SPUMS JOURNAL

South Pacific Underwater Medicine Society

OCTOBER TO DECEMBER 1980

"THEIR LAWYER DIDN'T LIKE MY BACK X-RAYS, NIC"

CONTENTS

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OFFICE BEARERS

EDITORIAL

The newcomer to diving meets Diving Medicine head on when he is required, ideally before wetting his flippers in earnest, to pass a "'Fitness Medical". The reasons for this barrier at entry to the hyperbaric/underwater world are logical, laudable and seemingly unarguable. But like most things in life, and certainly most things in Medicine, there are often matters where opinion is far from unanimous. It is this aspect of Diving Medicine which is drawn to your attention as meriting careful thought.

We are indebted to the Commercial Diving Center, Wilmington, California, for the opportunity to raise this very important matter. Regardless of the final decision(s) taken by employers in the Diving Industry in their efforts to reduce expensive "Bad Back" Claims, there is far more important issue of the growth of private, autocratic and possibly ill-advised "fitness" criteria in parallel with the Standards set up by Government bodies after (fairly) wide discussion among the interested parties. Possibly the fault has been that till now there has been too simplistic an approach to the problem, a presumption that "a diver is a diver is a diver", to misquote.

The Presidential Address at the AGM is the first report to be presented from the Singapore and Pulau Tiomau meetings. The sheer volume of interesting material awaiting publication is a welcome embarrassment to an Editor too long accustomed to a dearth of material from members. It is intended to print these papers, or extracts from them, in the coming year.

The troubles which may afflict a diver once he gets loose in the marine environment underwater world are legion. In this issue a number of significant but rarely considered ones are ably noted. Some of the troubles may seem humble everyday matters beneath the dignity of Diving Medicine to consider, but they are of real importance to those effected. Sea ulcers and "Bluebottle" stings are common troubles, the problems relating to the diver's jaw are often ignored, and the visibility of divers can be important to safety (if only to ensure that you are quickly picked up by the dive boat and not cut down by someone's propeller).

Safer diving is a common theme of this publication, and incident reports are frequently helpful in increasing awareness of critical factors. Readers are likely to find much of value in Peter Horne's report on South Australian Fatalities, a publication noted in our pages. This lay report will, it is hoped, spur our medical members to a greater awareness of the valuable input information they possess.

With this issue we wish all readers a Happy Christmas and a Prosperous New Year. Remember what your parents told you: if you can't be good, be careful. It is advice every diver should heed.

SUBSCRIPTIONS

Members pay $20.00 yearly and Associate Members $15.00. Associate membership is available to those neither medically qualified nor engaged in hyperbaric or underwater related research. Membership entitiles attendance at meetings and the Annual Scientific Conference and receipt of the Journal/Newsletter. Anyone interested in joining SPUMS should write to the Secretary of SPUMS, Dr Christopher J Lourey, 43 Canadian Bay Road, Mount Eliza, Victoria 3930.

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IDLE TALK

MEDICAL FITNESS TO DIVE, A DISPUTED CONCEPT

DOUGLAS WALKER

Professional divers are practical people increasingly plagued, they may well believe, by interfering non-divers. In the Armed Forces, and increasingly in commercial diving, they have learnt to accept and appreciate the contribution informed medical interest in their activities has produced.

Now, however the intrusion of the legal profession into fitness assessment threatens to introduce unpredictable changes in their job opportunities. Surprisingly there has been little interest in the obvious area of ensuring that only correctly trained and experienced divers are employed, at least till very recent years. Presumably there have been few damages claims made by victims of diving misadventures resulting in large payments of compensation. Now that old problem of industry, the "Bad Back", seems to have hit a jackpot payout for some diver (or the risk has been foreseen) and a panic response has occurred in some quarters. The reported policy (1) of some international diving companies to refuse to employ divers with certain x-ray appearances in their spines, regardless of their health record and the lack of medical basis for such an arbitrary decision, is in contrast with the omission of such criteria for employment by other companies.

This raises the question as to who should be involved in deciding such matters and whether there should be a range of "Diving Fitness" standards, from "should not be let out alone" to a type of "007" licenced to undertake deep open sea experimental dives. There is nothing to prevent some company setting a height standard or demanding post-exercise EEG, or Cold-, Bends-, or Anoxia-tolerance tests. This would lessen their need to prevent cold, understand decompression, and avoid anoxia.

It is of some interest to remember that when Commander Cousteau desired to select the 5 men for his underwater habitat in the Red Sea (2) he "chose men with the appropriate (marine research) qualifications and did not specially care whether they were experienced divers or not. Age and physical condition did not matter much either: the oldest man in the party was the cook, Pierre Guilbert, forty-three, who is stout, unathletic, and has mild atherosclerosis." While not suggesting that everyone can buck conventional wisdom as strongly as can Commander Cousteau, this approach has much to commend it. The idea that one should select out a bends-resistant diver group for experimental work evidently did not appeal to him. He thereby demonstrated the true safety of his concept of habitat management, not merely its possibility using exceptional physical specimens.

Another important demonstration of the need for individual consideration of all the circumstances before making wide exclusions of whole groups is the question of diabetics who dive. It should be obvious that diabetes is a condition of very varying severity affecting people of very varying personality and intelligence. The BS-AC Medical Committee, consequent on its interpretation of CMAS policy, has recently strongly urged that all diabetics should be banned from BS-AC membership even although they have many years of documented trouble free diving.

This is in the belief that the club's insurance cover would be invalidated if they were allowed to continue to dive. If safety was really the consideration some evidence of the dangers of diabetes should show in the BS-AC Incident Reports, which have been collected over many years.

Certainly diabetics can die, but so can the untrained, the careless and the red haired. But they will not lose their Insurance cover. A strange approach to a possible problem, to omit to seek the facts. The lay committee is said to have forced a modification of this medical decision.

It is arbitrary decisions such as these that stimulate the exceptional people to "do their own thing". The most remarkable, many may believe, is the example of Dr Nic Flemming (3). Despite traumatic paraplegia he not only re-learnt to scuba dive but organised and took an active diving interest in more scientific diving expeditions that most divers have made dives. His paper on the selection and training of paraplegics to dive is known to many SPUMS members.

It is persons like him and Commander Cousteau who make us stand back a moment from the easy position of Absolutes to think of the real question, the best road to increasing safety in diving.

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HYPERBARIC OXYGEN CONFERENCE

The Sixth Annual Conference on Clinical Application of Hyperbaric Oxygen is scheduled for June 10-12, 1981 at the Memorial Hospital Medical Center for Health Education. This clinically oriented conference will discuss the currently accepted uses of hyperbaric oxygen in plenary sessions, and will also include original papers, workshops, sound slides and scientific and commercial exhibits.

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THE LOW-BACK X-RAY AND DIVING FITNESS

Report of an ad hoc committee

During the International Diving Symposium (February 1979) in New Orleans, Louisiana, a committee meeting was held to consider the question of the use of pre-employment back x-rays in the commercial diving industry. The committee consisted of ten physicians currently active in diving medicine and representing a variety of medical specialities. In addition, two non-physician representatives of the commercial diving industry were present. The task of the committee was to consider a system used by some companies in the Association of Diving Contractors for the evaluation of pre-employment back x-rays. The problem imposed by this system was that, in many cases, young men applying for jobs as tenders were being rejected by some companies only to be hired by others. In addition, others were being rejected and were unable to find employment in commercial diving after having spent a considerable sum of money to attend a commercial diving school. Some questions had been raised within the commercial diving industry as to whether this system of evaluation had met with widespread acceptance within the field of medicine generally as well as whether it was being applied consistently throughout the commercial diving industry. Some suspicions existed within the commercial diving industry that this system was not fulfilling its intended purpose, namely to exclude those who were physically unfit to undertake a career in commercial diving while simultaneously permitting the industry the widest possible choice of suitable applicants. Though specific mention will be made of a classification scheme presently in use by Oceaneering International, identical or extremely similar systems are used by some other large commercial diving companies. The existence of this scheme was unknown to some members of the committee even at the time of the meeting and there was a distinct lack of familiarity by others.

Before the system under scrutiny can be discussed, a certain amount of background information is necessary. It must be stated at the outset that, within the medical profession generally, the exact role of pre-employment back x-rays has not been determined with any degree of certainty. Entire conferences, attended by various medical speciality groups, have been devoted entirely to this topic only to produce the most general kind of consensus. Experts in appropriate medical fields disagree considerably as to the exact predictive value of the pre-employment back x-ray, and the degree to which these x-rays allow one to say whether a given prospective employee will have back trouble in the future is simply not known. In addition, the lower part of the human back is an area of considerable anatomic variation and it is not possible to achieve any complete agreement as to what constitutes a “normal back”. Essentially the general public can be divided into two somewhat amorphous and overlapping groups, those with normal back x-rays and those without and each of these two groups can in turn be divided into two sub-groups, those who will have back trouble in the future and those who will not. The relationship of the first to the second is simply not known with any degree of medical certainty. One thing that is generally agreed upon within the medical profession is that the pre-employment x-ray should not be the only means of pre-employment evaluation, and yet applicants to some commercial diving companies have been rejected simply on the basis of a back x-ray which was taken on arrival, without even seeing a physician. While this may save money at times, it is open to question whether this ultimately is in the best interest of the prospective employer or applicant. It can be argued that the loss of a fit, motivated young individual (perhaps to one’s competitors) could be viewed as an economic loss to the company, though this is somewhat intangible. Statistically, it is highly likely that most young men in their twenties with a negative or essentially negative medical history, and an active vigorous lifestyle, will probably be physically fit a high percentage of the time. This description would seem to fit most young prospective tenders seeking to enter the commercial diving industry and any system which rejects a very high percentage of such young men must be viewed with some scepticism. Finally, in the age of computers, it is probably undesirable for moral, ethical, and legal considerations that young individuals be recorded as “unfit” by an examination that could be viewed as unreasonable, arbitrary, or unscientific. The general public often fears that such labels will follow them throughout their occupational lifetime and there is often a worry that this may jeopardize one’s future employability. Certainly in an area where the medical facts are simply not known, a company would be well advised to make its pre-employment evaluations appear as reasonable as possible.

With respect to the evaluation scheme in question, some criticisms can be made. One important fact is that this scheme, though used by a number of companies, is not in general use, even in the commercial diving industry. Though some members of the committee were quite familiar with this system, others were not and had never used it in their professional lifetimes, though some had heard of such a system. At least two members of the committee were totally ignorant of the existence of such a system up until the time of the committee meeting itself. Though the origin of this classification system is not known for sure, it is thought to have perhaps originated within the railroad industry. If this is so, the origins of this system by the railroad industry were due to certain federal laws and were intended to be as restrictive as possible. One member of the committee, an orthopaedic surgeon, stated that he had never heard of a system such as this, despite his many years in the field of orthopaedics and considerable personal experience with all manner of back problems.

The system itself states that classes I through III are eligible for employment, with classes IV and V employable with “special approval of the management”. Realistically, special approval of the management is not forthcoming and

anyone classified as a class IV or class V is simply not employable. As will be discussed, these two classes cover a considerable amount of ground.

The first classification in the system is the “normal spine” which is considered to be a spine that has “no abnormality” and this is considered to be a Class I. It is of interest to note that this is the only such example of a Class I on the entire list, but as was pointed out earlier, the concept of a perfectly normal spine can be difficult to define. Following this, the list contains some seventy-six different anatomic conditions which can be visualized on an x-ray, fifty-seven (75%) of which are listed as a class IV or V. It is probably a safe generalization to say that at least some of these fifty-seven conditions would be considered acceptable by at least a strong minority of physicians. In addition, it should be pointed out that one of the most common back problems, the herniated or “ruptured” disc, is not directly visible on x-ray as it is composed of cartilage rather than bone. Evidence for disc disease is based on <u>indirect</u> x-ray evidence, the reliability of which is a source of controversy within the medical profession.

The list itself is replete with ambiguous, subjective, and/or sweepingly absolute terminology. Examples of this are such phrases as, “*any* degree of”, *“marked* difference”, “*any* evidence of”, “questionable or definite, old or recent”, “suggestive of definite evidence” (emphasis added). It should be obvious that this sort of terminology simultaneously allows for either considerable variation in individual interpretation or completely deprives the physician of the use of his judgement. For example, when does an x-ray finding become “marked” as opposed to “moderate” and when is a finding “suggestive” as opposed to “normal” or “definite”? Does “any” mean the slightest amount detectable, or a degree which is judged to be of medical significance? It is obvious that terminology such as this can have considerably different meanings from medical examiner to medical examiner and it is felt the entire effect of the system is to be unnecessarily restrictive. As was previously stated, it is probably true that most young men of the sort who usually apply for careers in commercial diving will prove to be in excellent physical condition. One needs to ask oneself how much liability is avoided by the company with very restrictive standards for their pre-employment x-ray evaluations and at what economic cost, considering that many of these individuals may either be hired by one’s competition or find employment in other industries and be lost to the commercial diving industry as a whole.

Given the present inherent limitations and disagreements regarding the exact role of pre-employment back x-ray, as well as the stated deficiencies in the classification scheme under consideration, it was the feeling of the committee that this system of pre-employment x-ray evaluation should be abandoned by those companies in the commercial diving industry who are using it. It was the feeling of the committee that this system of evaluation is inadequate for its purpose, is an undesirable method of screening prospective employees, and does not serve the best interest either of the company or the prospective employee. Though it was not the task of this committee to propose a better method, it is felt that this can be obtained by these companies with the use of appropriate medical advice.

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<u>MINE HOME</u>

An old World War II mine was recently washed up on a Magnetic Island beach. The crowd of spectators which collected suddenly withdrew when it was noted that there was life in the mine still. But it was not explosives which so effectively induced a mood of caution, for they had dissolved out long ago, but rather the appearance of two stonefish from its interior which caused the scattering. Swords to ploughshares, mine to homeunit.

INCREASING THE VISIBILITY OF DIVERS ON THE SURFACE AND AT DEPTH

Quentin M Bennett

Clear water absorbs warmer colours such as red, yellow and orange, and by a depth of 100 feet they are not visible. The human eye does possess remarkable adaption processes to ambient light, and this disappearance of the warmer end of the spectrum is not quite as obvious to the eye as when recorded on film.

Natural light photographs taken at a depth of 10 metres are usually almost devoid of the colours, red, orange or yellow, although the experienced diver can usually see them. An experienced diver will be more certain of what he is seeing than will be someone less experienced.

Other factors come into play in the poor visibility of colours underwater. Much of the light travelling underwater is scattered by suspended particles. This causes the brightness of the water background: and a "veiling brightness" between the object being observed and the eye: thus reducing greatly any contrast.

If the contrast is low to start with because of the warmer brighter colours having been already absorbed, the final contrast is very low indeed.

Briefly, an object is seen if it appears of a slightly different brightness or colour to its background. Speaking very generally, the human eye can detect brightness differences of between 1% and 2% if the light level is fairly high.

If the water did not scatter light, but only absorbed it, the water background would appear black and all the light would come from above. As, however, the water both absorbs and scatters, light will come from all directions, with upwelling light being about 2%.

Water does not absorb light of all wavelengths equally, and it is those wavelengths which are least absorbed which give the water its characteristic colour. As the depth increases, the ambient light is restricted to a narrow band of wavelengths and, according to Tyler, the water behaves as a very efficient monochromator.

Clear ocean water is shown to be brightest in the blue green around 470 nanometer (blue) was found to penetrate farthest. Chlorophyll containing phytoplanktons and partly decayed vegetable substances give yellow and green shades to coastal and fresh waters.

So, whilst the phenomenon that red light is absorbed in blue water is well known and understood, it is often and easily forgotten that this is but an isolated example.

The absorption characteristics of different bodies of water vary considerably. Some inland lakes can be quite black, others are quite brown or yellow, or green and springs blue. Combinations can run from black, grey, brown, yellow, green to blue. Fairly obviously absorption characteristics, and hence visibility, are totally different for these different coloured bodies of water.

The visibility of divers is very important. The foremost rule of diving is 'never dive alone', and to carry out this it is essential to be able to see one's buddy diver.

With the advent of modern self adhesive materials, a new approach can be made in an endeavour to make the diver more visible. These materials are available in several fluorescent colours. The Dictionary of Visual Science defines fluorescence as 'the property of emitting radiation from some other source, the emitted radiation being of longer wavelength'.

Especially in blue water, the blue end of the spectrum is passed readily. Because it is the blue end of the spectrum that provides the excitation for fluorescence, it can be deduced that fluorescence is most effective underwater. This is very true, and interestingly enough, it appears to be very effective even in greenish water. Of course it probably appears all the more brilliant because the warm colours originating at the surface have been absorbed, and the eye has adapted to at least a certain degree; and the fluorescence will stand out to a stunning degree.

Fluorescent materials, such as used on aeroplanes, are very durable and most suitable for adhering to a diver's air bottle. Little else of his equipment is probably really suitable for attachment of the material, although his buoyancy compensator or life vest could be manufactured from fluorescent material. The front of his wetsuit hood could have a piece of fluorescent retro-reflective material sewn to it. Attaching the self-adhesive material to the outside of the diver's air bottle has the added bonus arising from the considerable protection that the material gives the paint on the exterior, thus prolonging the life and retaining the value of these expensive pressure vessels.

The 3M Company manufacture three fluorescent colours in the "Scotchcal" brand of film. They are red-orange, yellow-orange, and Saturn-yellow. There is not a great difference in colour between the red-orange and yellow-orange. Red-orange is quoted by 3M Company as having a much greater durability expectancy when under heavy ultraviolet degradation.

One important point is that too red a fluorescent material used in very clear water could mean that the red colour emanating from the fluorescence could have been absorbed before it reaches the observer. In other words, the clearer the water, the cooler the fluorescent colour should be.

On the other hand in such very clear waters, the visibility of the diver is less of a worry compared to that in more turbid water. Fay (1976) found that sensitivity of the eye underwater to red was considerably increased even in an adaptation period of only 30 seconds. This would probably indicate that in the 3M Company "Scotchcal" range of colours the warmer red-orange and yellow-orange would be mere suitable than the Saturn-yellow.

We are in the process of further study of all three colours in varying bodies of water and, it is hoped, under ice.

FURTHER READING

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This paper was read at the 49th Conference of the Australian and New Zealand Association for the Advancement of Science, Auckland, NZ, 24th January 1979

BLIND THEM WITH SCIENCE DEPARTMENT

We join with the editor of the Aviation Medical Society of Australia and New Zealand Newsletter in humble admiration of the Victorian Branch of the Ergonomics Society of Australia, which claim to print its address labels as follows:

"The mailing labels now appearing on the wrapping of your copy of the Newsletter are printed on a microcomputer system, involving a Cromemco system 3, a Teleray 1061 VDT and a Citoh line printer. For those interested, the Cromamco uses a Z80A microprocessor running at 4MHz, has 64K of fast (150 nanosecond access time), random access memory and a pair of Per Sci 277 8" disc drives."

It seems no time since your editor wrote the labels personally. Such is progress, the above may soon also seem old fashioned.

THE GREAT WHITE LIKES YELLOW

Valerie Taylor has a piece of information to impart which is not all good. In a recent article (Oceans, 1979, No 3) entitled "The Predator which doesn't eat people" she reports on experiments made by herself and her husband Ron during their years of work in the marine environment. The Great White has been found to seek our warm, light colours such as yellow, apricot and orange. Apparently it will attack such coloured floats even when bait is in the water nearby. Evidently taste and edibility came second to the colour attraction of the object in certain circumstances.

They found that a dummy wearing a black wet suit was ignored but one with an orange safety vest attracted attack with a few minutes. The dummies were not stuffed with food, though there was chum in the water. There are obviously occasions when the shark risk would make the orange-for-visibility vest a potential danger to the wearer. No cases of this having a practical importance are known, but if you like to "do your thing" with Great Whites, it seems only commonsense to dress in formal black.

A PUBLICATION OF SIGNIFICANCE
SOUTH AUSTRALIAN DIVING FATALITIES

Peter Horne

This provides a thorough and well researched review of all the known South Australian diving-related fatalities 1951-1979, with a discussion of sites and critical factors. There is a regular report available at a cost of Aus$3.00 (incl p&p) and a special issue available to those with a professional interest in Diving Safety, which contains confidential information not included in the regular publication, for Aus$5.00 (incl p&p).

The cases discussed include some from the early days of civil diving, while the more recent cases are those reported in the "Provisional" Stickybeak reports but not there given a locality identification. This report is highly recommended and the Author commended for both the information provided and its presentation. Copies are obtainable from:

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LETTERS TO THE EDITOR

Hospital Road,
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INDIA,

Dear Sir,

In the June-September 1979 issue of the Journal Dr Dries Jones reported "Discussion of a case of Pulmonary Barotrauma". I find some of the aspects of treatment puzzling.

1. There is no mention of the IV infusion regime, which all authorities now recommend as an adjunct to the treatment of neurological decompression sickness.

2. Why was a diuretic given as almost inevitably a diver is dehydrated when he emerges from the water?

3. The administration of a diuretic to a patient with a paraplegia without the precaution of catheterization is surprising. In this man it led to 2 hours of the symptoms of urinary retention which are highly uncomfortable if not more accurately described as acutely painful. The physiological changes accompanying pain, vasoconstriction and sweating, can hardly help with the elimination of inert gas.

4. I think that the man was allowed to resume diving too soon. It is known that the neurological scars of the illness increase susceptibility for further neurological incidents. There are even some centres where a man would be prohibited from diving again.

Yours sincerely,
MY KHAN

A copy of this letter was sent to Surgeon Captain Jones, whose reply is printed below.

Navy Medical Centre
Simonstown
Republic of South Africa 7995

Dear Sir

As regards to Dr. Khan's letter some background information seems necessary. This accident happened during September 1975.

At that stage no guidelines for medical ancilliary treatment for decompression accidents were laid down at our diving school.

Due to various unsatisfactory aspects in the management of the case a broad regimen of treatment has been drawn up.

This regimen is at presently under review. The relevant portions follow.

6. DECOMPRESSION ACCIDENTS

a. General

i. The call for medical treatment for a decompression accident will take one of two forms:

(a) The diver has already been transported to a two-compartment chamber and full therapeutic decompression facilities will be available.

(b) The victim will be within 5 hours travelling time from a two compartment chamber. Preliminary medical care and resuscitation will be needed before transport to the chamber.

ii. If the patient is transported in an ambulance he may under no circumstances receive Entenox: Entenox increases the bubble size, aggravating the condition.

iii. Decompression accidents might be complicated by hypothermia and/or near-drowning. In these circumstances concurrent treatment for these and the decompression accident will have to be carried out In priority to severity.

b. Specific treatment for cases away from a two-compartment chamber:-
(NB. The treatment (from 6.b.i. to 6.b.ix) is for all serious cases of decompression sickness and air embolism. Type I cases - where pain is the only symptom present - only 6.b.i., 6.b.iv., and 6.b.viii.)

i. Let the diver inhale 100/per/cent oxygen from the resuscitator; this tends to hasten the inert gas elimination from the body.

ii. The diver would already have received the following medication (see 2.b.);
- Valium 5mg - 2 tablets
- Soluble Aspirin 300mg - 2 tablets
- Vitamin C 250mg - 2 tablets
- Methyl Prednisone (Medrol 16mg) - 2 tablets.

iii. In the case of the unconscious diver:
- assure a clear airway
- assist ventilation if indicated
- assist cardiac function if indicated.

iv. Put up a reliable intravenous line and start infusion with Dextran 40
- First Vacoliter (500ml) to run in 30 minutes
- second Vacoliter of Dextran 40 during the next 30 minutes and
- third Vacoliter of Dextran 40 after 6 hours, to run in within 2 hours.

v. Administer Dexamethasone 100mg intravenously through the tubing of the Dextran drip (decadron Shock

Pack). Follow up every 6 hours with Decadron 8mg (one 2ml ampoule) intravenously.

vi. Administer 50ml of 50 per cent dextrose with the first drip. Do a Dextrostix evaluation and repeat when necessary.

vii. Catheterise the unconscious patient or the diver with urinary retention and check urinary output. It should be over 60ml/hr. Monitor pulse and blood pressure to avoid over infusion.

viii. Urge the conscious diver to drink at least 250ml of fluid every 45 minutes.

ix. Administer Heparin 2000 units intravenously every 6 hours.

c. Treatment of decompression accidents in a hyperbaric chamber.

i. Never put an unconscious diver in a one-compartment chamber.

ii. Start therapeutic decompression as soon as possible according to the laid-down therapeutic tables.

iii. In all serious cases of decompression sickness - that is type II with serious neurological and respiratory symptoms institute medical treatment (6.b.i.) to (6.b.ix.) as prescribed.

iv. In the less serious case just continue the first aid treatment as prescribed (2).

v. In cases where respiratory symptoms get worse on decompression, an underwater drain may have to be inserted in the chamber. The necessary equipment is in the pannier.

The specific points mentioned by Dr Khan:

1. The same IV infusion regime as per appendix 6.b.iv. has been followed.

2. The Lasix was given ten hours after the diving accident. The rationale being that his cerebral symptom were caused by cerebral oedema. It will however be noted that no Lasix is used presently due to haemoconcentration and the danger of disseminated intravascular coagulation.

3, This point is well taken. It will be noted that our treatment regime has been altered after this incident.

4. The question of fitness for diving after decompression accidents, involving the neurological system, has not been spelled out clearly. Our present approach to the problem is as follows:

If any neurological residue persists for twelve weeks after the accident we declare the person as unfit to dive again. It may however be too dogmatic in a diver with eg, loss of sensation of a big toe.

It seems only feasible to assess every case individually and restrict their diving accordingly.

(AG JONES)
Surgeon Captain
0C NAVY MEDICAL CENTRE

SEA ULCERS - IT'S TIME FOR SOME PREVENTIVE MEDICINE

Martin Bowerman

Skin infections known as 'sea ulcers' are a major problem for fishermen in northern Australia. Prawn fishermen in particular suffer from these painful and long-lasting sores

They might begin as apparently insignificant cuts or scratches, but soon flare into weeping sores that just refuse to heal. They may last weeks, even months, and, when eventually they do clear up, ugly purple scars and sensitive skin remain. From personal experience I know how painful and annoying these ulcers are.

Sometimes even the irritation of a pair of shorts or rubber boots is enough to give entry to bacteria and commence the cycle of infection. In fact many fishermen, when standing knee-deep in the sorting tray shovelling prawns, refuse to wear rubber boots or any other form of footwear - despite the fact that the sorting tray might also hold sea snakes or stonefish hidden amongst the prawns. They prefer to risk the slight possibility of a fatal bite or painful sting, rather than the almost certain ulcers that follow irritation of the skin by boot tops.

Fishermen working in the Gulf of Carpentaria and other remote areas have few opportunities to see a doctor, but even medical treatment often has little effect on the ulcers. Some fishermen are forced to spend weeks ashore - away from salt water and away from their livelihood - before the ulcers finally heal.

Sea ulcers thus represent a serious problem for individual fishermen and the industry in general.

Therefore everyone involved in the fishing industry, particularly in northern Australia, should read the following article. It has been written by Dr John L Reichelt, a microbiologist with the drug company Roche Products Pty Ltd, who is studying various types of marine bacteria. He explains probable causes and possible cures for sea ulcers.

A list of 'dos and dont's' can be compiled from the article, but basically he suggests fishermen should keep their skin clean of marine bacteria. They can do this with special disinfectants, used regularly, probably after each session at the sorting tray. Arms and legs should be washed. A tub or sink could be provided somewhere between the back deck and the accommodation and filled with disinfectant solution each day.

Some disinfectants are better than others in killing these marine bacteria. Dr Reichelt suggests one marketed as "Hibiclens" which incidentally, is not a Roche product).

For doctors, he points out that the ointment "Neosporin" is effective, as well as the antibiotics tetracycline and erythromycin (although other antibiotics are not).

Dr Reichelt is prepared to supply more detailed information to individual fishermen, fishing companies, medical practitioners or anyone else interested in the problem. To assist treatment he will also arrange identification of bacteria cultures prepared by doctors. The address is:

Roche Research Institute of Marine Pharmacology,
PO Box 255,
DEE WHY NSW 2099

Telephone (02) 982 0222.

If it is possible to prevent these skin infections with simply daily care, then individual fishermen, skippers or boat owners should ensure that it is done: sea ulcers have been allowed to plague fisherman for too long.

REPRINTED BY KIND PERMISSION OF THE EDITOR FROM "AUSTRALIAN FISHERIES". 1980; 39(5) May.

BACTERIA INVOLVED IN MARINE-DERIVED WOUND INFECTIONS

John L Reichelt

People working near the sea in tropical areas are familiar with the fact that minor wounds from coral or other marine animals frequently become infected, forming persistent ulcers. In some marine industries, marine-derived ulcers are a significant problem. Recent studies in microbiology laboratories have shown that these ulcers are most frequently due to a small group of marine bacteria.

Properties of the ulcer-forming marine bacteria

The bacteria isolated from marine derived ulcers gave been found to be uniquely marine bacteria, needing salt to survive. Because of this salt requirement, these marine bacteria do not occur outside of the marine environment, but human tissues contain sufficient salt for their growth.

A second consequence of the salt requirement is that conventional medical procedures have frequently failed to isolate the causative organism from marine-derived ulcers because of an inadequate level of salt in the bacteriological media.

These marine bacteria have been found to grow over a temperature range of 10° to 40°C and, at the higher temperatures, growth is extremely rapid. In fact cell division times of 10 to 15 minutes under optimal conditions make these bacteria some of the fastest-growing living organisms.

Consistent with these properties, marine derived infections are observed to be more severe in tropical areas, while in temperate areas most cases occur during the summer months. In tropical areas the rapid growth rates of these marine bacteria confer the ability to establish infection with unusual rapidity.

Ecological studies have shown that the ulcer-forming marine bacteria occur as a significant proportion of the total bacterial flora of coastal seawater in most parts of the world. Increased numbers are observed in the summer months in temperate waters and larger numbers of these marine bacteria are found in coastal waters than in the open ocean.

Although these marine bacteria have been found to occur in marine sediments and in association with marine animals, the numbers observed are not significantly enhanced over those seen free in the seawater.

Taxonomic studies of the marine ulcer forming bacteria have shown the infecting organism to belong to at least three closely related species. The most common species causes ear infections and infections of wounds. Another relatively common species is generally associated with gastroenteritis from seafood, but is occasionally associated with wound infections. The third species, which is much less commonly observed, has a greater tendency to cause blood poisoning. (These bacteria are most often obtained for identification from blood samples.)

Prevention and cure of marine bacterial ulcers

The old adage that salt water will heal wounds is completely false in this case. Because the ulcer-forming marine bacteria are present in seawater, rinsing wounds in seawater may lead to infection rather than prevent it.

In many marine industries frequent exposure of minor wounds to seawater is unavoidable. Under these circumstances preventive measures must take into account the extremely rapid growth rate of the marine ulcer-forming bacteria. An effective disinfectant should be applied within two to three hours, rather than at the end of the day.

Chlorohexidine gluconate (its trade name is "Hibiclens" and it is marketed by ICI) is an example of an inexpensive, readily-available disinfectant which is effective on these marine bacteria while being safe to apply frequently; it is widely used in hospitals as a daily skin-cleanser.

Where a marine-derived infection has become established, a doctor should be consulted. Two important facts should be noted.

Firstly, untreated marine bacterial ulcers can have very severe consequences, including serious blood poisoning and hospitalisation.

Secondly, these marine bacteria are not sensitive to penicillin, ampicillin, carbenicillin or related antibiotics which are widely considered to be the logical first choice for treatment of such infections from non-marine sources.

However these marine bacteria are sensitive to topical applications containing polymyxin (for example, 'Neosporin' marketed by the firm Burroughs-Wellcome) and to the antibiotics tetracycline and erythromycin.

Most of the medical reports of severe marine derived wound infections have involved initial ineffective treatment with one of the penicillins followed by effective treatment with a tetracycline.

Problem of awareness of marine bacteria

The major problem with marine bacterial infections has been a lack of awareness of the nature of the infection. There has been a lack of awareness of seawater as a source of serious human infection, of the rapid growth rates of the infecting bacteria, and of the resistance of these bacteria to penicillins.

Increasing knowledge of these facts and, in tropical areas, more widespread use of suitable disinfectants soon after infection should greatly reduce the incidence of marine bacterial infections.

Further reading

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REPRINTED BY KIND PERMISSION OF THE EDITOR FROM "AUSTRALIAN FISHERIES". 1980; 39(5) May.

Dr Reichelt is the Section Leader of the Microbiology Section of the Roche Research Institute of Marine Pharmacology at Dee Why in Sydney.

DANGEROUS CONE SHELLS

Q. Which cone shells are capable of biting, and perhaps killing, humans and in what areas are these animals likely to be encountered?

Also, are there other potentially dangerous univalved shells?

A. All cone shells are poisonous, but only the fish-eating species, with strong neuro-toxic venoms, are deadly to humans. Three South Pacific and Indian Ocean species, the geography cone (Conus geographus), the tulip cone (C. tupila), and the streaked cone (C. striatus), are all known to have caused human fatalities.

These species are common in shallow water on coral reefs. Other Indo-Pacific species, such as Eldred's cone (C. eldredi), the magician cone (C. magus), and the cat cone (C. catus), are also fish eaters and are potentially dangerous.

The textile or tent cone group, including the common textile cone (C. textile), the court cone (C. aulicus), the episcopal cone (C. episcopus), was previously thought to be deadly to humans. Recent ecological and toxicological studies, however, have shown these cones to be mollusc-eaters with low-potency venoms. (Unknowingly, people have often confused the deadly geography cone with the relatively harmless textile cones).

Most other cones are worm-eaters with weak venoms, and their bites are said to resemble bee stings.

In the Florida and Caribbean area, only one species, the agate or tortoise cone (C. ermineus), is known to be a fish eater and, thus, is potentially deadly. Fortunately this cone is uncommon and prefers less accessible deeper areas on the outer reefs.

Only two other groups of gastropods are capable of toxic bites: the auger shells (family Terebridae) and the turret shells (family Turridae). These univalved molluscs are common in shallow, sandy areas in tropical seas around the world. Although possessing harpoonlike radular teeth similar to cones, their venoms are weak and the tooth structure is relatively undeveloped. As far as is known, there have been no reports of bites to humans from auger or turret shells.

REPRINTED BY KIND PERMISSION OF THE INTERNATIONAL OCEANOGRAPHIC FOUNDATION FROM SEA SECRETS. 1980: 24,(2) MARCH-APRIL 1980.

SPUMS AGM and Scientific Meeting 1981

3rd June, 1981 to 12th June, 1981 at the Agao Beach Resort, Cebu, The Philippines.

The Guest Speaker and Keynote Lecturer will be Dr David Elliott, co-author of Bennett and Elliott, and President of the European Undersea Biomedical Society. Further details from Allways Travel Service, 168 High Street, Ashburton, Victoria 3147.

A REPETITIVE DIVE SYNDROME: STRESS AT DEPTH

K Jerome Dierks

During the northern autumn of 1978 while doing follow-on work to an earlier study[1] we experienced unexpected compression/decompression stress during and following the second of two "safe" dives performed 24 hours apart. The manifestations were explicit, and subsequent similar experiences indicated that they were repeatable and, to a degree, predictable (Table 1). The phenomenon is somewhat extraordinary in that initial onset of stress begins at depth during the second dive, and a period of non-diving "deacclimatization" preceding the first dive is required to elicit the stress response. It is our purpose here to briefly document and describe the phenomenon in order to stimulate the interest of others better qualified and better equipped to examine it further.

The standard compression/decompression exposure routine was a dive in open water to 30.5m (100 feet) depth for 25 min duration at various water temperatures and repeated 24 hours later. Ascent and descent rates were nominally 18 m/min (60 ft/min) and time on bottom was spent swimming a stretched line between anchor points or a depth contour. Air consumption was nominally 19 l/min per diver, referred to surface pressure. The tabulated water temperatures were those at depth; water surface temperature was nominally 27°C for all tabulated dives, which may have mitigated the "safeness" of the exposures.

The manifestations of stress that occurred during and following the second dive were: headache, and sometimes nausea, beginning during the latter half of the dive, ie. at depth, and exacerbated by surfacing; nausea, and sometimes vomiting, at surfacing; dyspnoea, at surfacing; and anorexia. Generally, all manifestations, excepting the headache, resolved within 15-30 min after surfacing, with no after effects. Headaches often persisted for several hours post-dive.

Although it cannot be stated absolutely that gas poisoning did not cause or contribute to the phenomenon, it can be said with some certainty that it probably did not. The air compressor is an in-house unit in use, at that time, almost daily. There were no reports of "bad air" or of stress of any nature prior to the 1978 experience. Following the latter the air remaining in the divers' tanks was tested for CO and CO_2 and tested "clean". Semi annual tests by an outside agency both preceding and following the dive periods indicated in the table have all reported air purity exceeding US Navy standards.

Regarding the requirement for a period of deacclimatization preceding the two repeated dives, during our earlier study (1) there were frequent exposures to up to 5 daily repeated dives with no stress manifested. However, during the period of that study (approximately 8 months) the *maximum* inter-exposure interval was only 5 days (mean interval 3.3 days; standard deviation 1.3 days). In fact, the 21 day non-diving interval shown for the 1978 exposure (Exposure 1 in the table) was imposed because it was felt that the divers had acclimatised to a rather intense compression/decompression regimen. The consequence of that hiatus was totally unexpected. The divers associated with the first 1979 event (Exposure 2 in the table) were performed for a reason unrelated to the present "study", the non-diving intervals tabulated were therefore happenstance. The other non-diving intervals (Exposures 3, 4, and 5 in the table) were, however, imposed.

Exposure (3) was two repeated dives to a shallower depth, 27.4 m (90 feet), for the same 25 min duration, which now was 5 min less than the US Navy no-decompression time limit for that depth. As the onset of stress at depth during the second dive generally occurred about mid-duration a slight diminution in depth seemed a more expedient perturbation than a major reduction in duration. This exposure was uneventful. Thus, a strict interpretation of the "data" would indicate that a non-diving interval of about 10-14 days followed by repeated dives to the US Navy no-decompression time limit at intervals as long as 24 hours may be unsafe. The generality of this conclusion with regard to other depths is of course unknown.

Gait et al (2) reported entrapment of microbubbles in the peripheral vasculature following a severe compression/decompression exposure, with subsequent release into the central circulation following recompression. The interdive interval in their study was measured in minutes whereas it is hours in the present work. But could the same mechanism be acting to effect the results described here? At this laboratory, and quite likely at many other facilities, dives to the no-decompression time limit repeated on a daily basis is not an unusual exposure regimen. Therefore the question is not a trivial one. Although the present evidence is perhaps tenuous, it is felt that the syndrome could be elicited ad lib, however the divers are understandably reluctant to do so. It is a phenomenon which appears amenable to investigation using an animal model, and it is hoped that a laboratory equipped to do so will examine it further. At best, it is disconcerting to the diver to anticipate possible stress following a "safe" compression/decompression exposure.

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2. Gait D, Miller KW, Paton DM, Smith EB and Welch B. The redistribution of vascular bubbles in multiple dives. Undersea Biomed. Res. 1975; 2(1): 42-50.

DATE WATER TEMP.	DIVE PROFILE SCHEDULE	DIVERS	PRECEDING NONDIVING INTERVAL	EXPOSURE	DIVE 1: SYMPTOMS, ONSET, RESOLUTION	DIVE 2: SYMPTOMS, ONSET, RESOLUTION
11-12 OCTOBER 1978 24°C	30.5 m/25 min Repeat 24 hr later	A,B	21 DAYS	1	A. SURFACED WITH MILD SINUS HEADACHE B. BEGAN WITH MILD SINUS HEADACHE; SURFACED WITH SEVERE ("SICK") HEADACHE	A,B. ONSET OF "POUNDING" HEADACHE 15-20 min INTO DIVE; EXACERBATED BY SURFACING; NAUSEA (10-15 min); DYSPNOEA (10-15 min); ANOREXIA (30 min, AFTER WHICH ATE HEARTILY) A. 5-6 RETCHES ON SURFACING B. HEADACHE PERSISTED UNABATED THROUGH FOLLOWING DAY: 1h O_2 BY ORONASAL MASK 10/13/78 PROVIDED MILD RELIEF
11-12 AUGUST 1979 14°C	30.5 m/25 min Repeat 24 hr later	A,C,D	A: 9 DAYS B:25 DAYS D:48 DAYS	2	UNEVENTFUL; D REPORTED SOME DISORIENTATION AT DEPTH (HAD NO PREVIOUS EXPERIENCE AT 30.5 m, 14°C WATER, OR LOW VISIBILITY)	A,C,D. ONSET OF HEADACHE 15-20 min INTO DIVE; EXACERBATED BY SURFACING A. SEVERE ("POUNDING") HEADACHE (20-30 min); ANOREXIA (20-30 min) MILD DYSPNOEA (10 min) C. SEVERE HEADACHE (6-8h) D. SEVERE ("POUNDING") HEADACHE (30-40 min); NAUSEA AND VOMITING (10-15 min); ANOREXIA (30-60min)
25-26 AUGUST 1979 19°C	27.4 m/25 min Repeat 24 hr later	A,C,D	13 DAYS	3	ALL DIVERS PRESENTED WITH MILD HEADACHES (10-15 min)	UNEVENTFUL
6-7 OCTOBER 1979 19°C	30.5 m/25 min Repeat 24 hr later	A,C,D	A: 9 DAYS C:17 DAYS D:14 DAYS	4	A,C. SURFACED WITH MILD HEADACHE	A,C. ONSET OF HEADACHE 15-20 min INTO DIVE, LOCALIZED TEMPORALLY/ CERVICALLY (6-12h) A. ONSET OF MILD NAUSEA 21 min INTO DIVE: MILD NAUSEA AND ANOREXIA AFTER SURFACING (10 min) C. SEVERELY DISORIENTED MID-DIVE: DISORIENTED AFTER SURFACING (10 min); ANOREXIA (10 min) D. NO ADVERSE AFFECTS
11-12 DECEMBER 1979 16°C	30.5 m/25 min Repeat 24 hr later	A,C	14 DAYS	5	A. MILD SINUS HEADACHE	A. MILD NAUSEA AT BEGINNING OF ASCENT (10-15 min); ONSET OF HEADACHE AT BEGINNING OF ASCENT (30-60min) C. ONSET OF HEADACHE DURING ASCENT (30-60min); MILD NAUSEA AFTER SURFACING (10min)

DISARMING THE BLUEBOTTLE - TREATMENT OF PHYSALIA ENVENOMATION

Beryl Turner, Peter Sullivan and John Pennefather

Recent discussions of treatment with *Chironex fleckeri* (box-jellyfish) envenomation[1] has cast doubt on current management of other jellyfish stings. The demonstrated discharge of *Chironex* nematocysts after application of methylated spirits[1] has suggested that more harm than good may be done by well-intentioned treatment of jellyfish sting with methylated spirits. Vinegar and the product Stingose (Hamilton Laboratories Pty Ltd) have both been presented as treatments preferable to methylated spirits. This report describes an attempt to compare methylated spirits, vinegar and Stingose in the treatment of *Physalia* stings *(Physalia physalis)*, also known as Portuguese Man-of-War and bluebottle.

METHOD

The forearms of 20 healthy, informed volunteers were divided into four quadrants as test sites. A 2cm to 3cm portion of live *physalia* tentacle was applied to each area, allowed to sting for two minutes and then treated with a different test substance in each quadrant. Salt water was used as a control and the treatment sites were rotated in different subjects. Subjective assessments of pain were made at treatment, five minutes and 15 minutes after treatment, and each subject noted the sites in order from most to least painful. The tentacles were left on the skin and kept wet with test solution. Skin reaction was also assessed at five minutes and 15 minutes. The test solutions were assigned a number and subjects and observers did not know which solution was applied to which quadrant.

TABLE 1

Summary Of Assessments of Pain and Skin Reaction

	Number of Responses			
Treatment	Most Painful	Most Relief	Most Skin Reaction	Least Skin Reaction
Vinegar	7	25	1	17
Stingose	4	19	6	20
Methylated spirits	27	1	17	2
Salt water	19	9	12	4
Unsure	3	6	4	7
Total	60	60	40	4

RESULTS

Table 1 is a summary of the assessments of pain and skin reaction. The item “unsure” in the treatment column is included because on some occasions there was no apparent difference between two or more treatments.

The results were analysed using Wilcoxon tests and regarding salt water as the control treatment. These showed that methylated spirits caused a significant increase in pain at the time of application $P<0.01$. After five minutes, the relief from vinegar and Stingose was approaching significance ($0.05<P<0.1$); after 15 minutes the reduction was significant ($P<0.05$). Statistical comparison of the efficacy of vinegar and Stingose did not show any significant differences between them.

DISCUSSION

The most noteworthy conclusion from this study is that methylated spirits does not appear to have any advantages as a treatment of bluebottle stings. The immediate increase in pain is attributed to nematocyst discharge. This has been previously demonstrated in vitro.[1] It is legitimate to ask why methylated spirit has been accepted as treatment for so long. One possible explanation is that, on a beach, evaporative cooling after methylated spirit application may give some relief. This effect would not be present in our tests which were performed indoors. If this explanation is correct, then crushed ice may have some use as a remedy.

The more important question is what remedy should be used for first aid for bluebottle stings. On the basis of this trial it would appear that vinegar has a slight advantage over Stingose. In a serious case the role of local anaesthetic ointment has been emphasized.[3]

ACKNOWLEDGEMENTS

We wish to thank the Director-General of Naval Health Services, Rear Admiral SJ Lloyd and the Department of Defence (Navy) for permission to publish this article. The assistance of Lieutenant Commander JW Rennie, who performed the statistical analysis, is gratefully acknowledged. We also wish to thank the beach inspectors and Able Seaman (Medical) M Boyle who organized specimen collections and, most importantly, the victims who consented to be stung.

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1 Hartwick R, Callanan V and Williamson J. Disarming the box-jellyfish. Nematocyst inhibition in *Chironex fleckeri*. Med. J. Aust. 1980; 1: 15.

2 Defying tentacles of death. The Bulletin. 1979; October 16: 32.

3 Edmonds C. Dangerous Marine Animals of Indo-Pacific Region. A Diving Medical Centre Monograph. Newport, Wedneil Publications, 1975.

Reprinted from The Medical Journal of Australia, October 4, 1980, by kind permission of the Editor.

Issued by Commander S A Warner,
Chief Inspector of Diving, Department of Energy,
Petroleum Engineering Division

Thames House South,
Millbank London SW1P 4QJ, UK

3 July 1980

DIVING SAFETY MEMORANDUM NO 8/1980

OXY-HELIUM DIVING TABLES 1970

The attention of existing holders of oxy-helium diving tables 1970 prepared by RNPL and published by CIRIA UEG is drawn to the fact that these tables are being revised in the light of modern practice.

7 August 1980

DIVING SAFETY MEMORANDUM NO 9/1980

TUNNELLING - THE USE OF JETTING EQUIPMENT

A recent accident offshore was caused by a jetting gun. The equipment was being used to jet a tunnel under a section of pipe prior to stropping and lifting the pipe to the surface.

The tunnelling action of the retro tube had been found to be more effective for this work hence the gun was being used the wrong way round! The diver was operating in the prone position and failed to notice that his leg was in line with the main jet causing a puncture wound above the knee.

The manufacturer of the gun has been informed of the incident with a view to producing a safe tunnelling attachment. Until such a jet is available, supervising personnel are to actively discourage this practice and continue to stress the need for care and vigilance when using this very effective but potentially dangerous equipment.

8 August 1980

DIVING SAFETY MEMORANDUM NO 10/1980

NORWEGIAN PETROLEUM DIRECTORATE BELL DIVER CERTIFICATE

Your attention is drawn to the following information issued by the Norwegian Petroleum Directorate, on "Bell Diver Certificates".

"From 1 September 1980 a Bell Diver Certificate will be required for divers working on the Norwegian Continental Shelf.

"We would like to inform you that the Norwegian Petroleum Directorate has decided that the deadline for applying for a Bell Diver Certificate for those qualified by experience will be 1st September 1980.

"After this time a Bell Diver Certificate will only be issued if the applicant successfully has completed a bell diver course, approved by NPD, and a certificate with reference to previous experience will only be issued in special cases. Even if the applicant has experience enough to obtain a certificate, they will normally have to complete an approved bell diver course."

22 August 1980

DIVING SAFETY MEMORANDUM NO 11/1980

DIVING TRAINING REQUIREMENTS/STANDARDS FOR AIR AND MIXED GAS/BELL DIVING

History has shown that in almost every accident that has been investigated there has been some element of "lack of training". The UK and the Norwegian Government have established standards for basic air diving and mixed gas/bell diving.

Efforts have been made by UK and Norway to seek agreement with overseas government for a system of mutual recognition of comparable standards of competence and training. In practice, although the UK has achieved progress with some European countries, eg. Norway, Germany and France, this has been impossible with the United States. Large numbers of American divers work in the North Sea and their government does not and will not in the foreseeable future, wish to recognise US national standards of training for divers or to devise a scheme whereby divers are certificated as competent by a government or an official body.

The UK government is working with the industry to seek a solution which enables American trained divers to reach the agreed minimum UK standard and to be certificated as acceptable under the UK regulations. A cardinal principle of the system is that the same standards of competence reached through training must apply to divers of whatever nationality. The standards of schools in USA are varied, and none of them have the depth of water available to carry out practical training which is necessary to meet agreed UK standards.

All divers, regardless of nationality, who wish to work in the UK or Norwegian offshore areas will, in the future, be required to be certificated to the UK/Norwegian standard.

The enclosed "guidance" is introduced to assist companies who wish to establish acceptable "training modules" to build onto existing courses.

Duties

Both the Offshore Installations (Diving Operations) Regulations 1974 and the Submarine Pipe-lines (Diving Operations) Regulations 1976 places the duties on the employers of divers such that divers must either have adequate experience or theoretical and practical instruction. The Health and Safety at Work, etc. Act 1974 places a general duty on employers to provide information, instruction and training to ensure, so far as is reasonably practicable the health and safety at work of their employees.

Failure to satisfy these requirements in respect of experience, instruction and training will be regarded by the Chief Inspector as a serious irregularity which may result in enforcement action being taken, varying from the use of improvement and prohibition notices under the Health and Safety at Work Act, to the taking of legal proceedings.

I am always available to advise.

SYNOPSIS OF THE TRAINING REQUIREMENTS/STANDARDS FOR AN AIR DIVER WORKING OFFSHORE IN THE UNITED KINGDOM (UK BASIC AIR DIVER)

REQUIREMENTS

1. Must be at least 18 years of age.

2. Must hold an "in date" medical certificate valid in the United Kingdom.

3. Must achieve the standard of competence by training experience or a combination of training and experience in accordance with the aims and terminal objectives for Basic Air Diving and Underwater Working issued by the Manpower Services Commission (MEC).

A trainee may receive his basic training on a "modular" basis; eg. part of the training may take place in a diving school and the reminder with the company, or, on an "in-house" scheme with periods "on" and "off" the job. The trainee should complete a "modular" training scheme within 6 months.

GUIDANCE FOR ACHIEVEMENT OF IN WATER TERMINAL OBJECTIVES

The minimum in-water training times required for a trainee to work offshore as an approved diver are as follows:-

Depth in metres	0 to 19	19 to 39	39 to 50
Time in minutes	1,600	250	150

Total time 2,000 minutes (inclusive of stoppage times)

NOTE

The above figures are the minimum and many trainees will require considerably mere than the minimum to achieve the acceptable standard. However, it is appreciated that adverse weather and tidal conditions can sometimes interfere with the achievement of 150 minutes at 39 to 50 metres in spite of good pre-planning. In very special cases the Certification Authority may accept compression chamber dives of up to 75 minutes in this depth bracket as counting towards the 150 minutes minimum.

"In-house"/"on site" training can only be conducted with the full support and cooperation of the "customer" who would be required to accept that the "trainee diver" involved in training will not be part of the operational team and that he is "additional" to the complement.

The following commercial diving schools in the UK are approved to run courses to the above standard:-

Underwater Training Centre

Prodive

Fort Bovisand

SYNOPSIS OF THE TRAINING REQUIREMENTS STANDARDS FOR MIXED GAS BELL DIVER WORKING OFFSHORE IN THE UNITED KINGDOM

REQUIREMENTS

1. Must be at least 19 years of age.

2. Must hold an "in date" medical certificate valid in the United Kingdom.

3. Must be a competent air diver and underwater worker with experience of working over representative range of depths to 50 metres (at least 12 months).

4. Must achieve the standard of competence by training experience or a combination in accordance with the aims and terminal objectives for "mixed gas diving" issued by the Manpower Services Commission (MSC).

A trainee may receive his basic training on a "modular" basis, eg. part of the training may take place in a diving school and the reminder within the company, or on an "in-house" scheme with periods "on" and "off" the job. A trainee must complete a "modular" training scheme within 6 months.

GUIDANCE FOR ACHIEVEMENT OR IN-WATER OBJECTIVES

The following minimum training dives and in-water times must be achieved to satisfy the requirements of the MEC training standard:-

25 bell lock-outs in shallow water;

Act as a bell-man for 25 lock-outs in shallow water;

Exercise recovery of an incapacitated diver 5 times;

Complete 4 bounce dives acting as a lock-out diver at progressive depths from 50 to 100 metres. (eg. 1 at 50 metres, 1 at 65 metres, 1 at 75 metres and 1 at 100 metres). Underwater tasks must be completed on these dives.

Complete an exposure to saturation conditions for a minimum period of 36 hours including decompression. Whenever possible a lock-out should be completed under these conditions. An excursion from saturation to a depth deeper than 50 metres can be counted as one of the bounce dives.

"In-house"/"on site" training can only be conducted with the full support and co-operation of the "customer" who would be required to accept that the "trainee diver" involved in training will not be a part of the operational team and that he is "additional" to the complement.

EXISTING APPROVAL ARRANGEMENTS FOR THE UK DIVING SCHOOLS

The Underwater Training Centre (UTC) at Fort William is presently the only commercial school in the United Kingdom approved to run courses to this training standard.

DIVERS DO IT DEEPER

(BUT NOT WHAT YOU THINK)

A brief note in the New Scientist (27 Sept 1979) casts an oblique light on the oft seen car sticker boast used by divers to advertise their skills. It has apparently become a source of wonder to the regular patrons of the Aberdeen pubs frequented by divers immediately before their return to the women-free oil rigs, that one of the last actions of the divers has been to rush into the appropriate room to utilise the machines which dispense an article singularly inappropriate for such monastic conditions. Sad though it is to spoil what seems to be the lead to a sensational Sunday Paper story, truth demands the sacrifice. Information has now leaked out that they are preparing not for their next shore leave but for the work conditions which await them. The items in question are used to enclose the divers' microphones, which otherwise become damp and perform poorly. As suggested on the original instructions for use, the condoms are used once and then discarded. How remarkable that no high power research lab thought of this!

UNDERWATER MEDICINE COURSES 1981

The RAN School of Underwater Medicine will run the following courses for medical officers:

Basic 7th September to 18th September, 1981

Advanced 21st September to 2nd October, 1981

Having passed, the basic course is a pre-requisite for attendance at the advanced course. The courses can be taken together. There are five places (at most) available for SPUMS members on each course. Applications to be addressed to

Dr CJ Lourey
Secretary SPUMS,
43 Canadian Bay Road,
Mt. Eliza, Victoria, 3930.

The RAN requires the following information

Date of birth
Medical School
Date of qualification and degrees
Reasons for wanting to take the course
Current address and telephone number

The RAN cannot provide accommodation for civilians. There is a charge for the course.

BS-AC DIVING RESTRICTIONS FOR DIABETIC DIVERS

The following is the present advice to BS-AC members who are Diabetic.

1. Diabetic divers on Insulin should ensure that they do not suffer from hypoglycaemic attacks while diving by taking additional sugar or sweets prior to the actual dive.

2. Their Diving Marshall and buddies should be aware that they are diabetic, know where additional sugar can be obtained and be warned that attacks of unconsciousness may be due to hypoglycaemic attacks, decompression sickness, or air embolism and should be asked to bear these possibilities in mind.

3. They should be accompanied by a diver of at least 3rd class qualification.

4. Ten minutes should be added to bottom times for dives up to 18m, and 5 minutes for dives beyond 18, when calculating no-stop and decompression times.

5. All divers who have not already done so should forward to the National Diving Officer at the BS-AC HQ a copy of their current BS-AC Certificate of Medical Fitness.

It is apparently intended that diabetic divers will have their fitness to dive assessed by an independent Consultant in conjunction with the Club Medical Committee.

INCIDENT REPORTS

UNCONSCIOUS DIVER

From a report made to "Project Stickybeak"

This report concerns an episode of loss of consciousness in a scuba diver from the viewpoints of the victim and the rescuer. Critical factors which operated to induce the incident are suggested, as also those which mitigated the danger and enabled a nil morbidity result.

The dive location was a dropoff on the seaward side of a large reef. The edge is in some parts cliff-like and in others is made up of a series of small ledges. Depth near the edge, on top of the reef, is 6-10m; beyond the edge it is 15-18m. Diving is traditionally confined to the "drop-off" in preference to the reef flats above, since the caves and overhangs along the edge are much more interesting. The sea was relatively calm, with a small swell, and underwater visibility was 5-6m. The tide was outgoing at the beginning of the dive, but was incoming at the time of the incident.

The diver was wearing a made-to-measure (in 1978) wet suit of 1/4" thick rather stiff material, consisting of Long Johns and jacket with hood attached. At the time of the incident the diver was 5kg heavier than when the suit had been made and consequently it was a tight fit, particularly across the chest and stomach. However no noticeable ill effects had resulted from this tightness on other dives, the most recent one being 2 weeks previously.

The dive party consisted of five divers, three in one boat and this diver with his buddy in another. While dressing he felt nauseated but was correctly confident that this would resolve once he had something to do, such as moving the boat or entering the water. It was agreed that the diver and his buddy, both of whom were interested in underwater photography, would stay generally together though not rigidly so. In fact the buddy remained at the 12m ledge on which they were anchored and the diver moved 5m seaward to a depth of 15m. In general they were in sight of each other.

After about 15 minutes the diver began to feel a little uneasy and then noticed that he was breathing faster and more shallowly than usual. The feeling of apprehension could not be ascribed to any specific cause so he decided to abandon the dive. By this time he was next to his buddy so he indicated his intensions and they both moved slowly back to the anchor, the diver concentrating on breathing normally. At the anchor, the breathing was steadier so he signalled that he would ascend and that his buddy should join the other three divers, who were 30m distant. This being agreed, he commenced his ascent.

At this point he was still concerned about his breathing so he dumped all the air from his compensator to avoid the possibility of ascending too rapidly. This meant that he had to swim up the anchor line, and this effort aggravated the fast, shallow breathing problem. Ascent was slow and steady and controlled all the way up - there was no panic - and although the entire ascent lasted less than a minute it seemed much longer. "Everything seemed to be happening very slowly. At about 5m I noticed that my hands were empty (no camera or anchor line). Above me I could see the hull of my boat 3 times. My thoughts at this point are very clearly remembered as follows: Taking a very long time to get there - something is very wrong nearly there, get ready to inflate compensator - keep mask on and regulator in mouth I'm there, blow the vest (I stopped when I could feel it overflowing) - I'm drifting away from the boat - ditch weight belt. I can remember feeling the weight belt buckle with my left hand (it is a left hand release) but was unable to make my fingers grip it and pull. The next thing I remember is being flat on my back in the bottom of a moving boat. My gear had been removed and my wet suit top cut open and I remember trying to say "I can't get enough air". With assistance I sat up and asked for help to get my wet suit top off. It had already been cut from the chin to the chest but was still attached across my chest. Its complete removal gave almost instant relief. When we reached the shore, I was assisted up the beach, where I had a rest and then walked to my car with minimal assistance."

It was indeed providential for this diver that there was another boat nearby in which were several divers preparing to enter the water. One of them noticed a fully equipped scuba diver floating on the surface with his buoyancy vest inflated, motionless, with arms outstretched. They immediately went over to investigate and found that he was unconscious, with eyes rolled up and lids part open: his breathing was slow and shallow. "We immediately called for help while removing his face mask, regulator, weight belt, and tank. We had difficulty removing his regulator because his teeth were tightly clenched", they reported. By this time three other boats had gathered and one was sent to shore to call an ambulance, one was deputed to await the ascent of the buddy, and the third attempted, unsuccessfully, to radio for help. With some difficulty the victim was got aboard one of the boats. As he was lifted he started moaning and appeared to be semi-conscious. They opened the neck of the victim's wet suit and then, at his request, sat him up and removed the wet suit top.

The diver apparently felt well, though tired, and had a rapid pulse and "low" (undocumented) BP at the beach. Check a short time later at a Medical Centre showed normal pulse and BP, and some redness of his throat.

The buddy had watched the first half of the diver's ascent from his position at the anchor and noticed nothing unusual. The victim believes that his buddy unaided could not have been able to get him safely into the boat and therefore his absence

was not a risk factor because other divers were in the area. This is an optimistic interpretation of the situation. He has subsequently discussed the events with others and discovered that breathing difficulties associated with tightness of a wet suit around the chest or throat has troubled others also, though not so dramatically.

COMMENT

This incident underlines the critical importance of attention to and complying with as many of the basic principles of diving safety as possible. In this incident it was only the presence of several significant factors which outweighed the negative factors which would have easily resulted in death.

Negative Factors:

- *Separation from buddy*
- *Restrictive equipment*
- *Unconsciousness*

Positive Factors:

- *Experience (equivalent to C Card plus 210 dives) which had reached an "overlearning" level such that he made correct responses and avoided panic despite impairment of consciousness*
- *Correct equipment ie. buoyancy vest*
- *Adequate remaining air*
- *An early decision to abort the dive*

Good luck:

- *Retention of grip on mouthpiece*
- *Buoyancy achieved (despite failure to drop weight belt) face upwards*
- *The presence of alert surface cover unrelated to the dive party*
- *Absence of aspiration of either sea-water or gastric contents*

The aetiology of the loss of consciousness can only be surmised. The restricted chest movements due to tight wet suit (and the other equipment) could result in hypercapnoea from poor tidal air flow, and possibly hypoxia from exercise induced increased oxygen needs. Constriction to the neck and chest could have caused thoracic vascular changes and vaso-vagal blackout. There was no suggestion of overdistension of the viscera with air. The mild seasickness may have contributed to the problem.

ACKNOWLEDGEMENT

Sincere thanks are offered to those involved in this incident, who notified the events in detail.

HYPEROXIC SEIZURE

From a report made to "Project Stickybeak"

Loss of consciousness from oxygen toxicity during the planned use of pure oxygen for a decompression stop at 50ft is described. The dive was Heliox at 150ft during a commercial diving course, descent being on air. Correct choice of equipment and excellent top-side management together resulted in a nil-morbidity result. The need for improved availability of information concerning such diving is strongly stressed.

A group of divers were conducting a series of deep dives on Helium-Oxygen mixtures as part of a training course in commercial diving. The dive procedure was based on the only available information for heliox diving, the US Navy Surface-orientated Diving Tables, which uses in-thewater decompression. All the divers had some experience of air diving and had logged at least 5 dives on the Kirby-Morgan Band Mask system, including one dive to 150ft with surface decompression in the chamber, on air.

Equipment used

A Kirby-Morgan Heliox 18 Band Mask with surface supply and with 2-way communication with the surface was used. The divers wore a wet-suit, weight belt, fins, and a KMB mask as above. They also had a 60cu ft bailout bottle filled with compressed air. The gas supply was a bank of G-cylinders filled with compressed air, medical oxygen, or heliox (21% O2:79% He). There was a Spiro-technique one-man decompression chamber ready rigged with its air supply from a separate bank of G-cylinders. There was a breathing mask in the chamber rigged to a medical air/oxygen manifold. Unfortunately it had been impossible to obtain a twin-lock chamber.

Dive Procedure (based on US Navy tables)

1. Descent to 150ft on air
2. Change to Heliox at 150ft.
3. Ascent commenced before 10 mins bottom time elapsed.
4. Change back to air at 100ft.
5. 1st in-water decompression stop at 50ft on pure oxygen (10 mins).
6. 2nd in-water decompression stop at 40ft on pure oxygen (11 mins}.
7. Ascent to surface on pure oxygen at 25ft per minute.

At each breathing gas change the free flow on the mask was opened fully for at least 10 seconds to ensure adequate flushing.

During each dive the following personnel were involved:-

a. A fully geared standby diver (wearing open circuit scuba) immediately adjacent to the entry point, which was the stern of a 40ft workboat.

b. The diving supervisor at the communications panel.

c. A change-over man for the breathing gas manifold.

d. This person was also responsible for operating the decompression chamber in case of an emergency.

The diver's tender to handle hoses and assist the diver with his entry and exit.

Description of the Incident

This was the first dive for the group on heliox. The dive procedure was as described above. The first three divers completed the dive without incident and the subject had no problems until 8 minutes into his first (50ft) decompression stop, when he was heard to say "change me to air". At this point the standby diver immediately entered the water, the gas was changed to air, and the supervisor told the diver to open his free-flow. A groan was then heard from the diver. His breathing was heard to be rapid and he ceased to respond to communications.

As the standby diver approached the subject was seen to be in a foetal posture and twitching in what appeared to be a classic hyperoxic seizure. He was also fumbling with his free-flow. His eyes were rolled back, showing the whites. The standby diver opened the free-flow fully and then, as he appeared to be breathing, brought the subject to the surface directly. At the surface he was quickly removed from the water, his gear removed, pulse and breathing checked, and placed in the chamber because of the omitted decompression (and the possibility of pulmonary barotrauma with air embolism due to his rapid ascent while having the seizure). This action was in line with the US Navy Diving Manual's advice.

At the surface he was noted to be unconscious, with white foam but no blood coming from his mouth. His eyes were rolled back. He had good breathing and pulse. The decision was made to recompress the diver on the emergency air table for omitted decompression on a 150ft dive unless symptoms of decompression sickness or air embolism occurred. Unfortunately the chamber was not large enough for an attendant so all monitoring had to be done from outside via visual ports and chamber telephone.

From the time the diver requested to be changed to air till blow-down commenced was approximately 2 minutes. Blowdown was completed by 1514 hours. The diver was heard to be breathing steadily but was not responding to any verbal or visual stimulation from outside the chamber. Nonetheless he was constantly reassured by the attendant.

He did not move until 1526, when he began to wipe his nose and was heard to say "Get me out of here". Later he related that he "woke up" in what he thought was his coffin and dressed in a suit at this point. He seemed agitated and moved about quite a bit, apparently trying to find a way out. Although he was being assured quite a bit he did not respond or settle down till 1531. The change at this point was remarkable. He began to converse freely, asked for details of the accident, and was able to take his own pulse, which was approximately 60 beats a minute at this point. From then on he seemed in good spirits, although impatient to get out of the chamber. The decompression schedule was as follows:-

60ft	22 minutes
50ft	30 minutes
40ft	35 minutes
30ft	42 minutes
20ft	52 minutes
10ft	68 minutes

All the depth changes were made as close as possible to 2 minutes for 10ft.

At 1700 hours, approximately 17 mins into his 30ft stop, he complained of a slight pain in the muscle 2-3" below the groin. This had faded by 1704. At 1708 a slight pain appeared in the right thigh muscle, and this remained for the rest of the operation. It was decided that unless it worsened it was not serious enough to alter the decompression schedule as it was most likely due to bruising during the rescue or to muscle torn during the seizure. At 1712 the subject complained of a headache. As this was thought to be CO_2 induced the frequency of chamber flushing was increased. Later it was deduced to be more likely due to sinus squeeze during recompression. No change of condition occurred for the rest of the operation and the patient was finally surfaced at 1943.

On release from the chamber he complained of slight dizziness and had a slight bleeding from his nose and slight pain above the eyes, almost certainly from sinus squeeze.

He was given hot soup and food and while he was eating visual, hearing and reflex tests were given: all responses appeared normal. Due to the location no medic with diving medicine knowledge was available but at a full CZ18 medical some days later the only sign of injury was a slight haemorrhage of one eardrum. The subject was kept under constant observation for the 24 hours following the treatment and tests were repeated. No further symptoms were reported.

COMMENT

The incident described is a classic hyperoxic seizure, the rapid return of consciousness and lack of residual symptoms supporting this diagnosis. The argument may be levelled that it was dangerous to give pure oxygen in the water. However the only obtainable table for heliox diving uses this. It

has been found since this incident that diving contractors no longer give pure oxygen in the water as they have had problems even with experienced divers who had quite satisfactorily passed oxygen tolerance tests (60ft on pure oxygen for 30 minutes). This important information was only revealed after the event. Another problem was that no Authority (or private contractor) with a suitable chamber would permit O_2 tolerance tests to be conducted, both before and after the incident. For obvious reasons the one man chamber was unsuitable for this test. The divers who underwent O_2 decompression did so voluntarily after the risks were explained. No further dives of this type have been carried out since the accident. Events demonstrate that all reasonable precautions were taken and that skilled backup was immediately available and deployed correctly.

Critical factors worth noting include the following:-

Equipment

The use of a KMB mask guaranteed protection from the risk of drowning when consciousness was lost. There was also certainty of breathing gas supply and a good communications link allowing a degree of monitoring of what was occurring. The communications facility was a vital safety factor.

Dive Planning

Thorough consideration of the proposed dive ensured recognition of all possible complications and the preparation of the appropriate responses. There were adequate reserve gas supplies, a recompression chamber and therapeutic Tables. The use of a one-man chamber was a consequence of the 'force majeure' of circumstances and its limitations were recognised.

Personnel

The trainers were all adequately experienced divers and aware of the potential problems. The "top side" supervision showed by their actions that they were both highly alert and well informed. Management of the chamber treatment indicated a deep understanding of the principles which governed management, the continued vocal encouragement of the subject showing appreciation of the fact that there was a person rather than a case in the chamber.

Heliox diving

Attention is drawn to the fact that the physical basics for such diving is readily available but the essential physiological knowledge (ie. the Tablets which enable safe usage) is highly restricted. Such secrecy can be rationalised but not excused in its present degree. The non-dissemination of information concerning the adverse experiences of diving contractors using the US Navy in-water oxygen decompression tables is another example of the imperfect awareness of the diving community of the necessity for centralisation of incident reports.

Oxygen toxicity

The practical difficulties which prevented the performance of this screening test are noted, as also the caution that to "pass" such a test is not a guarantee of immunity.

By the Editor:

This report is taken, virtually unedited, from the Incident Report. Permission to print it is acknowledged with gratitude. The "top side" staff, whose performance was excellent, understood the concept of responsibility so well described by Admiral Rickover at the Thresher disaster investigation:

"Responsibility is a unique concept. It can only reside and inhere in a single individual. You may share it with others, but your portion is not diminished. You may delegate it, but it is still with you. You may disclaim it, but you cannot divest yourself in it. Even if you do not recognise it or admit its presence, you cannot escape it. If responsibility is rightfully yours, no evasion or ignorance, or passing the blame can shift the burden onto someone else. Unless you can point your finger at the man who is responsible when something goes wrong, then you never had anyone really responsible."

Doctors, Diving Instructors and Supervisors, are particularly subject to the moral and legal implications of Responsibility. This diving organisation passed the test.

DOES A ROLE EXIST FOR DENTISTRY IN DIVING?

Adrian Gardiner

As a dentist with a long interest in diving and an association with SPUMS which goes back to 19/6 Manna Island meeting, (which spurred me to seek scuba qualifications and SPUMS membership) I have been frequently posed this question by me professional colleagues. With some experience and thought it became increasingly obvious to me that the answer was definitely "yes".

The most obvious and frequently encountered dental problem in diving is the occurrence of severe dental pain. The incidence of severe toothache associated with dysbaric conditions was noted and studied during World War II by the late George Christiansen during his term in the RAAF, and later as consultant oral surgeon to that service. This condition severely afflicted aircrews and impeded their performance. Briefly his findings were that small entrapped air pockets under fillings and restorations rapidly changed

their pressure and volume under variations in the ambient atmospheric pressure, causing acute pulpal inflammation in the involved teeth. This condition was readily and rapidly relieved by removal of the offending restoration and careful replacement using a sedative base under the filling.

It will be obvious that these findings are as readily applicable to the hyperbaric situation of diving as to the hypobaric situation of aviation. However, when faced with a case of dental pain in a diver, careful examination (using Radiographs and pulp vitality tests) is essential to eliminate obvious dental pathology as it would be unwise to encourage a patient to undertake diving with grossly carious teeth, periodontal disease or other obvious dental infections. The diver suffering these problems should be dissuaded from diving until the condition has been resolved. While the diver suffering from the above type of toothache has little doubt as to which tooth is affected, I have found that a significant number of divers seeking treatment complain of general pain affecting the posterior maxillary teeth either unilaterally or bilaterally, subsequent oral examination revealing no dental problems. Further examinations and questioning usually reveals and inflammatory condition of the facial sinuses particularly the maxillary sinus. Anatomically the apices of the roots of the posterior maxillary teeth are close to or within the maxillary sinus while their blood supply and innervation are intimate with the antral lining. Thus it is obvious that dental pain will be a sequel to maxillary sinus squeeze.

All the foregoing have relevance to an incident during the recent SPUMS conference at Pulau Tioman. A member had sought dental treatment for toothache shortly before leaving Australia. However, the pain persisted and increased in intensity during the week. There was an overlying sinus problem and apart from using analgesics and antibiotic therapy, I delayed radical treatment. However, on the Thursday of the week the pain became so intense while returning from a magnificent day of diving at Pulau Labas and Pulau Tulai that treatment could no longer be delayed.

I removed the offending tooth and sutured the socket in my hotel room under local anaesthetic (4 cc Citanest 15) with premedication (45 mgs Oxazepan) given 45 minutes previously. As I had given the patient 250 mg Moxacin tablets for 24 hours I got him to continue this therapy for the next 3 days as antibiotic cover for the initial healing period. Healing was uneventful and after sleeping off the effects of the premedication he was able to indulge in some snorkelling and free diving the next afternoon, but was dissuaded from scuba diving to prevent the very real possibility of air emphysema in the wound. The tooth was found to have deep caries on the mesial surface with pulpal involvement.

Another facet of dentistry with an important relevance to diving, is the field of prosthetic replacement of teeth. It is very evident that there are many divers wearing full dentures who are able to control their regulator mouthpieces with no functional problems whatsoever. The edentulous diver wearing small removable partial dentures presents a different set of circumstances.

Should one of these appliances become dislodged, as they can do, it is quite conceivable that it could become dislodged in the oropharynx with serious consequences to the airway. It is my personal feeling that divers wearing these prosthetic appliances should forego human vanity and store their partial denture in their dive bag while below the surface. This then leads to the situation of the diver whose dentition is so impaired as to make it impossible to effectively control a regulator mouthpiece in his mouth. It should be possible and in fact relatively simple to construct an individual mouthpiece from silicone or neoprene rubber that is comfortable and effective for these divers.

In the foregoing I have attempted to set down briefly personal thoughts on the role my profession has to play in diving medicine, but more importantly hope to urge all those members of SPUMS who are not in the Medical profession but in related occupations to contribute their knowledge and skills to their sport.

SPUMS AGM 1980

25th June 1980

PRESIDENT'S REPORT

1979/80 has been a year of progress for the Society. We have changed the Secretary and we have a new hand at the helm running the Society's business. Besides that, we have launched out into the first international joint meeting that SPUMS has been associated with. It is a great honour for SPUMS to be associated with a meeting, in Singapore, with the Singapore Armed Forces who could easily have put this meeting on by themselves with the backing of the medical profession in Singapore who are contributing to the conference. In my opinion, it is extremely important that as many members and their wives as possible should attend at least the opening ceremony and the first day. If you have read the programme you will agree that it should be an excellent meeting. There is a lot for us to learn about the problems that people have in this part of world, and we are hoping to enlighten the people who live around warm water of some of the problems we have with our colder water.

You might be surprised to know that we now run a Journal. It was a newsletter when it started, and then it was a newsletter-journal. Then when we applied for Category B publication status to reduce postal cost, the Post Office said that it had to be either a newsletter or a journal. It has not been a newsletter for years because the news that got into it was history by the time it got to us, so I said it was a Journal. So now our publication is a Journal. You will have noticed that the Journal has changed its shape and production. We had great difficulty getting the Journal out on time when it was being printed in Sydney. And with the constant rise in postal costs

and the fact that it is not a Post Office preferred size, the postage bill had become horrendous. Also we felt we were letting our members down in not getting the Journal out four times a year. You may have noticed that a number of times there have been two issues published as one. We now are using a system where Douglas Walker in Sydney selects the editorial matter and sends it to me in Melbourne to process into print. It means a lot of extra work for me which I am not always happy about but I hope that the rest of the Society get as much fun out of the Journal as I do out of laying it out. And they should be getting a lot of information.

We have had a large number of new members over the year, but sadly a number of our members have failed to renew their subscriptions. We have tried to have a meeting in Australia this year, but the Transport Workers' Union put a stop to that. It is a pity because the programme that Darrell Wallner and Alistair Robson had arranged for us was an excellent one.

For those of you who are speaking here and in Singapore your words are being recorded. When my secretary gets through taking it off tape, and it has been edited and all the -ums and -ers left out, it will be published in the Journal. Not necessarily the next Journal, but a Journal.

We have had a disappointment with the School of Underwater Medicine courses and the Hyperbaric Medicine course at Prince Henry Hospital in Sydney. This year, owing to reasons beyond our control, it was difficult for members to participate in the course at the School of Underwater Medicine. We have done very well recently. We have had far too many people going on the course. We were only entitled to five places, and the Navy has written reminding us that we are only entitled to five places. However we have been able to get many more people on in the past year or two because the Navy has been too short of doctors to fill the course. The course in Hyperbaric Medicine was cancelled this year and may not run next year. So we are faced with the fact that it is going to be extremely difficult for anybody to fulfil the basic requirements for the Diploma of Diving and Hyperbaric Medicine, which are doing the four weeks' course at HMAS PENGUIN and the one week course at Prince Henry Hospital. If Prince Henry Hospital is not running a course no one can possibly do it! And one must not forget that the thing that clinches a Diploma is six months' full time, or equivalent part time, in Diving or Hyperbaric Medicine.

We have suffered this year, as in previous years, from lack of audience participation. We have over three hundred members in Australia. Yet this year after the Secretary went round and leant on people we have just enough nominations to fill the committee. I do not think that is an acceptable situation for a Society that intends to improve the knowledge of Diving and Hyperbaric Medicine in the community, which is one of the charter aims in our constitution. I would urge you all to consider very strongly either serving on the committee or organising local meetings (or both). It is not very difficult to persuade a number of the members of the Society to come and talk at these meetings. They are quite happy to pay their own fares because they like the sound of their own voices. And we do have a number of people in this Society who are knowledgeable and can inform people who have little knowledge of diving medicine. I feel we have let Australia down this year, not through our fault, because we cannot compete with the TWU, a more powerful group than we are and a much larger one. But we ought to be having meetings in Australia as well holding our AGM every year.

We did have an active branch in North Queensland last year. They may well be active, but they do not write to us anymore and tell us what they are doing. So some Queenslander might like to go back and find out what is going on in the top end of Queensland and let us know.

To sum up, we have had a year where we have made big steps forward in the international field. Our contacts with the Undersea Medical Society have improved. We have continued our habit of borrowing senior members of that Society to lecture to us and we are all very pleased that John Miller is able to be with us. We have all, I am quite sure, enjoyed the talks he has given so far.

However we have got to pull our socks up about teaching Australia and New Zealand about Underwater Medicine and diving safety, and that we can only do by organising meetings. And we cannot leave it all to the committee. Also if you look at the committee you will see that most of us here are anaesthetists. Well there is nothing wrong with that, but most of us are over 40, some of us, certainly Victor Brand and I, are over 50, and while it is all very well to have good advice from elderly people, you do need the infusion of young and enthusiastic people to keep anything running. We do need the help of the members to improve the service the Society is offering to the community.

SPONGES AND THE RED TIDE

Q. What is the effect of a red-tide outbreak on sponges?

A. Because they lack a central nervous system, sponges are unaffected by the neurotoxins associated with red-tide blooms. Also unaffected are horseshoe crabs and bivalved molluscs, the nervous system of which are quite primitive. On the other hand higher marine animals with more complex nervous systems, such as the larger gastropod molluscs, polychaete worms, crustaceans, and fishes, are highly susceptible to the neurotoxins produced by dinoflagellates responsible for red tides.

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SPUMS ANNUAL MEETING 1980

MONDAY JUNE 23rd

DIVING ILLNESSES AND INJURIES

EYES AND DIVING

Dr Peter Cohen

The main eye problems have with diving are common sense ones. I think more problems come from divers on the surface than underwater. By this I mean, it takes 2.5-3 hours to get out there and you are under for an hour and then you come up and go home. I practice in a coastal suburb and I do see some divers - and people who go out on the ocean. The common problem I see is ultraviolet sunburn. They come in with the equivalent of a welder's flash with a sore eye. The treatment is quite obvious. Keep out of the sunlight for 2 days and the eye usually gets better.

The few professional divers that I know, just like professional fishermen and amateur or professional yachtsmen, get pterygiums. It amazes me that they get out there and there is a dead calm mirror ocean yet they never wear sunglasses. They end up with pterygiums. If you lop them off and the men go back onto the ocean they grow back. And they grow viciously and are very nasty.

Another problem that is practically confined to inexperienced divers is mask squeeze. I do not think an experienced diver will run into this problem. Mask squeeze can present some problems in that people may get, with severe mask squeeze, subconjunctival haemorrhages because the conjunctival vessels are unsupported. I consider sub-conjunctival haemorrhages are innocuous. I do see a fair number in my practice, not necessarily from diving but from any episode of raised venous pressure, and I generally tell them just not to worry. But with a severe mask squeeze they can get chemosis and the conjunctiva will prolapse outside the eye, which does tend to make people panic. However with a tulle gras dressing and an eye pad it should settle down without anything further needing to be done.

Coming on to people with medical eye problems that would be a contraindication to diving. One would be a very high myope who has a history of retinal detachment or retinal hole. I would very much predispose to getting either another hole or a retinal detachment. A retinal detachment in high myopes is a very severe thing. They often do not do well. Their retinas tear very easily as the retina is very stretched and the retina comes off easily. It is very difficult to get it back on. The technique of our surgery with retinal detachments, nowadays, is that we put encircling bands around the eye and we use a plomb, which is a piece of silicone which is pushed down to indent the sclera. We are trying to indent the sclera over where the hole is. With a high myope the sclera is very thin and you can easily perforate the eyeball. Then you are in more troubles than when you started.

The other thing that I am told would also be dangerous, but I have never been confronted with it, is a person with advanced glaucoma with a severe loss of visual fields. Both these conditions of high myopia and advanced glaucoma tend to occur in people who would not dive. So I do not worry about it too much. A high myope is not going to see very much underwater - so why dive? He is going to have trouble with what techniques we have trying to correct vision underwater.

On the whole I am consulted by divers about refractive errors. I am a myope, and I wear contact lenses underwater. But they do have their hazards which I will tell you about. A lot of people do wear lenses glued on to the mask, that is the only alternative. One girl I know actually has wired in, and sealed with some Araldite, a pair of spectacles so that they sit on her nose when she puts the mask on. But it is a very difficult thing to do. The problem with putting lenses in masks is that you have already got a restricted visual field from using the lens. The size of the lens is so large that you get peripheral aberrations, quite severe peripheral aberrations, in a lot of cases. If you are quite happy with having a further restriction to your visual field there is probably no trouble. A lens is adjusted to being a certain distance away from your eye. When you move it further away from the eye and glue it to a face mask and then start looking down and sideways through the lens you start to get oblique astigmatism and this really interferes with clear vision.

In my practice I am quite a fanatic. I believe in people wearing contact lenses. I seem to advise them all the time. Perhaps they think I am a nut because a lot of them lose them.

Over the years we have gone through a development of certain types of contact lenses. The first ones were the scleral lenses. This is the very earliest type of contact lens, and we still fit a few of them. They are made out of hard polymethyl methacrylate. They go right over the cornea and extend onto the limbus and under the eyelid. The first ones were made in about 1857. In those days they used glass. But these lenses were very difficult to construct. They have the advantage that they do not fall out underwater. One of the problems under water with any contact lens is that the lenses stick on with surface tension. If you flood your mask you can very easily have them come out. I do not fit these scleral lenses. I refer them on.

I know one ophthalmic surgeon in Sydney who does a few each year and he says that about his only call for these lenses, for optical purposes, is that he prescribes them for swimmers, especially water polo players where they really need to see what they are doing. They do have a practical role because they do not fall out. They can be used for cosmetic purposes as you can paint an eye over this lens for someone who has got a very scarred eye that is non-functioning. One problem with them is that they have a quite limited wearing time. Often the patient can only tolerate wearing them for 4 hours at a time. They are very difficult to make. To give you an example of why they are difficult to make. I will explain the procedure.

One places a small cup on the anaesthetised eye. There is a tube poking out from the cup. You get a 2 cc syringe and you squirt a quick setting substance down the tube. This gives you a mould of the front of the cornea. And from that negative mould you make a positive mould in plaster or something a bit harder than plaster. On that positive you start to make the lens. After which you start to grind the lens. It is a real hassle to make it and people must really want to have to make it. But for people who want to use contact lenses underwater in a situation where they could very easily lose them and they will be under for a short time they are a very practical answer.

The other types of lens that we have, and it has been around for a long while is the corneal micro lens which is made out of a hard material. The commonest material that is used is the same material from which scleral lenses are made, poly-methyl methacrylate. Nowadays they are mainly used in people with astigmatism and who are hypermetropic. Once upon a time they were the standard lens, before the soft lenses came in. The problem with them is that they are more easily lost and especially they are very easily lost in divers. You have just got to get the slightest amount of water in the eye and they lose surface tension and pop out. They have problems with adaptation. I have a continual parade of people who come in and say “I just cannot wear these things”. They are a lot harder on the cornea. Lately the materials they have been made of have changed so that the manufacturers say that they are of a semi-soft material. It is cellulose acetyl butyrate and has a higher oxygen transmission and is supposed to be better. But I am not quite sure. And we have got even later materials which I will not go into. The advantage of them over other lenses is that they are very easy to prescribe. The softer lenses in some people are quite hard to prescribe but these often are a bit easier. It depends on whether the patient has a lot of astigmatism or not. But the problem is that if people have high hypermetropic errors trying to prescribe our current plastics in soft lenses is a very difficult problem, if they want good vision and they want to wear contact lenses.

The soft lenses are the modern contact lenses. Someone added a water group on to the plastic molecule. That is what led to the start of the soft lenses. The interesting thing that it looks very easy to add water. It was done in Czechoslovakia and the firm that did it has since made about $600,000,000 out of putting that extra radical on the molecule. It is the dominant plastic that is now used in soft lenses. And soft lenses are a big business. They are very much a big business now. They are very flexible. They go over the corneal-scleral junction about 1.5 mm. Generally in a person who is myopic they are easy to prescribe. For someone who has myopic astigmatism they are reasonably easy to prescribe. And for people over about 50 years old who are long-sighted they are not too difficult. But our problem with them is that they have a low oxygen transmission and they are only about 38% water content. Which leads people who are often active in sport who want contact lenses to run into trouble. There have been some plastics which have come out over the last few years, that are 50% water content. They are claimed to be better. But I find that the problem is that as the water content of the lens goes up they become much more of a mechanical problem for the patients to look after. They tear very easily. They become also more expensive. We have even got up to the stage now of having a type of soft lens material that has 75% water content. The manufacturers of this material boast that it is a permanent wear lens. The interesting thing is that the ophthalmologists all refer to it as an extended wear lens because there is a problem with wearing these lenses all the time. With the normal soft lenses you have got to take them out every night. Clean them overnight and put them in the morning. But with these extended wear high water content lenses they are more oxygen permeable because of the high water content. The problem is that the lenses are not being disinfected. There have been a number of instances, even in Australia, where this has led to a number of corneal abscesses. You have only get to have one corneal abscess in a person who wants to wear a lens for cosmetic purposes to put you off these lenses for a very considerable period. The other big problem with a high water content lens is that, because of the high water content, they are very friable. The patients have to consult you quite frequently. You have got to be around all the time in case they run into trouble. You have got to see them once a month. It becomes both time consuming and expensive for the patient. So the practical application of these very high water content lenses, not the normal soft lens, is in aphakics and that is only in some people who are long-sighted. The biggest problem a lot of long-sighted people, really long-sighted people, have with contact lenses is that they cannot see the contact lens to put it in their eye, when they have got to put it in first thing in the morning.

Originally when the soft lenses first came out we could not prescribe corrections for astigmatism. We have reached the stage now when we use the same plastic and we can. We truncate it, that means we cut off the bottom of the lens. This helps the lens stay correctly positioned. We make it so that it is thicker at the bottom than at the top. The normal thing that happens with a normal contact lens when people blink is that it rotates. It spins around. And you can easily see what I mean when if you look at an eyelid closing slowly. It closes like a zipper from the outside to the inside. And that just spins the lens more or less inwards and upwards and out. The idea of making the soft lenses thicker at the bottom is so that every time they blink the lens settles down between blinks. It is not always easy to get these soft lenses sitting as you would like to think they should. We have various ways of doing it. We can make them even a little bit thicker at the bottom but this sometimes leads to problems in that they complain that every time they blink they can feel the contact lens between their eyelids and a lot of people really do not like it. We do get a lot of problems with these lenses.

Soft lenses are reasonably cheap and easy to make. When I mean by cheap is that the price is around $100 to $114 for a normal spherical correction. But these special astigmatism lenses in Sydney are $184 a pair. And you really would think twice about diving with them on, when you have got a very good chance, if you flood your mask, of losing them. For unlike the complete spherical lens these lenses will float off easily. We can make the same lens, completely spherical with the ballast just incorporated in a part that we would normally cut off. However I find I run into fitting problem.

Some attempts have been made and are still being made, and I am sure as time goes will be successful, of making silicone lenses. That is using silicone rubber. The problem with silicone rubber is that it is hydrophobic, it repels water. We were at one stage told these were the ant's pants for people after a cataract operation. They are easier to put in as the silicone lens is semi-rigid. Because they are hydrophobic and repel water the manufacturers put a chemical on the outside so that they would not repel water. If you do not you would get the tears sitting as little balls of water on the front of the contact lens, therefore interfering with vision. I was not the only one involved in this trial and we prescribed them. After about a year the patients all came back because the chemical had come off the front of the lens. Which was embarrassing when they had paid $150 for a pair of contact lenses. At the moment attempts are still being made, and some have been successful, to get these silicone elastomer lenses in some form that we can put into people that does not have all the disadvantages of the soft lenses.

The biggest disadvantage of the soft lenses is that they do take a fair bit of maintenance. We have got to spend about 10 minutes a night looking after them properly, sterilizing them. It does not worry me but it is a trial for some people.

That is basically all I want to say about eye problems of diving. As I said most problems are optical, not so much related to medical problems.

EAR AND DIVING

Dr Bill Hurst

I was asked to talk tonight about the ear. It is very difficult to talk to a group like this on topics that we have had year after year, You all know just about as much about ear barotrauma as I do. So I thought I would change it around and talk about dizziness because most people talk about deafness.

THE EXTERNAL EAR

When water that is either above body temperature or below body temperature enters the external ear convection currents are set up in the semicircular canals. This fools the ear because the fluid is moving either up or down depending whether your are using cold water or warm water. The vestibule on that side or the lower canal on that side thinks that there is motion, and because the opposite ear has not got an equal and opposite stimulus it throws the computer between the ears into confusion. Then we become dizzy. If in any way you get cold water into one ear more than the other you may get a caloric response. This will last only a short time. It is a true rotating nystagmus and it will settle down as the water warms up. Things that will cause this are wax blocking one ear or ear plugs. I put wax first because no diver in their right senses puts plugs in their ears. You do occasionally get some fool who has been scuba diving with ear plugs in and then you have to fish a plug out of the ear about six inches in. This causes quite a bit of trauma.

THE MIDDLE EAR

You all know the problems of descent and ascent, Eustachian tube obstruction and traumatic perforation. When you get a traumatic perforation there is exquisite pain, acute pain. Then you get a caloric stimulation. You get pain and immediate vertigo. Now the things that will cause a perforation are forceful auto-inflation, or more usually the fool who keeps going down when he has got pain in his ear. He keeps going down, down, down, and eventually it pops. He comes up screaming like a Polaris missile. The same can happen in ascent, this is the reverse Eustachian tube problem. Usually it is a passive mechanism in that as you are coming up the air goes down the Eustachian tube and escapes. I think that I might omit discussing locking on descent because someone might like to ask a question about that at the end of the discussion.

If you get a traumatic perforation while you are diving, the treatment is do nothing, unless you have a discharge from your ear. Strangely enough if you get a perforation in salt water usually there is no infection. This is true in the Melbourne waters. I am sure you would get a high plankton count in the middle ear here and you would probably get it infected. Certainly if you perforate your ear in fresh water, as we see often in water skiers, then you can get a discharge from the ear only a couple of hours after that injury. It is quite dramatic. In fact a lot them come in and they think that the water is still draining out of their ears from the incident. If you get a perforation you can also get cold water pouring into the middle ear and the caloric effect is even more dramatic than it was when it just goes into the external ear, because the cold water is close against the vestibule.

THE INNER EAR

I think that we really should put a lot of thought to the inner ear. Fistula formation is the in vogue condition with divers. ENT surgeons are making their name on seeing these little pools of perilymph. I think that we should be well aware of the possibility of divers coming in complaining of dizziness and deafness. I think really this is the thing that we have to exclude. But when trying to exclude it, you have got the problem of trying to make up your mind whether this is a decompression problem. And this is very, very difficult as they both have similar presentations, if there are no other symptoms apart from either dizziness or deafness. I do not know how you can do it. ENG (Electronystagmography) is not going to differentiate, because you get the same response. So I think you have to rely mainly on the history, and just determine whether this person has done a dive that exposed them to the risks of decompression sickness. If they did, they should be recompressed, because of the fact that their hearing will go and their labyrinthine function will not return without recompression.

But if you feel reasonably confident that your patient has a fistula of that their symptoms followed forced auto-inflation then they should be explored. It is a very simple procedure. You can roll the drum back without causing too much trauma. Then you see a little pool of fluid coming from either the round window or the oval window. I have no experience so for heaven's sake do not ask me questions about it. I understand that you scarify the area and just stick a hunk of fat there and hope that it stays there and does not float away. You should treat a fistula as soon as possible because the hearing tends to deteriorate with time. A few of them recover, but apparently a lot of them do not. So get in there quickly.

Perhaps I should briefly mention the causes of fistula. There are two theories that I would accept. There are a couple of others that I think are pretty airy-fairy. The first one is the forceful auto-inflation, where you go down having a bit of trouble, or and all of a sudden you equalise and air really goes up the Eustachian tube and the drum goes boom. If he has not perforated his eardrum he has pulled the ossicles right out and that will naturally pull the stapes out of the oval window. That is pretty straightforward. Also, if you get a lot of gas expanding in the middle ear as you come up, that could do it. Alternatively as you are descending, the drum can be forced in to such a degree that it forces the stapes actually into the vestibule. The other mechanism is a rise in CSF pressure coming through the cochlear aqueduct. When you strain as you do during Valsalva, it raises CSF pressure This comes through the cochlear aqueduct into the labyrinth and you get the pressure pushing the stapes out.

MISCELLANEOUS CAUSES

These really probably are not true vertigo. Syncope of ascent that is during rapid ascent while breathholding, is due to poor venous return and consequent poor cardiac output.

Motion sickness is something we are not really aware of. If you go down over some weed, turtlegrass or something like that, and watch it going backward and forwards, and you are just hovering over it, it is very motion sickness inducing. That really is just a what we call travellers' nystagmus being induced.

Chairman (Dr John Knight)

Peter Cohen ought to meet a ENT surgeon from Melbourne who went diving in the Seychelles. He had never been diving before. He did a resort course, but nobody told him about breathing out into your mask as you went down. He got down to 30' and could not see a thing. So he came up again. He could see again. Once again he could not see anything. When I saw him three weeks later his sub conjunctival haemorrhages still obscured the whole of the normally visible sclera. What happened was that his eyes and the surrounding soft tissue had been pushed into his goggles as he descended.

Dr David Cossar delivered a paper on sinuses. He outlined the development, anatomy and physiology of the sinuses and discussed the problems caused by the changes of pressure associated with diving.

COMMENTS

Dr John Miller

Apart from the mechanical aspects of dealing with the eye there are some other **aspe**cts that are of importance not directly in ordinary diving but in special sorts of situations. Particularly the effects of oxygen upon retinal perfusion. As you may know, if you have a patient breathing 100% oxygen during a compression and you continually look at the retina through an ophthalmoscope you will see at a pressure that ranges somewhere between 1.2 and 1.5 atmospheres absolute a sudden constriction of the arteries and of the arterioles in the retina. It seems to be a constant for the same person on a day to day basis but the normal range is somewhere between 1.2 and 1.5 atmospheres. There are some people who are really very sensitive to this and show the same sort of retinal spasm at very much lower partial pressures at something like 0.75 and 1 atmosphere absolute of oxygen.

Now this becomes particularly important in some of the older age groups who are exposed to these partial pressures of oxygen particularly for

relatively long periods of time. These are patients who are undergoing cycles of hyperbaric oxygen therapy, or somebody, an elderly person, undergoing or taking part in a prolonged saturation dive. The result from the prolonged retinal spasm appears to be a significant deterioration in vision that most times, but not always, is reversible. We see this frequently in the patients that we have with osteo-radio-necrosis of the mandible. These are patients who have had tumours of the head and neck, had radiation therapy, and then gone on to develop osteonecrosis of the mandible. This particular condition lends itself to regeneration of the bone, due to presumably revascularization, with hyperbaric oxygen. These people have a significant deterioration in vision for a fairly long period of time, like up to three months. The occasional one stays with permanent injury to vision. Recently during one of our long saturation nitrogen-oxygen treatments one of the nurses we had in there underwent the same visual deterioration after an exposure of six hours to 1.2 atmospheres of oxygen. She is a woman in her 50's who has been working for us for quite a long time accompanying patients into the chamber. She was exposed to air at 165 ft, for that length of time. It took her about a week and a half to get a significant return of vision. So that is one of the elements that I think it is important to recognise, that there are things that can happen at the back of the eye as well as the front of the eye.

Coming to the discussion of things to do with the ear and in particular the mechanisms involved and the history in trying to discriminate between a round window rupture and vestibular decompression sickness. The distinction has to be vital because in vestibular decompression sickness it would appear that the time between the onset of symptoms and treatment is absolutely critical. And is very short in the order of a maximum of 45 minutes. So that when this happens you have to make the correct diagnosis otherwise the individual is going to lose the inner ear on that side. These patients who have lost an inner ear on one side then compensate over the succeeding weeks. So that unless you do very precise testing they will frequently appear to be completely normal.

It is vitally important that a person who has had a decompression injury to one vestibule not dive again if that person wishes to avoid being made a cripple. The reason is if you wipe out both vestibules you wipe out the balance organs. Then you have to rely entirely on your eyesight to maintain your balance and orientation. So you can imagine that walking into a dark room becomes a real problem for those people. Closing their eyes at any time is a real problem. You also appreciate that, certainly in the law courts of North America if not the law courts of the South West Pacific, a customer who has a bilateral vestibular injury can be made to look a very dramatically damaged person in a court room.

The distinction between a round window rupture and a decompression accident must rest primarily as Bill Hurst was saying on the history. Almost invariably, at least in my experience, people who develop round window ruptures have clearing problems on descent. I have not seen a patient with this sort of problem who does not have a history of a clearing problem on descent. It may not be a very major clearing problem. It is usually associated with attempts to clear. It is not necessarily terribly painful, but sometimes it is. That history is the main thing that you can go on. An individual who has had a clearing problem and subsequently goes on to develop dizziness and nystagmus following the dive. In fact many times when inner ear windows rupture the person becomes so dizzy and so disorientated that the dive has to be aborted.

There are situations where someone could have clearing problems and go on to develop vestibular decompression sickness maybe and then presents with exactly the same thing with a history that is confusing. Dr Joe Farmer at Duke, who consults on a lot of these cases and who has in fact done a lot of the work describing these mechanisms, presently is consulting on a lawsuit case which is precisely this. An individual has had clearing problems, persisted, had a clean dive on the bottom. Subsequently he decompressed and become dizzy. The question is whether or not he had a round window rupture or whether it was a vestibular decompression sickness. The management is different in each case. Recompression on the one hand and other methods such as surgical repair on the other.

So the distinction between the two things must be made on the history. Statistically a round window rupture from a clearing problem is going to be much more common than from some other cause from the group of causes that Bill Hurst mentioned. Secondly, except under special circumstances, again I cannot really quote the numbers but I am saying essentially what my experience is, the only time I have ever seen a vestibular problem due to decompression sickness is an air-diving situation, as opposed to a deep helium dive, it has been associated with other symptoms of decompression sickness. In deep helium saturation, 1500 ft to 1800 it, this may be the presenting form of decompression sickness with no other symptoms at all. I know of a couple of people who had irreparable injury to their inner ears as a result of that particular syndrome without any other symptoms of decompression sickness.

With regard to any of the air spaces in the skull that communicate with our normal breathing passages, including in a sense the conjunctiva, may I remind you what Ed Lamphier taught in his basic course on diving medicine. That most of these structures are surrounded by bony cages which are non-compliant and the only thing that can really happen if you push it is that the pressure will equilibrate. And the only way that it can equilibrate is by bleeding. A very rapid compression, such as a submarine escape rather

than an ordinary descent in the water, can cause these sort of problems without very much pain but with sudden equilibration by bleeding.

Chairman (Dr John Knight)

I would like to remind everybody that the latest SPUMS Journal (March-June 1980) contains reports of a series of fistulae reported from Norway and one from the Royal Victorian Eye and Ear Hospital. That man did not equilibrate during his 10' breath hold dive. He got giddy on the bottom. Just before I left Melbourne a girl came back from Vila where she and her friend had dived. My girl swore she had no ear clearing problem but when you asked her about it she only cleared twice on the way down to 50'. And she had, clinically, a fistula. The other girl had Peter Freeman lift the eardrum and plug a fistula. So I think it is a much more common thing than people have thought in the past and I think we are going to see them.

Question: Dr John Miller

Bill Hurst what are the sequelae of an untreated round window rupture?

Dr Bill Hurst

They either get better, stay the same or get worse. One of the treatments of a fistula is absolute bed rest and just let the fistula heal itself. Even with surgical treatment the results can be poor. Being a true surgeon, it stands to reason that the later these people are operated on the worse the results are going to be. So if we can operate on them pretty quickly we can limit the damage that may be done from the leak and hopefully solve their problems for them.

QUESTIONS, ANSWERS AND COMMENTS

Question: Dr Mike Davis

Bill, I had hoped that you would like to talk about the mechanism of reversed block.

I thought that I would tell you a little case history of this particular problem that we had quite recently in Christchurch. He was a very competent scuba diver. He had been diving for 20 years. He never had any trouble with his ears in his life. He had had a perfectly ordinary dive doing what we tend to do round Christchurch which is trying to find crayfish. Be was in a cave having had a maximum depth of about 40'-45'. He was on a cave at 10' getting a crayfish out right towards the end of the dive. Came the time to come out of the cave and to ascend. He was totally unable to leave the cave because of a tremendous pain in one ear. He stayed there. His buddy, who happened to be a doctor as well, could not understand what was going on. This chap was just lying in the cave and every time that his buddy pointed to his contents gauge trying to get him to go up he said no by shaking his head. Finally his air ran out and he had to ascend. Hand over hand as slowly as he possibly could to the surface and for the whole time he was in excruciating pain.

When we examined his ear all you could see was a blob of blood. Two days later this had regressed and there was no apparent injury to the ear drum at all. What we assumed had happened was that air had actually tracked round the insertion of the drum separating the layers and evaginating the squamous cell outer layer of the drum down into the ear canal. By 48 hours later the drum was normal. There was no rupture. But one assumes that he had a severe ear problem.

Dr Bill Hurst

Without actually looking at the person's ear it is very difficult. Was it seen by an ENT Surgeon? (Yes). Reverse Eustachian tube obstruction presumably is due to blockage either by swelling of the Eustachian tube lining or a plug of mucus in the Eustachian tube. It is difficult to see how this guy could actually get a reverse block when he paused at 10'. I do not know. There is another thing that one can get. You being an anaesthetist can appreciate that you can get subcutaneous emphysema. Why not get it in the Eustachian tube?

Chairman (Dr John Knight)

I have a favourite theory about why these reverse blocks happen. I think that these people have a chronically unbalanced middle ear pressure, just slightly below ambient all the time during the dive. This leads to a collection of fluid in the middle ear which I suspect clots and forms a cork that is driven into the Eustachian tube by the expanding gas on ascent. It is as good as any other theory.

Question: Dr John Knight

A man or woman who suffers from presbyopia and the arms are not long enough for them to read their depth gauge. And they have to stand off the tube worms so far that they cannot really see the fine detail. I know what I do, but I would like to know what the experts would suggest.

Dr Peter Cohen

One advantage of diving is that when you dive there is magnification.

Dr John Knight

It is not enough for me to see close up detail.
Dr Peter Cohen.

Other than that there are standard lenses, very small ones, that you can glue on the face mask. They do come in varying sizes. There are

available, advertised in American Journals, stick on ones that you can buy.

There is just one point that I want to make. Your colleague who when he got to 30' could not see his main problem was retinal artery spasm, because the ambient pressure was just compressing his eyes completely. Short term it does not do any harm.

Dr John Knight

He was not wearing a mask, he was wearing goggles and they were just pushed in.

Dr Bill Hurst

I borrowed a face mask from somebody and I swam round in circles all afternoon. He has a tiny little lens down in the bottom corner of the mask. It is a one eye bifocal lens that enables him to read his watch.

Chairman (Dr John Knight)

Those of you who have seen me diving will have noticed that I wear a pair of spectacles outside my mask. So I have a bifocal that I can slide up and down the glass of the mask so that I do not have to squint through one eye.

Dr Peter Cohen

John Miller mentioned a very interesting thing that he found people who were exposed to hyperbaric oxygen developed visual problems with the retinal artery vasoconstriction that comes on with raised ambient oxygen pressure. The most fascinating thing is that I have never heard of it in adults. It has a very practical application because with retrolental fibroplasia people run around the neonatal paediatric units trying to monitor PaO2. And yet it occurs every year in any major neonatal paediatric unit. Children who develop retrolental fibroplasia without being exposed to high oxygen tensions at all. Some are even described as being normally born, normally full term and still getting it. The hypothesis has been advanced that just the change in oxygen tension from the foetal pressures to atmospheric pressures is enough to trigger the process.

Dr John Miller

Is that not the mechanism that is postulated for the shut down of the lenticular vessels?

Dr Peter Cohen

That is right.

Chairman (Dr John Knight)

I would like to let everybody know that a lot of high myopes do dive One of Australia's leading diving doctors is a high myope and he is always having his mask stolen by people who find that they can see very much better with his lenses than they can with no lenses at all. He has also had a retinal detachment and he still dives. So it is very difficult to persuade doctors to be sensible.

Dr Mike Davis

One of the mechanisms that has been postulated for fistula formation that we have not mentioned is the Valsalva itself. One of our ENT Surgeons has three cases of non-divers developing fistulae with manoeuvres which would probably increase central venous pressure.

Many years ago he was visiting a renowned French surgeon who specialised in the surgical management of this condition and he assured his visitor that he had 100% success. There were certain things that he would not allow them to do. That very afternoon they saw a young lady who came in with a recurrence of her symptom. The first question that the French surgeon asked was whether she had had intercourse and she rather bashfully admitted that she had. He said "Ah, well, what do you expect?"

Chairman (Dr John Knight)

One might say that too much sex will not only send you blind but make you deaf as well.

I was once asked to give an anaesthetic to a man who had a fistula. He was a diver but he had not burst his round window diving. He had burst it lifting a stone at work. He worked in a stonemason's yard. He picked up something rather too heavy and fixed his thorax and abdomen. Raised his intracranial pressure. And bingo, became giddy and deaf. So even if he is a diver it is not always due to diving.

Question: Dr Nick Cooper

Would there be any point in surgically draining an acutely painful sinus immediately after the dive?

Dr David Cossar

If one has a trocar and cannula in the **bo**at, yes I think that would probably be the thing.

My partner George Gray tells me that what you do is that if there is a vacuum situation and it seems more especially to relate to the frontal sinus, because of the length of the fronto-nasal duct, is you take a 3" nail and you clout the 3" nail through the floor of the frontal sinus. I said to George. Well that is pretty good because you would cure him either way. If you hit in too far you do a pre-frontal leucotomy. So he will lose his pain either

Question (unidentified voice)

Do you think that surgery has a place in the treatment of divers who have chronic problems with their sinuses?

Dr David Cossar

I think that is a very real point. I think that there is a justification for doing an endonasal antrostomy on a person who has problems

of this nature if it is a recurring problem on diving. If their desire to dive is such that they are prepared to undergo surgery. I think that it would be better to cure the mucosal cause of the blockage first. And I think that is more likely to be the conventional line of treatment. I think that there is a case that could be made for doing an endonasal antrostomy on some patients.

Question (unidentified voice)

What about using Quickenstet's test and the fistula test to distinguish between inner ear window rupture and labyrinthine decompression sickness?

Dr John Miller

Labyrinthine decompression sickness is rare.

Dr Bill Hurst

Why do Quickenstet's when you can get them to Valsalva? That is going to elevate the CSF pressure. I think that you are really going to compound the problem. For the fistula test you apply pressure to the external ear canal in people who have got the cholesteatoma. If the cholesteatoma has actually eroded into the lateral semicircular canal increasing or lowering the pressure in the ear canal is transferred through the cholesteatoma, to the semicircular canal and this causes dizziness. It is certainly not as dramatic as you get with getting a patient to Valsalva. However if you have an intact drum you are not going to get your pressure through the middle ear. So I doubt whether the fistula test would work.

Chairman (Dr John Knight)

While the experts are arguing I will make some comments. The incidence of labyrinthine decompression sickness in air diving is very low indeed. If we see one we are not going to see him within 45 minutes of it happening. The usual interval between a diver getting giddy and presenting is five days to three weeks. So we need not worry. We have got to look inside his ear and cure the fistula if he has got a hole and if he has not got a hole we cannot help him.

Dr John Miller

To continue with that. However even though there is nothing you can do for labyrinthine decompression sickness at the time, you are going to see it. What you can do for the individual is to recognise what has happened. And make sure that the patient understands the consequences of his continuing to dive.

Because if he wipes out the other labyrinth he is in problems. I generally regard this as an absolute contraindication to continuing to dive, one wiped out labyrinth.

Dr David Cossar

You keep on asking the novice to give his opinion. This is a bit hard for me. I would have thought that if you had a fistula through the round window and you subjected the middle ear to a significant pressure change while watching the ENG you would get a dramatic response on the ENG.

Dr Bill Hurst

I agree I have not seen this in the literature. I would love to get somebody with a fistula and try it out on him.

Question: Dr Janene Mannerheim

With regard to retinal artery constriction with raised oxygen partial pressures. How soon does it come on?

Dr John Miller

It happens right as you go to pressure. You do not have to wait for it at all. On compression, between 1.2 and 1.5 atmospheres usually, you just see the arteries clamp down. It happens right there. You can do it on yourself.

Question: Dr Mike Davis

Do they open up during the air breaks?

Dr John Miller

I do not know. We do not give our hyperbaric oxygen patients air breaks. They are paying for oxygen and they get oxygen.

Question: Dr Tony Slark

A bit more on this oxygen effect on the eyes. Is it useful at all in oxygen tolerance testing of divers?

Dr John Miller

I do not think so.

Dr Tony Slark

Is it a constant level of partial pressure of oxygen which causes the vasoconstriction that remains constant for each individual throughout his life?

Dr John Miller

I do not know if this persists throughout life at the same level but it certainly persists for a month at a time. This is the only length of time that I have looked at it and the only situation that other people have looked at it.

If you will accept the model of the retinal circulation being a mimicker of the cerebral circulation then may be the brain circulation is shutting down. And that happens. However recent studies using fairly sophisticated laser-type techniques, which can look at enzyme activity which are specifically oxygen linked, show that oxygen utilization is normal. Oxygen delivery is

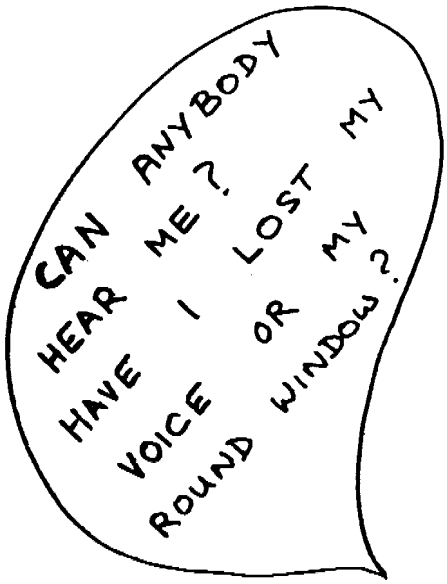
normal and perfusion appears to be normal. Yet you see this absolute blanching of the retina. There are differences between the retinal circulation and the cerebral circulation that are sufficient to explain the difference.

Question: Dr John Knight

The man who did the very deep breathhold record dive, Jacques Mayol, wore hard, airspace containing, contact lenses. I wonder if Peter Cohen knows anything of the technology of this. Because it would be very much easier to carry your own private air pocket that did not fog up inside your contact lenses than to have to keep on swishing water around inside your mask so that you can see.

Dr Peter Cohen

No comment



PROPHYLAXIS OF MALARIA

A recent letter to The Lancet (November 15 1980, p1079) from the medical committee of the Hospital for Tropical Diseases, London gives this advice.

"The following drugs are recommended for the prevention of malaria:

"Adult doses are given. Children under 1 year: quarter dose. Children 1-5 years: half dose. Children 6-12 years: three-quarter dose. Antimalarial drugs are safer than malaria in pregnancy.

(a) *Africa, Arab States, Pakistan, India (except Eastern India), Pacific Islands*

1. *Proguanil ('Paludrine') 200mg* daily (first choice), or

2. *Chloroquine 300mg weekly.*

(b) *Eastern India, Bangladesh, South-East Asia, Central and South America, Papua New Guinea*

3. *'Maloprim' (pyrimethamine and dapsone) one tablet twice weekly; or*

4. *'Fansidar'* (pyrimethamine and sulfadioxine) one tablet weekly. Not to be taken by persons sensitive to sulphomamides. The manufacturers do not recommend Fansidar in pregnancy.

For further information see *Preservation of Personal Health in Warm Climates*, published by the Ross Institute of Tropical Hygiene, Keppel Street, London WC1."