project Stickybeak Files)

The subject was a certificated diver, age 46 with 20 years experience of diving. He was on a diving tour in Papua New Guinea and had purchased a new BC and a regulator which had, in the console, a depth gauge with a metric scale, just before this holiday.

The tour leader gave a check-out dive without incident on the first day. The second day there was a dive where there was a drop off to 600m plus adjacent to a ledge at 10m where the boat was anchored. Maximum depths of 30m were advised and the tour leader inspected buddy couples underwater (visibility 150-200 feet), including this buddy couple at 30m. A few minutes later he noticed bubbles in blue water away from the drop off and descended the cliff to find the buddy at 40m looking down on the subject, who was much deeper. The tour leader rapidly descended to the subject, who was calmly taking photographs at 73m with his pressure gauge entering the reserve coloured portion. He forcefully grabbed the subject and initiated the ascent, getting him to the anchor line with his buddy as the subject ran out of air. Spare tanks were available and decompression stops of 1 hour 30 minutes were made (US Navy Exceptional Exposure Tables). No subsequent symptoms of decompression sickness were evident.

The buddy, a relatively inexperienced diver, had (quite correctly) been unwilling to dive below 40m. The subject became quite agitated while decompressing, pointing repeatedly to his depth gauge and the dive tour leader's, which was calibrated in feet. After the dive he was profoundly apologetic and said that he thought he was at 73 feet and was just about to come up.

COMMENT

1. *The diver was used to thinking in feet for depths and had done so for many years.*

2. *The "ideal" diving conditions were unlike anything he had seen before.*

3. *Narcosis at 30m caused him to start reading metric depths in feet, and forget his buddy.*

4. *It was lucky the tour leader was around.*

PROJECT STICKYBEAK

Send incident reports to

DR DG WALKER,
PO Box 120
NARRABEEN NSW 2101

SPUMS MELBOURNE MEETING 20th NOVEMBER 1982

CASES OF SEVERE NEUROLOGICAL DECOMPRESSION SICKNESS WITH VERY DIFFERENT RESULTS AFTER TREATMENT

Peter Laverick

This paper contrasts two cases of severe neurological bends and discusses their management. The second, more complicated case, particularly highlights some of the practical problems of management.

CASE REPORTS

The first case was a 26 year old abalone diver. In 1975, he was diving off the South East coast of Australia in depths varying from 80 to 30 feet of water in three separate dives for approximately 170 minutes. He then ascended fairly rapidly from about 75 feet and did not make any decompression stops. Within five minutes of surfacing there was rapid onset of paralysis of both legs and his right arm. Over the next 20 minutes he also experienced abdominal pain, dyspnoea and numbness of the left side of his face.

After lying on the deck of his boat for half an hour, he was helped into his diving gear and lowered to l0 feet. Within a few minutes power began to return to his limbs and his dyspnoea resolved, but he experienced severe limb cramps. He spent 30 minutes at 30 feet, and then ascended, with a 10 minute stop at 10 feet. His boat then brought him inshore, at which stage he was experiencing pain in his left arm and right leg which was becoming progressively worse.

He was immediately placed in a chamber and recompressed to a pressure equivalent to 60 feet of sea water (fsw) and commenced breathing oxygen from the built in breathing system (BIBS) for 20 minutes of every 25 minutes. This recompression was started approximately two hours from the onset of his initial symptoms.

He was subsequently examined by a medical practitioner about one hour after recompression, while still at 60 feet. He was quadriplegic and shocked, with a systolic blood pressure of 90 mm Hg. Two intravenous infusions were started and saline solution given. His bladder was catheterised and found to be empty. He was given Dexamethasone 20 mg intravenously. Once urine production began he was given Rheomacrodex in saline.

He was held at 60 fsw pressure for three hours and continued the oxygen breathing cycles. During this time he regained full movements of all limbs, but remained lethargic. He was subsequently decompressed on a straight profile at 6 minutes per foot without any relapse. He climbed out of the chamber carrying his intravenous infusion bottle. He had a large diuresis over the next six hours.

Careful examination by the medical practitioner involved, two weeks after the incident, revealed no abnormalities apart from moderate hypertension.

Despite medical advice he returned to abalone diving. He was known to have remained free of problems for the next two years, since when his whereabouts are unknown.

The second case is that of a 35 year old marine biologist who was collecting samples off the South East Coast of Australia. In January 1982, he was diving with two colleagues using compressed air.

They descended to between 190 and 200 feet and spent 12 minutes at this depth. The patient made a brief excursion to approximately 210 feet. His companions did not make this excursion. It was not part of the original pre-dive plan. It is likely he was suffering from nitrogen narcosis.

They had planned to ascend according to the US Navy Table for 200 feet for 15 minutes. This requires a 2 minute, 50 second ascent to 30 feet, then a 1 minute stop, with further stops at 20 feet for 4 minutes and 10 feet for 10 minutes.

At 30 feet he felt very fatigued and developed pain in his right elbow. This remained unchanged until after he surfaced. However, within two minutes of surfacing, his elbow pain became very severe and he was unable to lift the arm above his shoulder. Using fresh tanks, he and a companion re-entered the water and did stops of five minutes at 30 feet, 5 minutes at 20 feet and 10 minutes at 10 feet before surfacing. During this his symptoms improved so that on arrival at the surface he was experiencing only a mild ache in his right elbow. However, over the subsequent 30 to 60 minutes he developed paraesthesia in both hands, loss of co-ordination of all limbs and marked lethargy. It was at this stage that medical help was requested.

On reaching land he was given oxygen by face mask and an intravenous infusion started. Later he was flown at wave top level to a barge that was working in Bass Strait. There was a delay of 7 1/2 hours between surfacing and recompression, largely due to problems of communication and transport.

On arrival at the decompression chamber, he was assessed by a medical practitioner. He was almost quadriplegic with only minimal hip movement, absent power to the intercostal muscles, but good diaphragmatic respiration and anaesthesia below the level of the nipples. His cranial nerves were normal. He had peripheral vaso-constriction with a systolic blood pressure of 110 mm Hg.

He was compressed to the equivalent of 60 fsw using the same oxygen cycles as the first case. There was a medical practitioner in the chamber throughout his treatment. Rheomacrodex and Dexamethasone 12 mg were infused. Calcium heparin was administered subcutaneously and Diazepam was given as necessary to control severe muscle spasm. After two hours at 60 fsw, there had been no

improvement. The decision was made to compress further to the equivalent of 165 fsw on air. In retrospect, I think that was a mistake.

The patient was held at 165 fsw for two hours with some improvement in power, but not in co-ordination. We decided to attempt a cautious decompression using US Navy Table 4. However, on reaching 80 fsw, the patient began to deteriorate rapidly.

At this stage, we decided to recompress to the depth of maximum relief of symptoms, using an oxy-helium atmosphere, and maintaining a partial pressure of oxygen of 0.6 Bar. Over the following three hours the pressure was increased in increments of 30 fsw to a depth of 300 feet. There was no apparent improvement in the patient after 270 fsw pressure.

Assessment of the patient shortly after arriving at 300 fsw pressure revealed reasonable power above the waist, but very poor co-ordination. There was almost complete paralysis of the lower limbs, no bladder sensation and complete anaesthesia below the waist. The patient, doctor, and attendant were kept at this pressure for 102 hours. This was an arbitrary time in the hope of avoiding persistence of a gas phase in damaged nervous tissue.

We feel that it is not possible to determine from the published experimental data a time after which one can safely assume that a gas phase is no longer present. Clearly, the longer the time under pressure, the less the risk becomes.

However, there are factors, such as the psychological and medical care of a paraplegic patient in a recompression chamber, that must be considered. We decided to decompress on the profile shown in table one, while keeping a careful watch on the patient for signs of deterioration. Some of the holding periods were timed to allow sleep periods for the patient and physician in order to minimise the risks of missing an early relapse.

The decompression was completed uneventfully. The general condition of the patient was good, compared to his original problem. He had good power above the waist, but still had weakness in the legs, particularly the right and still required bladder catheterisation.

Full assessment suggested a cervical cord lesion at C5 level largely in the right lateral aspect of the cord involving the ascending lateral spino-thalamic tract and the descending right cortico-spinal tract with posterior column involvement bilaterally, as shown in figure 1. This distribution of damage is highly suggestive of the pattern seen in venous infarction with sparing of the grey matter.

His progress since then has been that of a steady improvement. He has returned to work and is able to walk. The main problems remaining are spasticity of his lower limbs and a contracted, small volume bladder.

CONCLUSIONS

There are several points to highlight from these cases. Both demonstrate the practical problems of adequate treatment in divers who have not considered the possibility of needing recompression treatment. I am sure their attempts at recompressing themselves in water made their lesions worse.

The first case demonstrates (as has been recorded many times before) that early recompression on a long oxygen table can give excellent results.

In the second case, there was a 7 1/2 hour delay before recompression. He showed no improvement at 60 fsw equivalent pressure on oxygen for two hours. The decision to compress to 165 fsw equivalent on air may have compounded the problem with further nitrogen accumulation in the tissues. His condition was so serious that to have completed his decompression from that depth could have led to a fatal outcome.

For practical reasons, it was more appropriate for us to convert to an oxyhelium atmosphere rather than use nitrogen-oxygen saturation therapy. We decided that the risks of oxygen toxicity could be kept to a minimum by maintaining the partial pressure of oxygen at 0.6 Bar. When one is faced with a critically ill patient such as this man, one is justified in recompressing on oxy-helium to the depth of maximum relief, if the chamber being used has that capability.

TABLE ONE

300 - 100 feet at the rate of 8 ft/hour
100 - 60 feet at the rate of 4 ft/hour
60 - 00 feet at the rate of 2 ft/hour

Stops were made at:

55 feet for six hours
15 feet for two hours
10 feet for three hours
5 feet for three hours

Total time of treatment - 189 hours, 29 minutes.

NOTES TO CORRESPONDENTS AND AUTHORS

Please type all correspondence, in double spacing and only on one side of the paper, and be certain to give your name and address even though they may not be for publication.

Authors are requested to be considerate of the limited facilities for the redrawing of tables graphs or illustrations and should provide these in a presentation suitable for photo-reduction direct. Books, journals, notices or symposia, etc., will be given consideration for notice in this journal.

THE MANAGEMENT OF DECOMPRESSION SICKNESS
PROBLEMS AND MISTAKES

Geoff Macfarlane

'Project Stickybeak' has well demonstrated that diving accidents and deaths are multifactorial in genesis. Usually there have been several bad choices or judgements leading to death or disability. Mistakes also occur in assessment and treatment.

This paper, based on experience gained since the first use of the short oxygen table in Australia, at Bairnsdale in early 1968 (1) by my then partner, Dr Palmer, is offered to help others avoid these mistakes.

The mistakes and problems mostly have a simple psychological basis in the need in all of us, and especially in doctors, to avoid the 'Red Face Disease', and to conceal the incidence of the 'Headless-Hen Syndrome'. Hence both doctors and divers often reject or rationalise.

Decompression sickness (DCS) is evidence of diving malpractice in almost all cases. Residual injury is often evidence of delay in treatment or of medical mismanagement.

In most doctors of first contact (ie. GP's and Admitting Officers) there is a serious or total lack of training, knowledge and experience of diving medicine. With these inadequacies, combined with lack of knowledge or referral and disposal, it is surprising that people with serious DCS do not die in the water, or on the beach, or in an inadequate treatment facility.

It should be emphasised that the treatment of DCS is primarily recompression, at maximum oxygen partial pressures. The diving doctor at the chamber also treats the fluid loss, the oxygen toxicity, the coagulopathy and the prostaglandin release.

Table 1 gives the common distortions of information reaching the diving doctor or the doctor of first contact. I have indicated the likely effect on the latter. As well, I have indicated the areas of error liable to occur amongst the more experienced diving doctors.

The common denominator of these varied factors is rejection, often of the objective. But the message is simple. Cases of DCS are almost always more serious than is initially perceived, and do often require more sophisticated facilities and management than is expected at the initial assessment. There is little danger in over treatment.

Two historical concepts need eradicating:

Firstly, In water recompression should be totally rejected. This has been adequately condemned in the August 1982 issue of "The Scuba Diver". (2)

The second legacy, is the nebulous concept of an 'acceptable clinical result' from treatment of DCS. This means that residual disability, ie. failure to improve, is acceptable. This is not so. An acceptable result is one with no detectable residual injury (Wood-Burgess). Residual paralysis (Charles Krebs) is not acceptable. These two cases show the need for speed and the unacceptable results of delay in spite of the use of sophisticated equipment and diving medical practice.

Since the middle of 1982, adequate recompression facilities have been available for sports divers in Victoria.

TABLE 1

FACTORS THAT NEGATIVELY INFLUENCE THE DECISIONS OF THE TREATING DOCTOR AND THE OUTCOME IN CASES OF DCS

DIVER

MINIMISES

Symptoms
(giddiness vs severe pain)
Severity
Depth of onset
Bottom time
Depth of dive (swell height ignored)
Avoidable intra-dive hazards
eg. temperature, current, visibility Equipment deficiencies
Equipment malfunction
Poaching or other peccadilloes
(therefore, frank lies about anything and everything)

MAXIMISES

Time at, and between, stops
Dive conditions
Predive planning (? nearest RCC)
Quality of equipment
First aid knowledge and administration

ATTENDANTS, BUDDIES, ASSOCIATES AND BYSTANDERS

MINIMISE

Likelihood of diagnosis
Severity of symptoms
Progression of symptoms

MAXIMISE

Difficulty of transport
Advantages of the only recompression facility they know

DOCTOR OF FIRST CONTACT

DISREGARDS

The need for speed
The need for specialist advice
The need for O_2, aspirin and IV therapy
The need for a catheter
The need for integration of communication

TREATING PHYSICIAN

MINIMISES

Severity of symptoms
(Increased severity requires a longer table)
Failure to respond
Failure to progress
Need for mixed gases
Need for saturation

A multiplace, 2 lock Recompression Chamber (RCC) is

available for treatment of divers. Access is through the National Safety Council of Australia (NSCA) Gippsland Region, based at 9 Chickerall Street, Morwell. Telephone 051-34-5212 or 051-34-1726, or through Bass Strait Medical Services, 281 Main Street, Bairnsdale. Telephone 051-52-3055 (all hours)(CG Macfarlane, AH: 051-52-4859; P Laverick, AH: 051-52-5233).

The chamber is equipped for mixed gas treatment, as well as saturation, and has complete logistical support, including an ambulance helicopter capable of night flights. The two compartment chamber, which can accommodate two patients lying down or eight seated adults, is mounted on a semitrailer powered by a MAN tandem drive prime mover. Also on the trailer are a diesel generator, a 95 cfm 150 psi compressor, high pressure cylinders of air, medical oxygen and 80/20 Heliox, as well as comfortable living quarters for the attendants. The operational team consists of a treating physician (diving doctor), a diving supervisor and two attendants. Table 2 shows the details of the equipment.

TABLE 2

NSCA MOBILE DECOMPRESSION CHAMBER

SPECIFICATIONS

	Entry Lock	Main Chamber
Length	1.30m (4'3")	2.70m (8'10")
Diameter	1.80m (5'10")	1.80m (5'10")
Volume	3,310L (120cf)	7,252L (259cf)

COMMUNICATIONS

External
- HF
- UHF
- Radiotelephone
- Telephone (Telecom provision fitted)

Internal
- Aqua Air Helium Voice Processor
- 2 National Video Monitors

MEDICAL FACILITIES
- Medical Lock
- 2 Scott oxygen masks
- ECG Input
- Suction unit
- Comprehensive first aid kit
- Oxygen monitor

POWER SOURCE
- 240 Volts/Mains (50m cable carried)
- or
- Dunlite diesel generator 10KVA (fitted)

GAS SUPPLY
- Ingersol Rand Compressor
- Capacity - 98cfm at 150 psi
- Domnick Hunter Filter System
- HP cylinders
- 92,400L (3,300 cf) HeO_2 (80:20)
- 184,800L (6,600 cf) Air
- 92,400L (3,300 cf) Medical O_2

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DECOMPRESSION ACCIDENTS IN WESTERN AUSTRALIA

Harry Oxer

The only treatment chamber in Western Australia belongs to the Royal Australian Navy (RAN) and is at HMAS LEEUWIN, inconvenient located in relation to Fremantle Hospital. A new building at Fremantle Hospital is designated as The Hyperbaric Facility, but at the present the money is not available to buy a chamber. So we continue to use the RAN chamber and are very grateful for the Navy's co-operation in treating our patients.

All diving accidents in Western Australia are referred to the Fremantle Hospital. I will discuss six consecutive cases which presented during the early part of 1982.

I would emphasize that we have seen more cases of arterial gas embolism than of decompression sickness. I believe this may be due to success in indoctrinating divers about the use of decompression tables and the dangers of long underwater times. Perhaps we have not done enough to warn them of the dangers of surfacing in an uncontrolled manner even after a very short time at a very shallow depth.

The first patient was a 32 year old sports diver who was operating on a hookah in about 9m of sea water off Augusta. He was by himself, diving from a small boat, when the compressor motor stopped. He nipped up to the surface. Unfortunately he had never heard of having to exhale on the way up. When he got to the surface he fortunately had buoyancy because he was partly paralysed, confused and dyspnoeic. One of the other boats nearby rescued him.

When he got to the hospital in Augusta, he had upper motor neurone signs in both legs, left complete pneumothorax, and gross subcutaneous emphysema in his neck and chest. He was confused and grey. He was managed with 100% oxygen, catheterised, and an intravenous infusion put up. He was given dexamethasone. A chest drain was put in. He was flown to Perth by the Royal Flying Doctor Service. They provide an excellent retrieval service and have three pressurised aircraft so that the patient can be kept at sea level from any part of the store. If a pressurised aircraft is not available, because all the centres of population where people dive are on the coast, we can fly at almost sea level along the coast.

When he arrived in Perth, he was neurologically assessed, then taken to x-ray. There they took his oxygen mask off as it was getting in the way of the x-ray machine. Soon he had a grand mal fit from hypoxia. Due to his pneumothorax, his PO_2 was around 50 when he was breathing oxygen.

He was taken to the chamber and given a short oxygen table. He got somewhat better. He was returned to hospital. He had bilateral up-going plantars and was agitated and confused. So he was sedated with a thiopentane infusion. He had alternating periods of 100% oxygen and air. Next day he had improved somewhat. He still had paralysis of his upward eye movements. It was later that day when I first saw him and wanted to recompress him again. However, the chamber was unavailable so we treated him with oxygen and fortunately he got better.

Of course, with a serious neurological problem he should have been compressed for longer and probably taken deeper. It was five or six hours after the accident by the time he was recompressed.

The second patient was a fit, 39 year old pilot of executive jet aircraft. The plane went unserviceable in Port Hedland and he had a weekend of fairly hectic social activity. On the Monday morning he took off about 0600 with a full passenger load and found that the air conditioning was blowing hot air the whole time (local temperature was 37°C and humidity was 100%) and the pressurisation was not working. He put the aircraft down and sent the passengers away. He worked on the plane all day. He took it up at 11 o'clock when the same things happened. The next day he got authority to fly it back unpressurised without passengers. They flew at 14,000 feet without oxygen for half an hour, but were getting through the fuel. They saw thunder clouds, and went over them at 28,000 feet using fairly low flow oxygen masks. The rest of the flight took 2 to 2 1/2 hours. He did not notice any problems en route but he was very fatigued and unwell after the landing. When he got home he noticed that he had a blotchy rash, and a creepy feeling in his skin. His colleague had no problems at all, in spite of being very overweight and having a beer belly.

Next day he had aches and pains all over, a blotchy rash and was feeling terrible. His GP was ex-RAAF who said 'Hey lad, you just might have decompression sickness' and sent him to me. We recompressed him on a table 6 and within ten minutes he felt absolutely splendid.

One must remember that not all decompression sickness is due to diving. Many years ago when the RAF used to operate unpressurised aircraft to 48,000 feet people regularly got bent. My two episodes were both after dining in nights. The pain usually went on descent but we had chambers to recompress people if necessary. We knew about it. Nowadays people do not know about it as air forces no longer operate unpressurised aircraft at those altitudes. It is worth remembering that a person who feels lousy, is fatigued and has a rash may have decompression sickness.

The third patient was a 24 year old SAS soldier undergoing scuba training. There was a suggestion that he was not doing very well in his training. He had had about 500 minutes of scuba training, and was doing free ascent training with a blacked-out mask. He did it from 10m and then from 18m. There was an instructor with him and they swore that he did everything right, breathed out all the way and so on. I think that is important as there are a number of cases that we have seen and plenty on record where people do all the right things and still get into trouble. You can certainly suffer arterial gas embolism without holding your breath. This appears to be such a case.

At the surface he was asked how he felt. He said that he felt a bit peculiar. So he was helped the four metres to the raft. He needed assistance to remove his gear. He then said that he could feel bubbles rushing up his arms to his head. He was inappropriately jocular and did not answer appropriately. Then he said he could not move his arm and his legs. He was not believed and was stood up and promptly collapsed over to one side. He was quite clearly paralysed on one side.

He was taken to HMAS LEEUWIN, 7 minutes away. During the trip he was given 100% oxygen and by the time he got there he was getting better.

By the time I saw him he had a right bilateral hemianopia, and upper limb weakness, some strange sensory impairment on his right upper chest and pain in it and his balance was impaired. He was clearly knocked off mentally. He had a right sided sore throat which in retrospect was clearly due to subcutaneous emphysema. We recompressed him ninety minutes after the incident and in ten minutes all his signs had gone.

When he got to Fremantle Hospital he still had some mediastinal emphysema with air tracking up into the right side of his neck. He had no further problems and no detectable neurological abnormalities.

The fourth case was the worst of the lot. The incident occurred at Rottnest Island, a holiday island about 12 miles offshore, to a US Navy sailor from the USS Constellation. He was a certified scuba diver instructor (PADI). They were diving on a wreck from a glass bottom boat in about 15 feet of water. After about five minutes he indicated to his buddy that he wanted to surface. He pressed his stomach and indicated something was wrong. They had been eating lots of hamburgers and a fair amount of beer on the previous day. We think that he probably had severe abdominal colic. He came up all doubled up and we feel that he possibly held his breath as a result of that. The dive was only five minutes at fifteen feet. At the surface he lost consciousness and was given expired air resuscitation. He had shaking and rigors and his respirations were said to be rapid and shallow. He was taken to the nursing post on the island where he was given oxygen. When he got to the nursing post the nursing staff phoned the RAN Medical officer who said "Put him head down on his side and give him lots of oxygen."

Then they got in a GP who was on holiday on the island. He said that the patient was hyperventilating and hysterical and gave some IV Valium. He also suggested stopping giving oxygen. After about half an hour to an hour the patient started to respond and improve somewhat and became reasonably orientated but was complaining of photophobia and abdominal cramp. The sister got onto the US Navy which had about six ships and 5000 men in Perth on R&R and asked for a helicopter and a medic with some oxygen to collect the patient. Two and a half hours later a boat arrived, with no medic and no oxygen and only two men on board, to take him back. His condition seemed reasonably stable, so rather unhappily, the sister sent him off and his diving buddy went with him.

During the 7 to 8 mile transit to the USS Constellation he had four to five attacks, which may have been grand mal. The story was that he shook and then stopped breathing and went unconscious. On each occasion he had to have expired air resuscitation from his buddy. There were no medical people in the boat. He was noted to be losing limb power and sensation. When they got to the USS Constellation the medical officer examined him and sent him to HMAS LEEUWIN and by the time he got there he was in deep coma. HMAS LEEUWIN is a cadet training establishment and the clearance diving team that operates the chamber is not always there, they are often at HMAS STIRLING which is 12 miles away on Garden Island. This was so that day. The US Navy had a submarine mother ship in Perth which had a chamber and eventually, six hours after the accident, the man was recompressed in that chamber. He had normal vital signs but his pupils were widely dilated and he was in deep coma. He was recompressed to sixty feet and became conscious within about 10 minutes but he had a very tender abdomen. His reflexes appeared to be intact. He had gross photophobia. He appeared to be alert but appeared not to understand anything. They just could not communicate with him at all. It was noted that he had no sensation from the umbilicus down and that he had no bladder sensation, so he was catheterised. The US Navy discussed the problem with their Experimental Diving Unit at Panama City who recommended that he should be saturated. Some nine hours later he was coherent and could sit up and could remember what had happened and could converse normally. After 24 hours in the chamber he could stand up and eat and so on. So they commenced a very slow decompression of two feet an hour from sixty to ten feet and one foot an hour from ten feet to four, and a hold at four feet and then eventually to the surface. The problem was that during the end of that decompression he got worse again. As the ship was due to leave they decided to decompress him anyway.

They had rung me up during this time and asked me to see him before they took him to sea. Then they rang and said that he was not as well as all that and they might have to leave him. By the time they brought him to me he was apparently alert but totally deaf in the right ear. He had the most profound expressive aphasia that I have ever seen. I would speak to him and he would look at me and then about a minute later he would give a response which was quite logical. He had bilateral, red bulging ear drums. He had the most appalling photophobia that I have ever seen. We had the curtains drawn and blankets up at the windows and when I opened the door he would scream. One could not see any iris, the pupils were so dilated. We could not examine his eyes at all. In very, very dim light he could just count fingers. He was virtually blind, virtually deaf and had peculiar tetanic-like episodes which resembled decerebrate posturing. He was spastic in his lower limbs and had a stocking pattern of sensory loss. We did the usual investigations. The neurologists wanted to do an EEG and a CAT scan but I managed to get him into the chamber before they could.

I got him in the middle of the night and by the time I had had a look at him and decided to contact the US Navy, for more information, it had sailed. So there I was with what I thought was a moderate to middling sick boy on the third day after his accident. We recompressed him in the RAN chamber to sixty feet and decided to saturate him and push oxygen as hard as we could, giving him oxygen 25 minutes on and 5 minutes off. Four hours later he was much improved and was chatting fairly normally. He was hearing better. On the fourth day he maintained his improvement and by the fifth day he was decompressed on a long slow leak and taken to the Fremantle Hospital.

On examination he still had virtually no hearing in his right ear while his left ear was somewhat better. He still had some photophobia. By this time he could read the 6/12 line on a chart at about 50 cm. Still pretty poor but it turned out to be an accommodative paralysis. With lenses he could improve his vision quite a lot. We were pretty pleased about this because it meant that he had not simply knocked off the neurones in his visual cortex. The audiograms showed sensorineural not conductive deafness. So we recompressed him again on the sixth day for very little change. The audiogram showed an 80 decibel loss on the right and 30 off the left. We did not recompress him on the eighth day but did on the ninth. Quite suddenly, about 30 minutes into the recompression, his hearing came back. He picked up the phone and told me, I was outside the chamber, “I can hear the motors outside and I can hear you all talking outside”. When we tested his right ear it was totally normal and his left ear had a 10 to 20 db loss in the 3000 to 6000 cycle range, which one would expect as that was the ear towards the aircraft when working on the flight deck of the aircraft carrier. His vision was still somewhat blurred but improving.

The fifth case was a 38 year old man who decided to do a diving course. He went to a man who advertises a lot as a trainer of divers, but who has not certification of any sort. He normally trains about 50 people at a time by himself. One of the routines is that he puts four scuba sets at the bottom of the 5 metre diving pool. To develop confidence underwater the trainers take a breath from one and swim to the next one and take a breath and so on. The victim took a breath from one and got a mouthful of water. He coughed like blazes, panicked and shot to the surface. No one had told him to breathe out on the way up. He was unconscious for three to four minutes, his pulse was feeble and the rhythm was irregular. He was given oxygen by oxyviva

and brought to Fremantle Hospital quite quickly. I got the message over the ambulance radio in my car and so arrived at the same time. He was confused and very shaky. His speech was hesitant and respiration was irregular. He had a non-specific loss of sensation from his elbows down and odd feelings of coldness and numbness in his thighs. His haematocrit was a bit raised. There was nothing on his chest X-ray. I considered that he had had a significant arterial gas embolism. The medical registrar on duty felt that it was a whole load of rubbish.

Within fifteen minutes of recompression he was a changed man, completely normal and we had no further problems with him.

The sixth patient was a 25 year old sports diver using a hookah for some crayfish diving. He had spent about an hour and a half at 25 feet and come up as usual on a slow oblique swim up. He was breathing quite normally all the time. At the surface he had chest pain so he drove himself to hospital. It is an excellent hospital about 400 to 500 miles up the coast. When he arrived there he had a pericardial rub. A pneumomediastinum and a pneumo-pericardium were shown on X-ray. There was subcutaneous emphysema in the lower neck. He had no neurological problems of any sort. The doctor there rang me for advice. I suggested that they gave him 100% oxygen for alternate hours, observe him very carefully and if he did not get better to send him to Fremantle. In fact he got completely better and could not understand all the fuss and wanted to dive the next day.

I have no doubt that man has had a tear of his lung substance and has been very lucky not to have had a tear into a blood vessel. I am sure he is at risk if he dives again.

Another air embolism case was a 23 year RAN diver who surfaced rapidly from 15 feet. I believe that he was using an oxygen set. He had two fits as soon as he surfaced. When he was examined he had a left homonymous hemianopia, left sided weakness and proprioceptive deficit. He was clearly confused. He was recompressed to 165 feet on RN table 63. He made a full objective and subjective recovery after about 20 minutes and had no further problems.

These very brief case histories illustrate firstly that all decompression sickness is not necessarily due to diving. Those of us who are involved in recompression treatment should remember this.

Secondly, arterial gas embolism is much more common than we think. In Western Australia we are certainly seeing it more often than we see decompression sickness.

I believe we should be emphasising the dangers of an uncontrolled ascent, even from shallow depths, more during diver training.

AIR EMBOLISM AND CARBON MONOXIDE POISONING

Charles Hackman

At Prince Henry's Hospital we do not have six hour delays between accident and the chamber. Ours are longer, in my first case the delay was 72 hours.

AIR EMBOLISM

Case A

He was an amateur diver who appears to have suffered a severe air embolus while diving with a highly reputable and experienced diving group. However he was not referred for treatment until he finally contacted his general practitioner two days later.

He was a fit 27 year old man who had been diving regularly at weekends for two years. He had dived to 130 feet for twelve minutes. He ascended at '60 feet a minute' and made brief stops at 30 feet and 10 feet before surfacing. So on the face of it he had done things about right.

He then decided to dive again to use up a bit more of his air. He tried standing upside down on the bottom of the dive boat for several minutes to see if he could become disorientated. He claims that he did not. But he became bored, and swam to the surface quite uneventfully.

On reaching the surface he abruptly felt an odd sensation on his left leg. He looked down to see if he had been hit by a shark, but he had not. Everything looked normal but his leg still felt useless although he was able to move it. He swam over to the boat and managed to half pull himself up the ladder before collapsing back into the water, quite helpless. He did not lose consciousness. He was unable to see or communicate in any way. He was dragged into the boat where he was seen again to be hyperventilating vigorously. Shortly afterwards he began to suffer a series of clonic extensor muscle spasms, which were extremely painful, affecting his back, arms and legs. He virtually went into opisthotonos for periods of five minutes at intervals of about 15 minutes. His companions diagnosed hysterical hyperventilation and made him breathe out of a paper bag. Within 30 to 45 his vision began to return and the spasms subsided. By the time the dive boat reached the shore he was able to stand and walk with some assistance, but he had great difficulty controlling his left leg. Soon afterwards, he developed a severe frontal headache, with nausea and vomiting, but these settled in a few hours when he reached his home.

Over the next two days at home he noticed that he was still feeling tired and unwell. He was having difficulty concentrating. He had generalised aches and pains, mainly affecting the muscles that had been involved in the spasms. He also often collided with the furniture, He was unable to position his left arm accurately for tasks requiring co-ordination, he noticed it particularly when he was trying to pour tea. He was quite unable to read consecutive lines of

print. He would get to the end of a line and would not be able to find the beginning of the next line. Finally, presumably after the carpet had become saturated with tea, he consulted his general practitioner. He was referred to Prince Henry's Hospital on the third day after the incident.

On arrival at Prince Henry's he was observed to be very unsteady on his feet and would fall over if he shut his eyes. Movements of his left arm and hand were very clumsy. The examination was suggestive of a cerebellar injury. He had no other signs of neurological damage but he did have an abnormally loud closing sound, pulmonary closure and so we wondered if he had also had some embolism to his lungs. I would be interested to know if this has been seen in other cases of systemic arterial gas embolism.

The differential diagnosis was between a cerebral air embolism from the lungs or possibly some other source, decompression sickness, (although the symptoms had regressed at a time when they should have been worsening), a cerebro-vascular accident, thrombosis or haemorrhage, possibly into a tumour (pretty unlikely), epilepsy precipitated by hyperventilation (possible, but very unusual as he had no previous history of epilepsy of any sort), and finally, hysteria (but this certainly would not explain the pulmonary hypertension, although it could, conceivably, explain all the other findings). There were no other objective neurological findings. The chest X-ray was normal. Because we had already waited 3 days, we decided that we would do a CT scan to exclude some sort of cerebro-vascular accident or tumour. It also was normal.

We decided to recompress him in 100% oxygen at 3 atmospheres absolute (ATA) for 1 hour, then at 2 ATA for 2 hours. If he did get very dramatically better, that would be fine. If he did not, we would send him on to another facility with capabilities for saturation.

In fact, he had very rapid resolution of all his signs and symptoms. However, the following morning, his ataxia had returned very slightly. Although much less than before, it was there. So he had two further similar sessions. These resulted in complete permanent resolution by the fourth day of his stay in hospital, now one week after the accident.

He was reviewed four weeks later when everything was normal, neurologically and cardiologically. He complained of difficulty in writing for the first three weeks after his discharged, but this had now cleared up. He had poor concentration for the first week, several episodes of flushing, and faintness also occurred in the first week. The weekend before being reassessed, he noticed poor co-ordination when he went skiing. He did not notice it any other time, but when skiing he was all over the place. So, clearly, he had suffered some mild, permanent brain damage.

Discussion

The important points about this case are firstly that if he had been treated immediately he would almost certainly not have suffered any significant, permanent, injury. Secondly, that delay can obviously maim or kill a diver who has suffered barotrauma. Thirdly, a point that is not appreciated enough, immediate treatment will not hurt a hysteric. The circumstantial evidence of a recent dive is quite enough to suggest that a diver's illness is dive related. Lastly, despite the dangers of delay, hyperbaric oxygen therapy often does give marked improvement in neurological bends or embolism, even after any bubbles should have dissolved. Of course, it cannot be proved that hyperbaric therapy does more than accelerate an improvement that would have taken place, but it certainly seems to be beneficial.

CARBON MONOXIDE POISONING

We have had two of these cases in the past 18 months. Both were experienced abalone divers over the age of 40. They were both using hookah/demand valve systems with oil free nylon piston compressors. Neither had effective activated charcoal filters. Both were diving in dead calm conditions with known defects in the engine or known faults in the operation of the system.

Case B

The first man was a fifty year old man with no really significant previous history, except for sinusitis and hay fever. He had had an episode of decompression sickness (DCS) some ten years previously. He did a six hour dive, mainly at 60 feet, surfacing briefly every 15 minutes. He may have spent the last one to two hours at 30 to 45 feet, because this was his usual practice, but he had absolutely no recollection of this period. He was using an oil free compressor with dust and water filters on the intake only. He knew that he had a leaking compressor motor exhaust manifold which was close to the compressor inlet manifold. It was dead calm conditions, and he was working close to an overhanging cliff. He had very vague symptoms after surfacing about 5 pm. He came ashore, weighed in his catch, and went home. He showered, according to witnesses, and then, in the shower, two hours after surfacing, he suddenly realised he had no idea how he got to the shower. He did not recall coming ashore. He was totally amnesic for that two hour period. He also realised that he was dizzy and nauseated. He was ataxic. He had blurred vision, myalgia, dysarthria and nominal dysphasia. Eventually he was transferred, via Port Fairy hospital, to Prince Henry's Hospital, by road ambulance with oxygen. There were some subjective improvements in transit. He arrived at Prince Henry's at three o'clock in the morning, 10 hours after leaving the water. By then he was amnesic for the seven hours from 5 pm to midnight. He was slightly nauseated and still had some myalgia. He was noticed to be centrally cyanosed, but when blood gases were done, he did not have low arterial oxygen tension. He also had some decreased power in his quadriceps. This was related to pain. Neurological examination was generally normal.

He was recompressed at 3 ATA for one hour and at 2 ATA for two hours on 100% oxygen. He had some relief of his nausea and his muscle pain. The next morning he felt tired but well and he was only amnesic for the original two hour

period. But later that day he had no recollection of the morning interview. On this occasion some computerised tomography was performed and as usual was normal. However, an EEG showed minor diffused abnormalities.

The diagnosis was that, although he was perfectly entitled to have decompression sickness, he probably had carbon monoxide (CO) poisoning. He was treated with high dose steroids for 72 hours as prophylaxis against possible basal ganglia degeneration. He made a full recovery and returned to work. Over the last 18 months he has not suffered any problems.

Case C

The second case was more recent and was very similar. The diver was a 44 year old man, who also had DCS 10 years previously. By his story, whether one should believe it or not, he had been remarkably good for an abalone diver. He did a four hour dive, with only 30 minutes at 60 feet, one and a half to two hours at 50 feet, 30 minutes at 40 feet and one hour at 15 to 20 feet, with five transient surface breaks. Once again he was using an oil free compressor. He did have an activated charcoal filter, but there was no silica gel filter before it. It was a small, disposable filter cartridge which he changed once a month, if he remembered. He had a new sheller/diving attendant who he had never taken out before. While he was down he noticed that the man was running the main engines for a considerable time while the boat was stationery, and he could not work out why that would be. The man subsequently confessed that he had also kept the compressor running while he was refilling the fuel tank, and on two separate occasions, he had spilt petrol over the compressor. Once again it was dead calm conditions with an oily swell. The diver began to feel unwell in the last hour of his dive. When he got up onto the boat, he breathed some oxygen from a brand new oxygen cylinder that he had there. He did the right thing. However, it was an industrial oxygen cylinder, and there was a very odd smell from it. Later he thought that perhaps the oxygen cylinder was contaminated with another welding gas. At this time he rapidly developed dizziness, nausea, ataxia, blurred vision, tingling in the hands, pain in the right shoulder and in the chest and abdomen. He developed a wide spread itching and a mottled blue skin rash on the trunk which slowly spread out to his limbs. Three hours after leaving the water he arrived at Portland Hospital. By this time, his symptoms and signs had completely cleared except for the rash and the shoulder pain. He was treated with aspirin, steroids, and an antiemetic. A saline drip was put up and he was transferred by road ambulance on 100% oxygen.

We really should not have trusted the story from Portland Hospital because when he arrived he was definitely ataxic. If we had got the story right we probably would not have accepted him in our unit because he would have qualified as a patient who might require more intense recompression than we have available. However, we decided to treat him rather than allow further delay. As usual we did a chest X-ray first. This confirmed the clinical impression that he had chronic obstructive airways disease and quite possibly, some lung cysts. He was treated with hyperbaric oxygen, one hour at 3 ATA and two hours at 2 ATA, with very little change in his symptoms. He was put on steroids. At 7 in the morning, 15 hours after surfacing, he was still slightly ataxic and he still had slight abdominal pain. Forty eight hours after surfacing, he was no longer ataxic but was feeling tired and washed out and was sent home.

He had probably had hydrocarbon poisoning plus or minus CO poisoning, and he may have had decompression sickness as well. Gas samples are, I hope, now being sent to CIG for analysis.

Discussion

People get lulled into a false sense of security by using oil free systems. The protection that they normally provide themselves against oil vapour coming from the compressor is not good protection against other noxious fumes coming into the inlet manifold. All systems should be equipped with effective charcoal absorbers. The compressed gas should be dried before passing through the activated charcoal as water vapour can reduce its capacity to absorb other impurities. If a non-regenerable, disposable system is too expensive to use properly, then an alternative system has to be found. Certainly, there does not seem to be available a cheap, effective monitor to detect impurities in the gas supply. If anyone knows of an available system with sufficient sensitivity, I would be very pleased to hear about it. It is a difficult problem as one is looking for a robust, but quite sensitive, piece of equipment.

These diagnoses are really largely based on circumstantial evidence and they can be challenged. The central cyanosis in the first patient who had a high arterial oxygen tension is quite well described in CO poisoning. The brick red colour applies to corpses only.

Lastly, both of these men, at their age, and particularly the second man with his lung lesions, should be planning retirement from abalone diving. They are not planning any such thing. The Victorian government regulations prevent them from transferring their businesses as abalone licenses are not transferable. This may or may not be a good thing. But it means they cannot sell their businesses. Often abalone divers know no other trade and are trying to save enough money to retire on. They tend to overwork and they cut corners and take considerable risks. I think the attitude of the Victorian government is possibly that expressed by the senior official who I heard quoted recently "We are the fishermen, the divers are just the hooks we use".

A question by Dr Harry Oxer was imperfectly recorded. The answer was properly recorded.

Dr Charles Hackman

We are happy to take people late who we would not have been happy to treat early on when they might need more pressure than we can provide.

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

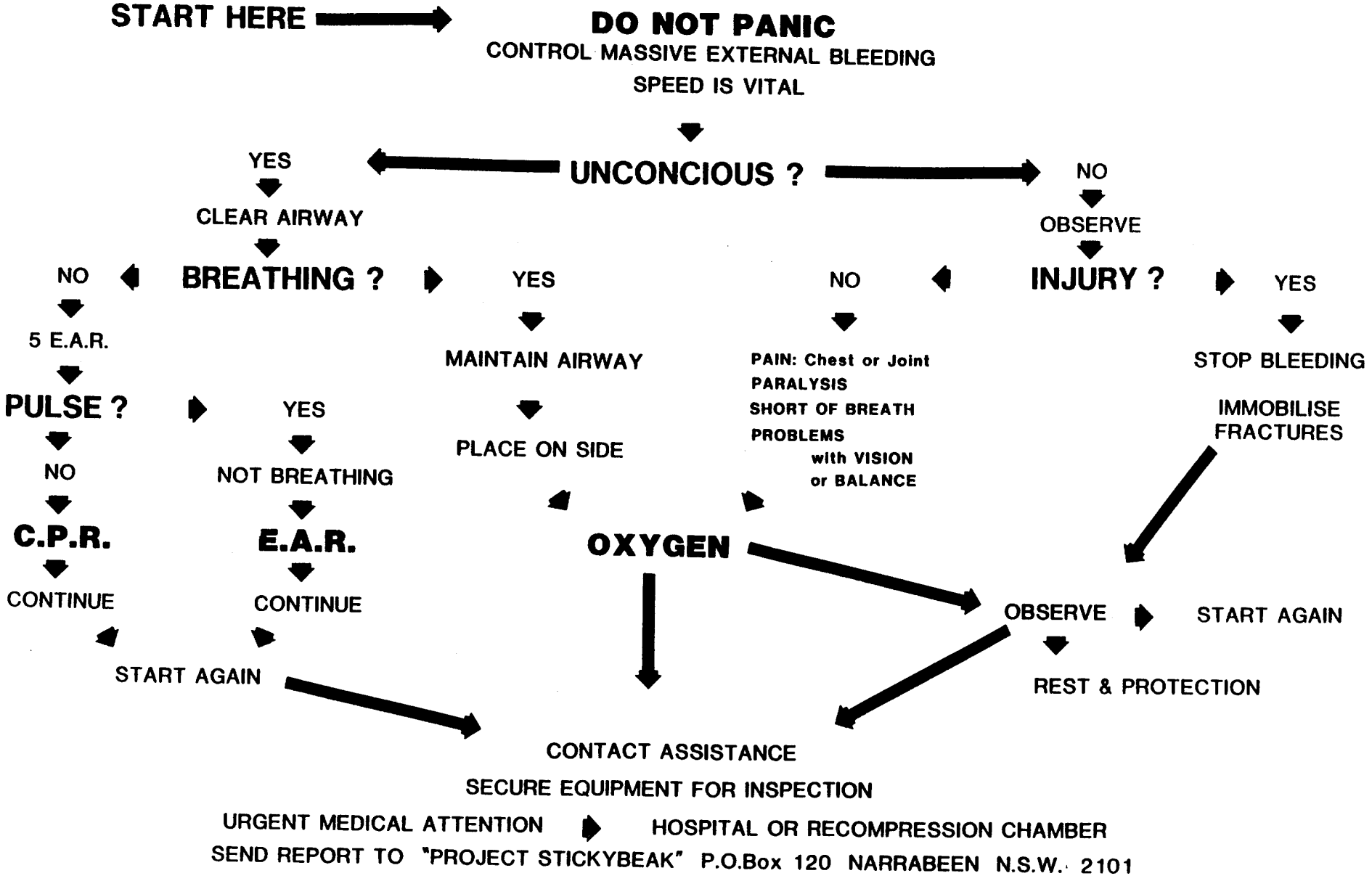
First steps in first aid for diving accidents is a message that we all ought to be taking to the divers we talk to so that the people who have diving accidents have a better chance of surviving, because most of the stories we have heard today were mishandled at the first point. A common error is that 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.

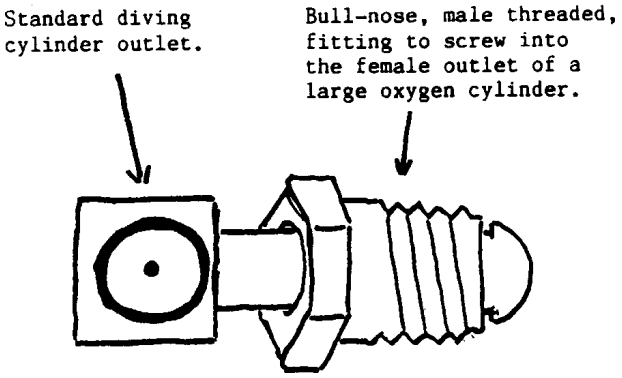
Mike Davis' chart (1) was designed to help the diver, not the doctor, cope with an accident. I have tried to make it a little easier to follow by making it clear that the rescuer asks himself questions about the state of consciousness, breathing, pulse and injury. Each time the answer starts him on a 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

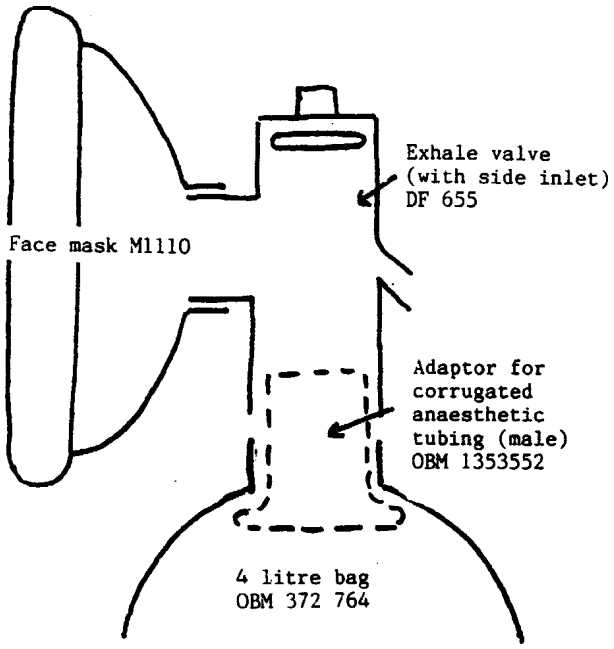


The equipment in Figure 3 is suitable for anaesthetists, intensive care and recovery room nurses and Mobile Intensive Care Ambulance (MICA) personnel, but few others, as it depends on getting a good seal between face and mask to deliver 100% oxygen. It has advantages as one can watch the bay moving and 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.

REFERENCES

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:

Dr Chris Acott
Secretary of SPUMS
Rockhampton Base Hospital,
Rockhampton QLD 4700

THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY

CONSTITUTION AND RULES

NAME: 1.1 The name of the Society is the "South Pacific Underwater Medicine Society".

OBJECTS: 2.1 The objects of the Society are:

a. To promote and facilitate the study of all aspects of underwater and hyperbaric medicine.

b. To provide information on underwater and hyperbaric medicine.

c. To promote intercourse between its members and to publish a newsletter.

d. To convene members of the Society annually at a scientific conference.

MEMBERSHIP: 3.1 Members shall be divided into the following classes:

a. Full Members.

Legally qualified Medical Practitioners, and other persons elevated to full membership by vote at the Annual General Meeting, provided that medical members shall at all times constitute a majority of at least 60% of Full Members. Only Full Members may hold office in the Executive Committee.

b. Associated Members.

All persons other than Medical Practitioners. Associate members may speak at meetings but are not entitled to vote or to hold office on the Executive Committee.

c. Honorary Members.

Persons who have made a meritorious contribution to underwater or hyperbaric medicine or to diving safety may have Honorary Membership conferred upon them by the Executive Committee. An Honorary Member may speak at meetings but not vote.

d. Corporate Member.

Organizations in sympathy with the aims of the Society may be elected to corporate membership and may appoint one delegate who may speak at meetings but is not entitled to vote.

e. Life Members.

Life Membership may be conferred upon any Full Member who has rendered outstanding service to the Society over a period of not less than ten years duration. Nomination shall be by the Executive Committee and confirmation by a two-thirds majority of members voting at an Annual General Meeting. The number of such Life Members shall at no time exceed five, nor shall more than one be elected in any one financial year. Life Members shall have the right to vote.

ELECTION OF MEMBERS: 4.1 Every candidate for membership shall be proposed and seconded by a Member of the Society. Nomination for membership of the Society shall be accompanied by the appropriate membership fee for the current financial year.

4.2 The Executive Committee shall decide upon acceptance of an application for membership. A candidate will be elected if he receives a simple majority of votes taken. In the event that a candidate is not elected such fees as have been submitted in accordance with Clause 4.1, shall be returned. The Committee shall be under no obligation to give any reason for its decision not to elect a candidate.

RESIGNATIONS: 5.1 A member may resign from membership at any time by letter delivered to the Secretary but shall be liable for the current year's subscription if not paid, and for any other moneys owing by him to the Society at the date of such resignation.

EXPULSION: 6.1 The Executive Committee shall have power to expel from the Society any member whose conduct is such as shall, in the opinion of a majority of the Committee, be injurious to the character and interest of the Society.

SUBSCRIPTIONS: 7.1 There shall be an annual subscription, the level of which shall be set at the Annual General Meeting.

7.2 All Annual Subscriptions become due on 1st July, and shall be payable not later than 31st August in each year.

7.3 If any member's subscription is in arrears or other moneys are owing by him to the Society for a period greater than nine months, the Executive Committee may direct that the member's name be removed from the register of members, and he shall then cease to be a member, provided that the Executive Committee may at any time at its discretion restore membership upon payment of all moneys due to the Society.

EXECUTIVE COMMITTEE: 8.1 The Society shall be governed by an Executive Committee. The Executive Committee shall consist of a President, a Secretary, a Treasurer, the Editor of the Journal and three other members of the Society.

8.2 In the event that any two positions on the Executive Committee are occupied by any one member, the Annual General Meeting shall elect an additional committee member to maintain the total number on the Executive Committee at seven.

8.3 The President, and four of the members of the Executive shall be legally qualified medical practitioners.

8.4 The President shall, when present, preside at all meetings of the Executive Committee.

8.5 If the President be absent from any meeting the Executive Committee shall appoint another of its members to preside.

8.6 Four members of the Executive Committee personally present at a meeting shall constitute a quorum. A written vote on any specific resolution considered by the Executive Committee shall be accepted as a vote on such resolution. Proxy votes are invalid at meetings of the Executive Committee.

8.7 A member of the Executive Committee regardless of whether he occupies one or more positions, shall be entitled to only one vote.

8.8 In the event of a tied vote on any matter that item shall be held over for decision at the next meeting of the Executive Committee.

8.9 Any member of the Executive Committee who fails to attend three consecutive Executive Committee meetings without leave of absence being granted, shall cease to be a member of the Executive Committee.

8.10 The Executive Committee shall meet at such times and places as it shall from time to time determine, and in default of such determination, at such times and places as the President and the Secretary shall determine.

8.11 The minutes of the proceedings and all resolutions shall be recorded in writing.

8.12 A transcript of the minutes of proceedings of all meetings of Executive Committee shall be incorporated in the next edition of Journal for the information of members of the Society.

8.13 Public statements in the name of or on behalf of the Society shall be made only by the President, the Secretary, or by a member specifically designated by the Executive Committee to speak on a particular matter.

ELECTION OF EXECUTIVE COMMITTEE: 9.1 All members of the Executive Committee shall be elected by postal ballot before the Annual General Meeting and shall hold office from the Annual General Meeting until the following Annual General Meeting unless removed by special resolution of an Extraordinary General Meeting of the Society.

9.2 At each Annual General Meeting of the Society all members of the Executive Committee shall retire but shall be eligible for re-election.

9.3 Nominations for the Executive Committee shall be in the hands of the Secretary not less than 28 days prior to the date of the Annual General Meeting. Each Nomination shall be signed personally by the proposer, seconder and candidate.

9.4 In the event that a candidate for election to a particular position of the Executive Committee is not elected to that particular position, his nomination shall be deemed to be an acceptable domination under Clause 9.3 for another position on the Executive Committee, provided that the candidate signifies his acceptance of such other position.

9.5 If the required number only of candidates is nominated the chairman of the Annual General Meeting shall declare them as duly elected members of the Executive Committee. If more

candidates are nominated than there are vacancies on the Executive Committee to be filled, election shall be by secret ballot of the general body of members.

9.6 The Secretary shall conduct the ballot and shall certify to the Chairman of the Annual General Meeting the names of the persons elected.

9.7 The required number of candidates receiving the greatest number of votes shall be elected. In the case of two or more candidates receiving an equal number of votes the Annual General Meeting shall decide the matter by secret ballot or ballots.

9.8 Where a casual vacancy occurs in the Executive Committee, or where a member of the Executive Committee anticipates leave of absence of six months or more, between successive Annual General Meetings, the Executive Committee shall have the power to fill such a vacancy.

ANNUAL GENERAL MEETING:

10.1 The Annual General Meeting of the Society shall be held each year at a time and place determined by the Executive Committee.

10.2 Notice of the Annual General Meeting shall be posted to members at least 42 days before the date chosen. This notice shall include a call for nominations for the Executive Committee.

10.3 The business of the Annual General Meeting shall be:

a. Receiving from the Executive Committee a report and financial statement from the preceding financial year.

b. Receiving the results of the ballot for the election of the Executive Committee, and, if necessary, electing replacement members as required by 8.2 and conducting extra ballots as laid down in 9.7.

c. Transacting such other business as has been notified to the Secretary for discussion at the Annual General Meeting, at least 28 days prior to the date of the Annual General Meeting and which shall have been notified to members at least 14 days prior to the date of the meeting.

10.4 The President shall, when present, preside at all General Meetings of the Society. If the President is absent from any one meeting then the members present shall appoint a chairman to preside in his place.

10.5 At the Annual General Meeting 20 financial members entitled to vote, including proxies, shall constitute a quorum.

10.6 At General Meetings Full Members and Life Members only shall be entitled to one vote, personally or by proxy. A proxy must be a Full Member or Life Member of the Society, and an instrument appointing a proxy shall be signed by the appointer. The instrument appointing a proxy confers authority to demand, or join in a demanding poll.

EXTRAORDINARY GENERAL MEETING:

11.1 The Committee may at any time, and the President or Secretary shall upon a requisition in writing signed by at least 10 members stating the business for which it is required, convene an Extraordinary General meeting for any specific purpose.

11.2 Notice of such meeting will be given to members at least 28 days prior to the data fixed. No resolution shall be passed at such a meeting unless supported by two-thirds majority of members present either personally or by proxy and entitled to vote, and then only provided there are not fewer then 25% of members present personally or by proxy.

ORDER OF BUSINESS:

12.1 The Order of Business shall normally be:-

a. At Annual General Meetings:

1. Apologies.
2. Reading and confirmation of Minutes from previous Annual General Meeting or any Extraordinary General Meeting.
3. Matters arising from Minutes.
4. Annual Report.
5. Annual Financial Statement.
6. Fix the subscription for the coming year.
7. Announcement of the newly elected Executive Committee and the holding of any ballots necessary under 8.2 and 9.7.
8. Appointment of Honorary Auditor.
9. Any business of which notice has been given.

b. At Extraordinary General Meetings:-

In accordance with the Notice convening the meeting.

ADJOURNMENT OF MEETING:

13.1 The Chairman may with the consent of the meeting adjourn the meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting other then that left unfinished at the meeting from which the adjournment took place.

REGIONAL BRANCHES:

14.1 There shall be regional branches of the Society for the purpose of organising meetings, field excursions and activities consistent with the object of the Society. Regional Branches may charge members to cover costs. Each Regional Branch shall maintain proper accounts.

14.2 A Regional Branch of the Society may be established at any place in the South Pacific area to further the objects of the Society in that place.

14.3 Any persons wishing to establish a Regional Branch shall apply in writing to the Secretary who shall submit the application for approval by the Executive Committee.

14.4 Each Regional Branch shall be directed by a Regional Sub-Committee of at least two members.

14.5 Each Regional Branch shall be governed by this Constitution and Rules. The action of Regional Branches shall be subject to the over-riding authority of the Executive Committee of the Society, which shall do everything possible to assist Regional Branches in their operation.

14.6 Should the Executive Committee resolve that the activities or conduct of any Regional Branch are not in accordance with the best interest of the Society, the Committee may withdraw its approval and the Regional Branch shall cease to be a Branch of the Society forthwith. Such action will be submitted for approval at the next Annual General Meeting of the Society.

14.7 The records, accounts (and funds) of all Regional Branches are the property of the Society and in the event that a Branch ceases to exist the funds held by that Branch shall be forwarded to the Treasurer of the Society forthwith.

FINANCE:

15.1 The Society shall maintain a bank account. Any cheques drawn on the account shall be signed by the Treasurer.

15.2 The Treasurer shall submit an audited Statement of Accounts at the Annual General Meeting.

15.3 For the purpose of Audit the books shall be audited by such person or persons as the Society shall appoint at the Annual General Meeting.

15.4 Branches may be required to furnish within a reasonable time accounts of any financial transactions at the request of the Executive Committee at any time.

15.5 The income and property of the Society wheresoever derived shall be applied solely towards the promotion of the objects of the Society as set forth, and no part shall be paid or transferred directly or indirectly by way of dividends, bonus or otherwise howsoever by way of profit to members of the Society.

15.6 If on winding up or dissolution of the Society there remains after the discharge of all debts and liabilities, any assets whatsoever, the same shall not be paid or distributed among the members of the Society, but shall be given or transferred to some institution having similar objects to the Society, to be determined by the members of the Society at or before such time of dissolution.

PUBLICATIONS:

16.1 A publication, to be known as the SPUMS Journal, shall be produced and distributed to all Full, Life, Associate, Honorary and Corporate Members. The costs shall be borne by the subscription income.

16.2 The Editor shall be elected in the same manner as other members of the Executive Committee.

16.3 The Executive Committee may co-opt or appoint such persons to an Editorial Board as is deemed necessary to assist the Editor.

16.4 The Editor shall be a member of the Executive Committee and shall be chairman of the Editorial Board. The Editor shall have regard to the view of the majority of the Executive Committee as to editorial policy as established at any time by the Executive Committee in publishing material.

ALTERATION OF CONSTITUTION AND RULES:

17.1 This Constitution and Rules may be altered only by a two-thirds majority of full or life members voting in a postal ballot and then only if at least 25% of eligible members vote.

17.2 This postal ballot to be conducted by the Secretary who will act as the Returning Officer.

17.3 The result of such ballot shall be published in the next edition of the SPUMS Journal.

Adopted 31st March 1980
Amended 28th February 1983