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EDITORIAL

The introduction of DES (Divers Emergency Service) will legitimise the de-facto status of the RAN School of Underwater Medicine in the Australian diving community while in no way obtruding on the sometimes more immediate available local recompression chambers and diving medical services. In case of need, such services will still be able to avail themselves of the support and advice of the specialist knowledge and the expertise of HMAS Penguin. DES is the new title of a long available aid to divers in the Australasian region, a system now copied in the USA under the title of DAN. Naturally it is to be hoped that calls on the service will be few, and far from dramatic, but this seems an unlikely prospect as there is some evidence that the present generation of divers does not appreciate the problems inseparable from repeat and/or deep dives. However, as the RAN gains from the opportunity such divers give it to hone its therapeutic skills, there are gains to all parties from the present arrangements.

The use of hyperbaric oxygen (HBO) in the management of diving problems is both increasingly accepted and possible, though the risks are possibly overlooked. Such include chamber fires, oxygen toxicity, and incautious diving practices being condoned in the mistaken belief that therapy has a 100% success. The present list of conditions where HBO is mandatory in the management protocol, prepared by an Undersea Medical Society (UMS) Workshop, includes intimation of the probable addition of MS (Multiple Sclerosis) to this list when more therapeutic trials have been reported. This subject will not be advanced by poorly conducted commercial chamber series or one-off medical treatments and it is to be hoped that trials will be very carefully documented to enable validation of subjective reports of results.

In any discussion of diving there is a general expectation that everyone is at more or less the same level of technical expertise and using similar equipment, give or take a few "growing points" and experimental diving. This is not necessarily true. It is salutary to read that "the days of our ancestors in diving" are still the realities of today. The holiday report of Drs Biggs and Hayman on the Greek Sponge Divers is a reminder of the simpler, and far more dangerous, ways of using compressed air. It was about 1866 that Dr Alphonse Gal showed the Greek divers the "Aerophore" diving apparatus, and a few years later was able to report the occurrence of death and disaster among the users. Progress seems to have been limited since those days, a reflection of the attitude to safety when weighed against immediate profit, which, unfortunately, is not limited to sponge divers.

While it is natural, and possibly accurate, to regard readers of this Journal as careful, conscientious and well informed divers, nevertheless the several case reports in this issue may be found instructive. A high index of suspicion aids survival, physical in the case of the victim and professional in the case of the doctor consulted. In time of possible need, remember DES, DAN and the RNZN are willing to offer support. Then please send a report to Project Stickybeak, the University of Rhode Island or the NZUA so that others can benefit. ALL divers owe a debt to those who provide reports which enable us to learn from other's misfortunes.

This being the Christmas Season it is particularly appropriate to wish everyone safe and pleasant diving. The Executive Committee of SPUMS hopes that this Journal contributes to your enjoyment, and avoidance of trouble, when diving.

SPUMS NOTICES

MINUTES OF AN EXECUTIVE COMMITTEE MEETING

held on 2 June 1984 from 1445 to 1700
at 80 Wellington Parade, East Melbourne, Victoria

PRESENT Drs C Lourey (President), C Acott (Secretary), J Doncaster (Treasurer), J Knight, J Mannerheim.

APOLOGIES Dr D Walker (Editor), Dr D Davies.

MINUTES OF THE LAST MEETING

These were accepted as correct. These have been published (SPUMS J 14(3): 3-4).

BUSINESS ARISING

1. SPUMS Poster (see SPUMS J 11(3): 11).

   Dr G Phillip's letter was discussed. It was apparent that non-diving medicos were missing the important aspect of the poster (OBTAIN EXPERT ADVICE) and reading the advice on First Aid as a definitive treatment protocol.

   C Acott to change the wording or redesign the poster to avoid misunderstandings. There are approximately 250 posters in stock.

2. Heron Island

   C Acott reported on his recent visit to Heron Island. It was generally agreed that there were no suitable facilities and so Heron Island would not be considered for an AGM in the near future.

3. Secretary's Report

   This has been published (SPUMS J 14(3): 4).

GENERAL BUSINESS

1. Treasurer's Report

   This was not ready in time for the meeting.

2. Annual Scientific Meeting, 1985

   The Maldives will be investigated. C Lourey and C Acott to arrange the Scientific Programme. Drs C Edmonds and S Sutherland to be invited as guest speakers.

3. Diving Tables

   Wal Williams, Chairman AUF Technical Committee, had enquired whether SPUMS recommended any particular diving tables. J Knight suggested that SPUMS should print Bruce Basset's revision of the USN tables on plastic and distribute it free through dive shops and the National Qualification scheme as the best compromise between safety and repetitive dives at present available. After lengthy discussion it was decided that SPUMS could not recommend any particular tables.

   It was considered that SPUMS should stress the importance of diver education in the use of diving tables, and advocate a separate examination on the use and understanding of diving tables, in which the pass mark should be 100%, before a C card could be issued.

   J Knight to write to Wal Williams.

4. Medical Examinations for Australian Sports Divers

   The Committee agreed with J Knight's recommendations to the AUF.

   J Knight to write to Wal Williams (This correspondence appears on page 6 of this issue).

5. Subscriptions for 1984-1985

   It was agreed that these should be:

Full members	$30.00
Associate members	$20.00

   An insert to be put in the next issue of the SPUMS Journal, 14(2), informing members of the new rates and requesting objections to be sent to the Secretary.

6. Nominations for the Committee

   Appropriate forms to be inserted in the next issue of the SPUMS Journal, 14(2).

7. Scientific Conference, 1986

   C Lourey discussed the possibility of holding this conference in Australia on similar lines to the 1980 Singapore conference. Further considerations deferred to the next meeting of the Executive.

CORRESPONDENCE

1. Australian Resuscitation Council

   Professor Tess Brophy will ensure that a note concerning the hazards of ENTONOX (50% N20 50% oxygen) for pain relief in divers be added to future handouts from the Ambulance Training School.

PLACE AND DATE OF NEXT MEETING

To be held in Adelaide during the Australian Society of Anaesthetist's meeting in October.

A MEETING OF THE EXECUTIVE

Three members of the Executive met, Chris Lourey, Chris Acott and John Knight at the Hilton International Hotel, Adelaide, on Saturday 20th October 1984 at 5.15 pm.

Several issues were discussed:

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 3OTH APRIL 1984

Opening Balance			
Cash on Hand		2.00	
RESI Card		340.93	
RESI 30 Day Investment		4117.67	
National Savings		192.56	
CBC		2783.71	
Standard Chartered Finance		1000.00	8436.87
Add Income			
Subscriptions		9697.84	
Interest	- Standard Chartered Finance	92.69	
	- RESI	123.16	
	- RESI 30 Days	522.30	
	- CBC	109.87	
	- National Bank	1.20	
	- National Australia Savings	223.11	10770.17
			19207.04
LESS EXPENDITURE			
Secretarial Service		2509.75	
Post		1257.43	
Stationery		224.84	
Journal		3123.37	
Travel		3523.90	
Meeting (HMAS Penguin)		7.20	
Subscription (Aust Resus Council)		50.00	
Bank Charge		23.58	
Audit Fee		60.00	10780.07
			$ 8426.97
TOTAL FUNDS 30 April 1984			
Represented by:			
Cash on Hand		2.00	
RESI Card		302.74	
RESI 30 Days		3687.47	
National Australia Bank		3434.76	
Standard Chartered Finance		1000.00	
			$ 8426.97

AUDITOR'S REPORT

I have examined the above statement of receipts and payments of the South Pacific Underwater Medical Society and state that the statement gives a true and fair view of the financial transactions of the Society.

....
LES NEWMAN AACA (SWB) ACIS.

Positions on the Executive Committee

There had been only one nomination each for the positions of President, Secretary, Treasurer and Editor. There were four nominations for the Committee. John Knight agreed to accept a co-opted position on the Committee as Assistant Editor (he has been responsible for the layout and printing of the Journal since 1979) in order to avoid the trouble and expense of an election. As a result the executive is:-

President	Chris Lourey
Secretary	Chris Acott
Treasurer	John Doncaster
Editor	Douglas Walker
Assistant Editor	John Knight
Committee	David Davies
	Peter McCartney
	John Williamson

Travelling expenses of Committee Members

Chris Lourey recommended that Committee members who attend Committee Meetings (except the Annual Scientific Meeting) be reimbursed the full return airfare, plus one night's accommodation if this is required. If any member of SPUMS has any objections to this will they please write and let the Secretary know.

The 1985 Annual Scientific Conference

Great interest has been shown by members of SPUMS this year. Approximately 200 members have indicated that they are hoping to attend SPUMS has only booked 70 rooms at the resort, so members will have to indicate their wishes early if they want to be assured of a room.

The academic programme will be varied and hopefully interesting, not only to members but also spouses.

The 1986 Annual Scientific Conference

Consideration is being given to holding it at Rarotonga and Auckland.

Letters from the President

To Dr P Linaweaver. Congratulations from SPUMS on becoming President of UMS.

To the Federal Minister of Health. The reply confirmed that Medical benefits are still not claimable for Diving Medicals. This correspondence appears below.

To the Victorian Post Graduate Medical Foundation declining their offer of providing a range of administrative, secretarial and educational services.

The Meeting was closed at 6.15 pm.

The following letter from Dr Chris Lourey (President of SPUMS) to the Minister of Health is published, with the Department of Health's reply, to bring to the attention of members that Medicare has NOT altered the Health Department's view of Diving Medicals. They are still regarded as a "health screening service" and are not rebatable. Issuing an itemized account for a Diving Medical is MEDIFRAUD.

16th July 1984

Dr N Blewett
The Minister for Health
Commonwealth Department of Health
12th Floor, Commonwealth Department Centre
Chifley Square
SYDNEY NSW 2000

Dear Dr Blewett

Re: (i) Dr Carl Edmonds letter to you dated 3rd July 1984 - "Medical Benefits for Routine Chest X-Rays for Scuba Divers".

(ii) Medical Benefits for Medical Examinations of Divers.

Dr Carl Edmonds has forwarded to me a copy of the abovementioned letter.

As President of the South Pacific Underwater Medicine Society, I endorse completely his statements.

As Physicians involved in Diving Medicine, we have a professional responsibility to both the medical and general community for the maintenance and development of medical standards to prevent and/or minimize the development of illness related to diving and the aquatic environment in all sections of the community.

Despite repeated requests from individual professionals and medical societies during the last five years, the Department of Health continues to ignore or "Fudge" this serious problem.

However, I can assure you, that, what relatively small amounts of monies saved by excluding the Benefit will be more than offset by the cost (short and long term) of treating the problems once developed.

Finally, the restrictive nature of Section 24 in relation to Scuba Diving would appear to be philosophically in opposition to your stated aims of Medicare to Community.

I again request Sir, that the restrictive nature of Section 24 be repealed. Thanking you for your consideration.

Yours sincerely

Christopher J Lourey
President - South Pacific Underwater Medicine Society.

Commonwealth Department of Health
22nd August 1984

Dr CJ Lourey
President
South Pacific Underwater Medicine Society.

Dear Dr Lourey

The Minister for Health has asked me to thank you for your letter of 16 July 1984 concerning correspondence from a Dr Carl Edmonds and the non-payment of Medicare benefits for routine medical examinations for divers.

The routine performance of chest x-rays and medical examinations for divers is regarded as a health screening service and as such the payment of Medicare benefit is precluded by subsection 19(5) of the Health Insurance Act, 1973, which states:

> "Unless the Minister otherwise directs, a medical benefit is not payable in respect of a health screening service, that is to say, a professional service that is a medical examination or test that is not reasonably required for the management of the medical condition of the patient."

This provision was introduced into the Act in 1978 to prevent certain abuses of the medical benefits system, eg. payment of benefits for fitness testing of sporting teams, compulsory medical examinations to obtain various types of licences or medical examinations for entrance to educational institutions. The present Government supports this provision and it considers that it is not appropriate for Medicare to bear the financial burden of health screening services. I am enclosing a copy of MB Circular No. 174 issued by the Department, which provides detailed information on such services.

I note your request for the repeal of this proscription as it applies to divers but in this regard, I must advise that only three Ministerial directions, permitting exceptions to be made to the general rule, have been issued under subsection 19(5) since its introduction in 1978. Your attention is drawn to page 3 of MB Circular 174, ‘Direction under sub-section 19(5)’, which deals with one of the orders.

The other orders refer to unemployed persons undergoing medical examinations at the request of a potential employer and compulsory medical examinations for persons over 70 years or suffering from either diabetes or epilepsy as a pre-requisite to obtaining a driving licence.

The exception for elderly people and others, as described above, was made not only on compassionate and humanitarian grounds, but also as a contribution towards improving road safety, as this has implications for the general public.

It is not accepted that this proscription as it applies to divers is contrary to the stated aims of Medicare. The stated aims of Medicare as a universal medical and health insurance scheme are to provide all Australians with basic medical and public hospital treatment at a cost they can afford. However, the intent of section 19 of the Act is to ensure that the Medicare scheme is not encumbered with financial burdens which are not appropriate to it and, as diving is either a recreational or professional pursuit undertaken at the diver’s own volition, the Government considers that it is reasonable to expect the diver to bear any costs associated in following this pursuit.

I regret that the Government is unable to assist you on this occasion.

Yours sincerely,

Frank Archer
Director
Eligibility & Co-ordination Section Medical Benefits Division

MEDICAL EXAMINATION OF SPORTS DIVERS

CORRESPONDENCE BETWEEN AUF AND SPUMS

Australian Underwater Federation
14 November 1983

Development of Appropriate Medical Examinations for Australian Sports Divers

As Chairman of the Technical Committee of the Australian Underwater Federation (AUF) and member of the Standards Committee of the National Qualification System (NQS) for divers, I have been asked to approach Australian medical organisations associated with diving or sport to seek assistance with the development of appropriate medical examinations for Australian sports divers.

The NQS currently sends all prospective scuba divers a medical questionnaire form along with their log books, and insists that they be passed as medically fit to dive before the start of their course and annually from then on while they dive. The questionnaire, a copy of which is attached, has been reprinted from the Australian diving standards of 1972 (Figs 1,2,3, p 8-10).

Unfortunately not all GP’s are familiar with the peculiar needs of underwater medicine and the questionnaire suffers from being designed around the needs of the commercial diver, not the sports diver. The GP is given no indication of which test to exclude for the sports diver and can therefore either miss an important test or subject him to inappropriate, unnecessary and expensive medical examinations, eg. long bone X-rays

In the April-June 1983 issue of the magazine of South Pacific Underwater Medical Society (SPUMS) there was an article by Dr J Knight which highlighted this problem and gave a suggested alternative medical questionnaire which had been modified from the 1979 Standards. Unfortunately this questionnaire still does not give any indication on which tests are considered essential for sports diver examinations. Also for some time now there have been various opinions expressed by contributions to SPUMS that the NQS requirement for an annual medical is unnecessary, especially for the ‘under 40’ diver.

To further complicate matters, there is a growing tendency at some holiday centres, mainly on the Great Barrier Reef, to allow untrained tourists to “discover the wonders of diving”. This practice has already led to fatalities, and the AUF supports any initiative by commercial enterprises to restrict the issue of scuba equipment to untrained divers.

The main reason used by the resorts concerned, for not insisting on any form of training, is that the present NQS scuba diver course is too technical and takes too long to teach. The typical tourist who wants to dive is just not willing to sacrifice five to six days of this precious holidays learning to become a qualified sports diver when he may never use the skill again.

There is a recognised need for a resort diver course similar to those conducted in other countries. Such a course will teach only the basic theory and skills necessary to enable a tourist to safely dive to a 10m limit while always accompanied by a trained diving assistant. The NQS is working on the design of such a course and it will be introduced as quickly as possible in order to stop this dangerous practice.

Such a course will fill the needs of the resorts, provided the tourist arrives with some proof of medical fitness to dive. Such a requirement could be a stipulation prior to arrival. The real problem arises when the tourist makes up his mind at the resort to try diving. In most cases the only medical authority on the Barrier Reef island resorts is a nursing sister. It is possible to design a medical examination suitable to be conducted by such an authority, and what would be the medical legal implications of such an examination in the event of an accident?

With the growing popularity of the game of underwater hockey, and the continuing popularity of spearfishing, the AUF has been successful in gaining recognition of three levels of snorkel coach in these reports by the National Coaching Accreditation Scheme (NCAS). Snorkelling is also becoming a very popular school-sponsored sport. There is a growing need for a medical examination suited to the needs of the snorkel diver, so that both coaches and schools can ensure that a prospective player is suitably fit.

I therefore need your advice and assistance with the following projects:

a. The design of two appropriate medical questionnaires to suit the needs of the snorkel and scuba diver (Perhaps only one form will cover both cases).

b. Advice on how often the NQS should insist on medical examinations for sports divers.

c. Design and development of appropriate medical examinations to suit the needs of a prospective:

   1. Scuba diver

   2. Resort diver

   3. Snorkel diver

d. An appropriately worded text to support the questionnaires so that the doctor who is unfamiliar with the needs of underwater medicine, may examine the diver appropriately. This should be concise enough to be printed on the back of the questionnaire.

If any further information is required on any of these matters I am only too willing to provide any assistance I can. I would appreciate your comments on these problems and your advice as to whether you will be able to assist.

Yours faithfully,

Wal Williams
Chairman AUF Technical Committee

Also sent to:

Australian Sports Medicine Federation
RAN School of Underwater Medicine
Australian Council for Health, Physical Education and Recreation.

SPUMS
9th February 1984

Development of Appropriate Medical Examinations for Australian Sports Divers

Your letter of 14 November 1984 to SPUMS has been forwarded to me by the President, Dr Christopher Lourey, for me to answer.

I will deal with the topics you raise one by one.

Medical Examinations

The reasons for a medical examination of prospective divers are:

1. To detect conditions that could be lethal with changing pressures. These include lung cysts (detectable only by chest X-rays), previous pneumothorax, asthma and obstructive airway disease.

2. To detect conditions that could be lethal with exertion, such as angina and heart failure. Asthma figures again as a cause of incapacitating breathlessness.

3. To detect conditions that can cause sudden unconsciousness, such as epilepsy or diabetes treated with insulin, which can, because of the equipment used by Scuba divers, result in the unconscious person drowning.

4. To detect conditions which will damage parts of the body with changing pressures. For example a person who cannot clear his ears should not dive. Medical treatment may enable him to clear his ears and allow diving. A person who has middle ear surgery and has an artificial replacement for part of the normal chain of small bones in the middle ear should not dive.

5. To detect conditions which will be adversely affected by immersion. An example is a perforation of the tympanic membrane (ear drum).

6. To detect conditions which may be adversely affected by accidents when diving. An example is someone who is completely deaf in one ear. If he loses the hearing in his good ear he will be very considerably handicapped and should be warned of the possibility.

7. To detect those who are over-represented in the statistics of burst lung. Those whose Forced Expiratory Volume in One Second (FEV1) to Forced Vital Capacity (VC) ratio is less than 75% are in this category.

8. To establish a base line for future reference. The audiogram is an example. A number of divers damage their inner ears when diving. They are deaf and giddy and usually nauseated. But by the time they get to a doctor they may only be deaf. If their hearing was known to be normal it is more likely that they will be considered for operation and repair of the inner ear fistula (fluid leak) which is the only way to prevent further loss of hearing and which may restore their hearing to normal.

9. To educate the diver about his medical handicaps and to advise him on ways of coping with them. Also to teach the diver how to clear his ears and how often to do this to avoid barotrauma. This is an area where diving instructors, who must be able to clear easily to cope with their job, often fail to educate their students properly so that they present to the diving doctor part way through their course with avoidable barotrauma of the ears.

The main purpose of the medical examination of prospective divers is to detect those who should not dive and advise them.

A medical examination is recommended for diving trainees to lessen as much as possible the fatalities and injuries associated with immersion and the consequent pressure changes. These changes are absent from all other sports, which moreover take place in a respirable (breathable) medium (air). The scuba diver is entirely dependent for his life on his air supply and his intact lungs. A person can live

A1.1.MH (MEDICAL HISTORY) TO BE FILLED IN BY CANDIDATE

1. SURNAME	OTHER NAMES	2. DATE OF BIRTH
3. ADDRESS	PHONE	4. SINGLE ☐ MARRIED ☐ 5. SEX: MALE ☐ FEMALE ☐
6. NEXT OF KIN	ADDRESS	
7. PRINCIPAL OCCUPATION		
8. HAVE YOU ANY DISEASE OR DISABILITY AT PRESENT? ☐ NO ☐ YES	NAME OF CONDITION:	
9. ARE YOU TAKING ANY TABLETS, MEDICINES OR OTHER DRUGS? ☐ NO ☐ YES	TYPE OF DRUG:	

HAVE YOU EVER SUFFERED OR DO YOU NOW SUFFER FROM ANY OF THE FOLLOWING DISORDERS:

	NO	YES
10. RHEUMATIC FEVER		
11. SWOLLEN OR PAINFUL JOINTS		
12. ANY HEART DISEASE		
13. HIGH BLOOD PRESSURE		
14. ABNORMAL SHORTNESS OF BREATH		
15. BRONCHITIS OR PNEUMONIA		
16. PLEURISY OR SEVERE CHEST PAINS		
17. COUGHING UP BLOOD		
18. T B (CONSUMPTION)		
19. CHRONIC OR PERSISTENT COUGH		
20. PNEUMOTHORAX (COLLAPSED LUNG)		
21. ASTHMA OR WHEEZING		
22. ANY OTHER CHEST COMPLAINT OR CHEST INJURY OR OPERATION ON CHEST		
23. HAY FEVER		
24. SINUSITIS		
25. ANY OTHER NOSE OR THROAT TROUBLE		
26. DEAFNESS OR RINGING NOISES IN EAR		
27. DISCHARGING EARS OR OTHER INFECTION		
28. OPERATIONS ON EARS		
29. EYE OR VISUAL PROBLEMS		
30. WEAR GLASSES		
31. FAINTING, BLACKOUTS, FITS OR EPILEPSY		
32. SEVERE HEADACHES OR MIGRAINE		
33. SLEEPWALKING OR FREQUENT NIGHTMARES		
34. SEVERE DEPRESSION		
35. CLAUSTROPHOBIA		
36. ANY OTHER MENTAL ILLNESS		
37. KIDNEY OR BLADDER DISEASE		
38. DIABETES		
39. INDIGESTION OR PEPTIC ULCER		
40. VOMITING BLOOD OR RECTAL BLEEDING		
41. RECURRENT VOMITING OR DIARRHOEA		
42. JAUNDICE OR HEPATITIS		
43. MALARIA OR OTHER TROPICAL DISEASE		
44. VENEREAL DISEASE		
45. SEVERE LOSS OF WEIGHT		
46. HERNIA OR RUPTURE		
47. HAEMORRHOIDS (PILES)		
48. ANY SKIN DISEASE		
49. ANY REACTION TO DRUGS OR MEDICINES		
50. ANY OTHER ALLERGIES		
51. UNCONSCIOUSNESS		
52. CONCUSSION OR HEAD INJURY		
53. ANY MAJOR JOINT OR BACK INJURY		
54. ANY FRACTURES (BROKEN BONES)		
55. ANY PARALYSIS OR MUSCULAR WEAKNESS		
56. DENTURES		
57. MOTION SICKNESS (CAR, PLANE, SEA)		

NOTES ON HISTORY

FIGURE 1
FIRST PAGE OF
AUF
MEDICAL FORM

MEDICAL HISTORY (CONT'D)

	NO	YES
58. DO YOU SMOKE		
59. APPROX. NUMBER OF CIGARETTES A DAY		
60. HAVE YOU EVER BEEN REJECTED FOR INSURANCE		
61. HAVE YOU BEEN UNABLE TO WORK FOR MEDICAL REASONS		
62. HAVE YOU EVER BEEN ON A PENSION		
63. HAVE YOU ANY DISABILITY WHEN FLYING IN AIRCRAFT		
64. HAVE YOU EVER LIVED WITH A PERSON WITH T B		
65. HAS ANY MEMBER OF YOUR FAMILY HAD T B		
66. OR ATTEMPTED SUICIDE		
67. OR HAD MENTAL ILLNESS		
68. OR FITS, EPILEPSY		
69. HAVE YOU ANY INCAPACITY DURING PERIODS (FEMALES ONLY)		
70. ARE YOU NOW PREGNANT (FEMALES ONLY)		
71. HAVE YOU BEEN IN HOSPITAL OR A MENTAL INSTITUTE FOR ANY REASON		
72. HAVE YOU HAD ANY OPERATIONS		
73. HAVE YOU ANY OTHER ILLNESS OR INJURY NOT MENTIONED IN THIS LIST		

NOTES ON HISTORY

A1.2. DMH (DIVING MEDICAL HISTORY) TO BE COMPLETED BY CANDIDATE

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

HAVE YOU EVER SUFFERED, OR DO YOU NOW SUFFER FROM ANY OF THE FOLLOWING DISORDERS RELATED TO DIVING?

	NO	YES
8. SEVERE EAR SQUEEZE		
9. RUPTURE OF EARDRUM		
10. DEAFNESS		
11. GIDDINESS OR DIZZINESS		
12. SEVERE SINUS SQUEEZE		
13. SEVERE LUNG SQUEEZE		
14. RUPTURED LUNG (BURST LUNG)		
15. EMPHYSEMA		
16. PNEUMOTHORAX		
17. AIR EMBOLISM		
18. NITROGEN NARCOSIS		
19. DECOMPRESSION SICKNESS (BENDS)		
20. NEAR DROWNING		
21. SEVERE MARINE ANIMAL INJURY		
22. OXYGEN TOXICITY		
23. CARBON DIOXIDE TOXICITY		
24. CARBON MONOXIDE TOXICITY		
25. DYSBARIC OSTEONECROSIS (BONES)		
26. ANY OTHER DIVING INCIDENTS		

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

SIGNED: DATE:

FIGURE 2
SECOND PAGE OF
AUF
MEDICAL FORM

Diving Medical Centre

MEDICAL HISTORY QUESTIONNAIRE

Please fill in pages 1 and 2

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

12 DO YOU TAKE PHYSICAL EXERCISE? YES NO
13 DESCRIPTION OF ACTIVITY

14 FREQUENCY

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

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

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

NOTES

FIGURE 4
FIRST PAGE OF KNIGHT MEDICAL FORM

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

NOTES .

DIVING HISTORY

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

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

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

SIGNED

DATE

FIGURE 5
SECOND PAGE OF KNIGHT MEDICAL FORM

1. Physique Good Average Poor	2. Height cm ins	3. Weight kg lbs	4. Colour Eyes Hair Skin	5. Expansion Exp. cm ins · Insp. cm ins · Diff. cm ins
6. Vision R6/ Corr 6/ L6/ Corr 6/	7. Colour Perception	8. Urinalysis Albumen Glucose		9. Chest X-ray Date........................ Place........................ Result......................

10. Skeletal (Long Bone) X-ray
Date ....Place ....
Result...
(Pro divers only)

11. Respiratory Function Test
Vital Capacity .... After ....
$FEV_{1.0}$ .... Broncho ....
Percentage .... Dilator ....

12. Audiometry

		Frequency Hz						
		250	500	1000	2000	4000	6000	8000
Air	Loss in dB (R)							
	Loss in dB (L)							
Bone	Loss in dB (R)							
	Loss in dB (L)							

REMARKS:

CLINICAL EXAMINATION	Normal	Abnormal
13. HEAD, SCALP, FACE AND NECK		
14. NOSE, SEPTUM, AIRWAY		
15. SINUSES		
16. MOUTH, THROAT, TEETH, SPEECH		
17. EARS GENERAL		
18. TYMPANIC MEMBRANE		
19. EUSTACHIAN TUBE FUNCTION		
20. PUPILLARY REFLEXES		
21. EYE MOVEMENTS		
22. VISUAL FIELDS		
23. ABDOMEN AND G I TRACT		
24. ENDOCRINE SYSTEM		
25. LYMPHATIC SYSTEM		
26. POSTURE AND GAIT		
27. SPINE		
28. UPPER LIMBS		
29. LOWER LIMBS		
30. CRANIAL NERVES		
31. REFLEXES		
32. SENSATION		
33. CEREBELLAR FUNCTIONS		
34. EMOTIONAL STABILITY, PHOBIA		
35. MENTAL CAPACITY		
36. IDENTIFYING MARKS		
37. CHEST, LUNG FIELDS		
38. CARDIAC AUSCULTATION		
39. VASCULAR SYSTEM		
40. OPHTHALMOSCOPY		
41. STEP TEST		
42. ECG AT REST		
43. ECG AFTER EXERCISE		
44. BLOOD PRESSURE		
45. PULSE RATE/MIN		
46. SHARPENED ROMBERG SCORE		SECS

NOTES ON ABNORMALITIES

FIT TO DIVE
UNFIT TO DIVE
OTHER
REASONS:

SIGNED: DATE:

FIGURE 3
THIRD PAGE OF
AUF
MEDICAL FORM

PHYSICAL EXAMINATION

1 PHYSIQUE GOOD AVERAGE POOR	2 HEIGHT INS CM	3 WEIGHT LB KG	4 COLOUR EYES HAIR SKIN	5 CHEST EXPANSION INSP EXP DIFF INS CM · INS CM · INS CM
6 VISION R 6/ CORRECTED 6/ L 6/ CORRECTED 6/	7 COLOUR PERCEPTION (PRO DIVERS ONLY)	8 URINALYSIS ALBUMEN GLUCOSE	9 CHEST X-RAY / / PLACE RESULTS	

10 SKELETAL (LONG BONE) X-RAY (PRO DIVERS ONLY)
DATE
PLACE
RESULT

11 RESPIRATORY FUNCTION TESTS
VC
FEV_1
%
AFTER EXERCISE OR BRONCHO-DILATOR VC
FEV_1
%

12 AUDIOMETRY

LOSS IN DB		FREQUENCY IN Hz						
		250	500	1000	2000	4000	6000	8000
AIR	R							
	L							
BONE	R							
	L							

13 B.P.

14 PULSE

CLINICAL EXAMINATION	NORMAL	ABNORMAL
15 HEAD, SCALP, FACE, NECK		
16 NOSE, SINUSES, AIRWAY		
17 MOUTH, THROAT, TEETH, SPEECH		
18 EARS GENERAL		
19 TYMPANIC MEMBRANE		
20 EUSTACHIAN TUBE FUNCTION		
21 PUPILLARY REFLEXES		
22 EYE MOVEMENTS		
23 VISUAL FIELDS		
24 ABDOMEN AND GUT		
25 ENDOCRINE SYSTEM		
26 LYMPHATIC SYSTEM		
27 POSTURE AND GAIT		
28 SPINE		
29 UPPER LIMBS		
30 LOWER LIMBS		
31 CRANIAL NERVES		
32 REFLEXES		
33 CEREBELLAR FUNCTION		
34 EMOTIONAL STABILITY		
35 SENSATION		
36 MENTAL CAPACITY		
37 IDENTIFYING MARKS		
38 CHEST, LUNG FIELDS		
39 CARDIAC AUSCULTATION		
40 VASCULAR SYSTEM		
41 OPHTHALMOSCOPY		
42 STEP TEST		
43 ECG AT REST (PRO DIVERS ONLY)		
44 ECG AFTER EXERCISE (PRO DIVERS ONLY)		
45 SHARPENED ROMBERG SCORE		SECS

NOTES ON ABNORMALITIES

FIT / UNFIT TO DIVE
REASONS

SIGNATURE

DATE

FIGURE 6
THIRD PAGE OF
KNIGHT
MEDICAL FORM

his life fully and actively on the surface with a lung full of cysts and yet die from air embolism ascending to the surface after a dive. Only an X-ray can detect lung cysts.

I have raised this matter with FAUI in 1980 and in 1981. I suggested that a short explanation of the medical contraindications to diving be included with each blue form (medical questionnaire) to assist those doctors who have little or no knowledge of diving medicine.

A far better method of ensuring a sensible medical would be for NQS to issue a list of those doctors who have passed the courses at the RAN School of Underwater Medicine, and are able to see divers, to all diving schools. (In Melbourne most diving schools do not hand out the NQS log books before the course has started. So many prospective divers come for a medical during the course rather than before it.) This would ensure that the diving candidates are examined by doctors who know what they should do. However this would mean that in some areas there would be no properly qualified doctor. I recommend that:

(a) NQS issues to all diving schools a list of doctors who have passed the RAN courses, with their addresses. This information would be available from the Secretary of SPUMS, Dr Chris Acott, Rockhampton Base Hospital, Rockhampton, Qld. 4700. NQS should encourage diving schools to use only these doctors whenever possible.

(b) NQS prints “Advice to the Examining Physician” (printed at the end of this letter), on the back of the medical history questionnaire and examination form.

Medical History Questionnaire and Examination Form

The 1972 Australian Standard was, as is the current 1979 Standard, for commercial divers. It is not necessary for a sports diver to be as fit as a commercial diver, who is often an underwater labourer working very hard indeed.

If an unfit person wishes to learn to dive he is the person who will be taking the risks and it is not the doctor’s job to forbid diving, but to explain the risks and how to minimize them and leave the decision to dive or not to the patient.

The questionnaire published in the SPUMS Journal 1983, 13(2) April-June: 17-22 (Figs 4,5,6) is designed to elicit all the answers relevant to diving safety. The extra questions about exercise, tiredness, shortness of breath are there to alert the doctor. If someone has his activity limited by shortness of breath he should improve his cardio-vascular fitness before attempting strenuous exercise, and diving can be strenuous exercise.

The physical examination is to establish normality of the function of the diver’s body, both as a baseline in case he has a diving accident causing decompression sickness or air embolism with neurological changes, and so that advice can be given about the best way to dive inspite of abnormalities. This requires that the doctor has a good knowledge of diving medicine.

The recommended tests required by the Knight medical examination form are:

a. (Nos 2 and 3)
Height and weight, which gives an estimate of obesity.

b. (No 5)
Chest expansion measurement. A chest expansion of at least 5 cm is normal.

c. (No. 6)
Vision. Divers who are short sighted need correcting lenses in their masks so that they can find the diving boat again.

d. (No. 8)
Urinalysis is part of any general physical examination.

e. (No. 9)
A Chest X-ray is required to make certain that the candidate does not have cysts in his lungs that could expand during ascent and cause air embolism. X-ray is the only way to detect lung cysts. The chest X-ray should preferably be taken in both full inspiration and full expiration.

f. (No. 11)
Respiratory Function Tests. Experience has shown that among those who have burst a lung during an emergency ascent the proportion with a Forced Expiratory Volume in 1 second to Vital Capacity (FEV_1/VC) ratio less than 75% is much larger than in the general population. In other words people with FEV_1/VC ratios of less than 75% are more likely to burst their lungs during an emergency ascent than those with a higher, more normal ratio. Respiratory function tests are the only way of discovering these people who need to be advised to ascend slowly and to never run out of air underwater.

g. (No. 12)
Audiometry (hearing testing) is included to establish a baseline so that should the diver hurt his ears, and many do, his hearing before the diving accident is known which helps the diving doctor work out what is actually damaged.

h. (Nos 13 & 14)
Blood pressure and pulse rate are normal parts of any physical examination. A large proportion of the population has a raised blood pressure (hypertension). Some of these people will need treatment for this before they are fit to dive without danger to themselves. Pages 14 and 15 of the SPUMS Journal 1983, 13(2) April-June, contain a clear description of the dangers of uncontrolled hypertension and of the dangers of therapy.

i. (Nos 16 - 20)
Examination of the ears is essential as diving is contraindicated if the person cannot blow air up his Eustachian tubes. Diving doctors can often teach the candidate how to do this.

j. (Nos 21 - 41)
These parts of the physical examination are to establish that the candidate's body functions normally.

k. (No. 42)
The step test is a rough test of exercise tolerance.

l. (No. 45)
The Sharpened Romberg test, where the person stands with one foot in front of the other, crosses his arms, and then closes his eyes, is a sensitive clinical test of the integration of balance and muscle control. Normally people have no difficulty in staying steady for at least 30 seconds.

The only items of equipment which are unlikely to be in a GP's surgery are the Vitalograph (for respiratory function testing) and the audiometer. The chest X-ray will have to be done by a radiological clinic.

To sum up all the tests on page 3 of the questionnaire, except those marked "pro divers only", are necessary for a proper diving medical for sports divers.

Far more important than doing the tests is being able to interpret what results mean in relation to diving safely. Which comes back again to using doctors trained by the RAN School of Underwater Medicine whenever possible.

Annual Medicals

Commercial divers in Victoria are required by law to have a medical every 6 months. Healthy sports divers do not need regular medicals to prove that they are still normal. All annual medicals of healthy people do is occupy doctor's time and increase their incomes. Even BS-AC, which is a much more autocratic organisation than the NQS, only requires a medical every five years until age 35, then three yearly until 45, then yearly. This is probably too often. A medical every 5 years is reasonable in healthy people of any age.

The justification for a diving medical is to ensure that the person can dive safely. Once that has been established, and the diver remains healthy, there is very little chance of a routine medical discovering any problem. There is a place for a diving medical after a serious illness, chest infection or chest pain before resuming diving to be certain that safe diving is possible. Once again this should be done by a properly trained diving doctor.

I recommend that the NQS drop its requirement of annual medicals, but insist on a proper diving medical before starting a full course of instruction. Further medicals should only be required after serious illnesses, before resuming diving.

Resort Diver Course

The formulation of a proper "quickie" course at resorts is overdue. However these "quickies", in places with sketchy medical facilities, will not be any safer if the local sister does a "quickie" medical. A diving medical should be done properly or not done at all. Medical conditions are far less of a risk diving in warm water than are inexperience and poor swimming ability.

The onus for the client's safety is on the diving instructor, who should use questions to screen out those with:

a. epilepsy
b. diabetes
c. asthma
d. previous spontaneous pneumothorax
e. shortness of breath on exertion
f. pain in the chest on exertion
g. middle ear surgery to restore hearing

all of which are absolute contraindications to diving.

This will be more effective for the diver's safety than a "quickie" medical done by someone with no knowledge of diving medicine, as long as the instructor teaches them to clear their ears and makes sure that any diver with pain in the ears gets out of the water immediately.

Snorkelling examinations

There is no medical indication for a medical before snorkelling.

Anyone who can swim and clear their ears can learn to snorkel. The snorkeller does not use compressed air so is only at risk from barotrauma of descent and hypoxia. Instructors should hammer home the need to clear the ears during descent and the dangers of hyperventilation before diving and of deep diving, both of which can cause anoxia and unconsciousness in breathhold divers. Epileptics and diabetics on insulin are also liable to sudden unconsciousness but can snorkel if their normal physician considers that there is no risk of this occurring.

The answers to your questions

a. 1. No medical is necessary for snorkellers

2. a. Use the enclosed questionnaire (Figs 4,5,6) modified by deleting those parts marked "Pro Divers only", and laid out more tidily. Print "Advice to the examining physician" on page 4 of the questionnaire.

b. Recommend that diving candidates be examined by doctors who have passed the RAN School of Underwater Medicine Courses.

b. Annual medicals are a waste of the doctor's time and the diver's time and money. Medicals in healthy people should be at least 5 years apart, unless a serious illness (1 week in bed) or chest pain or chest infection occurs. Then the diver should be examined by a doctor trained by the RAN School of Underwater Medicine before diving again.

c. 1. The diving medical outlined above is suitable for prospective scuba divers.

2. Resort divers cannot be given a proper medical so should not have any. The instructor should

screen out those with absolute contraindications to diving. Those remaining should be taught to clear their ears and advised to surface as soon as they develop pain in the ears.

3. Snorkellers do not need a medical

d. "Advice to the examining physician" is the appropriate text.

I have written at length as this is a very important topic. It is our duty as instructors and doctors to make the underwater experience as safe as possible. Not many people should be excluded from diving but even one death that could have been avoided by a proper medical is a tragedy. But safety does not lie in having medicals performed by people without knowledge of diving medicine. A simple history will exclude the great majority of those with conditions which may be lethal or damaging while diving. Inexperience, poor swimming ability and poor training are usually greater risks for divers than medical conditions.

I can see the relevance of your approach to SPUMS and the RAN School of Underwater Medicine but fail to understand why you have approached the Australian Sports Medicine Federation for advice. That Association has no diving medicine experience or expertise.

I hope this letter is of use to you. Please do not hesitate to ask for further information.

Yours faithfully,

John Knight
Committee Member
and Past President SPUMS

Enclosure

ADVICE TO THE EXAMINING PHYSICIAN

Issuing an itemised account (so enabling the patient to claim Medicare benefits) for diving medicals is prohibited by paragraph 25 (page 1B-4) of Section 1, Part B of the Notes for the Guidance of Medical Practitioners in the Health Benefits Schedule Book, dated 1st February 1984.

Diving is a sport carried on in a non-respirable environment, the sea, using breathing apparatus. Sudden unconsciousness under water is usually fatal when using Scuba equipment as the relaxation of muscle tone accompanying unconsciousness results in the regulator falling out of the victim's mouth. The diver's next breath will then be water. This makes any condition which can cause sudden unconsciousness an absolute bar to diving. Such conditions include, epilepsy, diabetics on insulin.

A further problem with the water environment is that pressure increases very rapidly with descent. One atmosphere extra pressure for every 10m of depth in the sea. The use of breathing apparatus providing gas at ambient pressure prevents problems of pressure-volume imbalance in the lungs during descent. However the middle ears and sinuses will develop problems on descent unless the pressure in these spaces equals ambient. There is no way of establishing the patency of sinus otia by clinical examination. However patency of the Eustachian tubes, and so the ability to equalize the middle ear pressures, can be established easily. Observation of the tympanic membrane while the patient holds his (or her) nose, shuts the mouth and blows (Valsalva Manoeuvre) will reveal ingress of air to the middle ear by movement of the drum. The Eustachian tube opening in the naso pharynx is normally closed. Swallowing opens the ostium. So a combination of a Valsalva and swallowing during the manoeuvre will give the best chance for air to travel up the Eustachian tube. Another way of opening the Eustachian tube is to protrude the jaw and wriggle it from side to side while performing a Valsalva manoeuvre. Failure to autoinflate a middle ear is an absolute bar to diving until the person can auto-inflate.

A further set of pressure related problems also occur in diving. These are related to decreasing ambient pressure, ie. the ascent phase of the dive.

If an air-containing space cannot vent when the surrounding pressure is reduced two things can happen. If the space has elastic sides it can expand. If the space has rigid walls the pressure in the space, remaining at the original pressure, becomes higher than ambient. The chest wall is elastic, but after a certain expansion the stretching of the lungs results in tears of the lung substance. Air can then enter the pulmonary venous drainage, pass through the left heart and be carried to the brain as air emboli. Unconsciousness and death can result. Thus any condition preventing normal emptying of the lungs is an absolute bar to diving.

Lung cysts, bullae, and other areas that empty slowly or not at all are an absolute bar to using compressed air under pressure. These conditions are best detected by taking an X-ray of the chest in full inspiration and another in full expiration. Asthma is another such condition. It is in order to detect expiratory airway obstruction that a Vitalograph (or similar) test is required. Experience in the Navies of the world, whose experience with submarine escape training in many thousands, has shown that a disproportionate number of those suffering burst lungs have FEV_1/VC ratios of below 75%. Such people do not need to hold their breath on ascent to damage their lungs, all they have to do is rise too rapidly. People with a FEV_1/VC ratio below 75% cannot be considered fit for diving.

A normal FEV_1/VC % but clinical signs of bronchospasm, especially on forced deep, rapid ventilation, is an indication of unfitness to dive.

Treatment with drugs is not suitable as:

a) the effects can wear off underwater,

b) the effects of pressure on broncho-dilator drugs are uncertain.

It is hoped that the foregoing makes a list of absolute and relative contraindications to diving logical and comprehensible.

ABSOLUTE CONTRAINDICATIONS

Conditions causing unconsciousness
- Epilepsy
- Diabetics on insulin.

Lung conditions
- Asthma
- Lung cysts
- Previous spontaneous pneumothorax
- Obstructive lung disease
- Lungs which empty unevenly (X-ray appearance)
- Previous Thoractomy.

ENT conditions
- Inability to autoinflate the middle ears
- Perforated eardrums
- Previous middle ear surgery with insertion of prosthesis to replace any of the ossicles.

RELATIVE CONTRAINDICATIONS
- FEV_1/VC ratio less than 75%
- Poor physical condition
- Previous myocardial infarction
- Pregnancy

If in doubt about a candidate's fitness it is safer for the candidate to be classed as unfit than fit to dive. Difficult decisions should be referred to a doctor experienced in Diving Medicine. These are to be found in each State.

RECOMMENDED READING:

Edmonds C and Thomas RL. Medical Aspects of Diving, Parts 1,2,3,4,5 and 6. *Med J Aust*. 1972. 1199-1201, 1256-1260, 1300-1304, 1367-1370, 1416-1419, 1458-1460.

Edmonds C, Lowry C and Pennefather J. *Diving and Subaquatic Medicine*. 2nd Edition. Sydney: Diving Medical Centre, 1982.

The South Pacific Underwater Medicine Society exists:

a) to promote and facilitate the study of all aspects of underwater and hyperbaric medicine;
b) to provide information on underwater and hyperbaric medicine.

Enquiries should be addressed to the
Secretary, SPUMS
Dr Chris Acott
Intensive Care Unit
Rockhampton Base Hospital
ROCKHAMPTON QLD 4700

or to SPUMS
c/- 80 Wellington Parade
EAST MELBOURNE VIC 3002

Australian Underwater Federation

20 March 1984

Your letter dated 9th February 1984 in answer to my questions on diver medicals was just what I wanted and I am most appreciative. Based on your advice I intend to recommend the following to the NQS Standards Committee:

a. That NQS issue an "AUF Recreational Diver Medical Form" with every log book package. This form is to be in the format as described in your letter and incorporating your "advice to examining physicians". (Why it should be an AUF form and not an NQS document I'll enlarge on later.)

b. That the NQS Standards Committee continue with the introduction of a Resort Diver course with the resort instructor being responsible for the medical screening of his tourist. I will design a simple application form which incorporates medical questions for the tourist to complete himself.

c. That the NQS log book packages contain a leaflet with the addresses of all doctors who have passed the RAN School of Underwater Medicine course. I am uncertain at just how far we can go towards actually recommending that divers use these doctors only. What position does this put the NQS in as regards the Restrictive Trade Practices Act and the AMA position on advertising and channelling?

d. That the NQS requirements for medical examinations for divers be reduced to every five years. Actually I am inclined towards the idea of this period reducing to say every two years for the over 40's and we will probably have to compromise at something like that.

I have suggested that the medical form be produced by the AUF and not the NQS as this will then allow the form to be supplied to all diver instructor bodies, eg. PADI, NAUI or 'Joe Bloggs' etc. as the Australian recreational diver medical test. To ensure that the form is not amended or distorted to suit individual instructor body standards I would suggest that it might be wise to copyright it. What do you, as the author, think of such an idea? It could be produced, at cost, to all bodies as a service to the Australian Diver or be allowed to be copied provided it was not amended to suit individual needs.

The Australian Council for Health, Physical Education and Recreation (ACHPER), have already produced a snorkel programme (of sorts) as part of their Aquatic Activities Programme to be taught at schools. My question on the need for medical examinations for snorkel divers came about from queries from various schools, and I added ACHPER as an addressee out of courtesy. I was unaware that the Australian Sports Medicine Federation has no diving expertise, as I know of some members who are also members of SPUMS, and hoped that they might give me answers more from the sports angle on the competitive underwater hockey requirements. I obviously cast as wide a net as I could think of to get as many opinions as possible. Unfortunately I have only had one reply, yours.

You may also have received a letter from me to SPUMS (also sent on the wide net) regarding the question of which decompression table should be taught by NQS instructors. You will be aware of the rather alarming increase in the incident of decompression sickness around Australia and

I believe most of this is caused by schools teaching the US Tables without a proper warning (or knowledge) of the dangers. (AIMS treated 9 cases of decompression sickness from one school in Townsville in 6 months and two of these cases were "assistant" instructors).

Once again many thanks for your direct and concise advice, it really was 'just what the doctor ordered'.

Yours in diving,

Wal Williams

SPUMS
29th March 1984

I can see no possible objection to the AUF publishing a list of doctors who have done the RAN School of Underwater Medicine (SUM) courses if the introduction goes something like, "As most doctors have little or no knowledge of underwater medicine it is in the trainee diver's best interests to have his or her diving medical done by a doctor trained in underwater medicine, who will be able to offer soundly based advice should a problem be discovered. This leaflet contains the names of doctors who have acquired a training in underwater medicine by passing courses conducted by the Royal Australian Navy School of Underwater Medicine."

The Medical Boards of the States (not the AMA) do not object to doctors describing themselves as "Surgeon", "Obstetrician", "Anaesthetist" in the Yellow Pages. I would be very surprised to find them taking the view that the AUF publicising a list of diving doctors was any different from the Department of Transport publishing its list of doctors approved to do flying medicals.

I know nothing about the Trade Practices Act except that at first it was thought that this would stop the AMA publishing its list of fees. But the AMA still publishes its list of fees (and still gets clobbered in the newspapers for doing so). So presumably the AUF would be OK. But the AUF might like to pay for a legal opinion.

I feel strongly that most repeat medical examinations are a waste of time and money. The first one is well worth while but for someone just growing older the chances that anything will be picked up is minimal, <u>unless he or she has developed symptoms since the last medical</u>.

I doubt whether the form is copyrightable as much of it is borrowed from AS 2299! I agree that it should be an AUF form and you are welcome to use it. Besides the advice to the examining physicians I would suggest that you include a (perhaps tear off) blank "CERTIFICATE OF FITNESS TO DIVE" form which would be given to the diver to send to NQS. The doctor would keep the medical form. This has a few advantages, less paper to be stored (or destroyed) by NQS, the doctor has a record of the occasion and medical confidentiality is preserved (the contents of the document are only known to the diver and his doctor).

Underwater medicine expertise in Australia is very thinly spread. SPUMS now has over 500 members in Australia and in all only about 40-30 people have ever done the RAN courses. Membership of SPUMS is no guarantee of underwater medical expertise!

I presume you have not, as yet, had a letter from Chris Acott to whom I forwarded your letter about decompression tables. I cannot speak for SPUMS on this topic, having only been authorised to deal with the medical examination side. It is a large subject and I believe you are right. The fault lies with the instructors not teaching properly. However the US Navy never dives its tables! They always add extra bottom depth and time to that actually done before calculating what, if any, decompression is needed. I will raise this matter at the next committee meeting, which will be some time after Easter.

Yours sincerely,

John Knight

OBJECTS OF THE SOCIETY

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

To provide information on underwater and hyperbaric medicine.

To publish a journal.

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

MEMBERSHIP OF SPUMS

Membership is open to medical practitioners and those engaged in research in underwater medicine and related subjects. Associate membership is open to all those, who are not medical practitioners, who are interested in the aims of the society.

The subscription for Full Members is $30.00 and for Associate Members is $20.00.

Membership entitles attendance at the Annual Scientific Conferences and receipt of the Journal.

Anyone interested in joining SPUMS should write to:

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

NOTES TO CORRESPONDENTS AND AUTHORS

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

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

SPUMS MEETING HMAS PENGUIN
27 August 1983

THREE VIEWS OF HIGH PRESSURE OXYGEN

Ed Salzman

Today I would like to tell three stories. They are on separate topics, all related to diving and relate to three areas of recent research activity of great interest to me. I will tell these stories simply by giving the theme then by describing how the theme came to be understood. Then I will comment on my understanding of what each of these topics means in diving medicine.

Topic number one has to do with aerobic performance in men subjected to greatly increased atmosphere pressures. A series of six dives has been performed to beyond five hundred metres in a hyperbaric chamber with the greatest pressure exposure at 68 atmospheres. The following observations relating to aerobic performance were made.

Firstly the individuals involved have been able to perform substantial exercise, albeit less than they could at the surface.

Secondly the maximal levels of ventilation that were possible were less than would be expected breathing denser gas at great depths, but they did out perform, by some 15-20%, the ventilatory levels that would have been expected from square root calculations on gas density.

Thirdly, and this is very important, the oxygenation of arterial blood was essentially appropriate, and correspond clearly to the inspired partial pressure of oxygen. They were breathing approximately 0.4% oxygen at 66 atm, giving a PO2 of inspired gas of approximately 354 mmHg and the PO2 measured in arterial blood was appropriate. Despite the normal oxygenation of arterial blood, the most interesting observation to me was the level of exercise under conditions that were otherwise typical for surface experiments.

Oxygen uptake was less, arterial pH was lower and the levels of lactic acid in the blood were higher. These observations can be interpreted most speculatively and most interestingly by the concept that these very greatly increased ambient pressures something happens to either the microcirculation or to intracellular metabolism, so that there is some impairment of aerobic metabolism or of oxygen transfer within the microcirculation. That is a speculation. One could also argue that blood vessels and cell membranes become more pervious to lactic acid and the higher concentrations in blood simply reflect a different distribution rather than a different level of production.

At any rate, this is an intriguing indirect observation. I leave it with you to think about. It may or may not relate to such problems as the high pressure nervous syndrome. But there clearly are some events that are occurring with aerobic metabolism at depth perhaps due to the pressure of the gas breathed that we are yet to sort out.

Topic number two again deals with oxygen. Very recently, two of my very bright young colleagues have performed an experiment which clearly proves to me that oxygen toxicity is very complicated in the mammalian systems. Oxygen toxicity is due to free radicals. They have in the same experiment also satisfied me that for the first time oxygen toxicity has been prevented in an animal model, in a specific rather than unspecific manner, with total prevention of biochemical or morphometric injuries to the lungs and to the brain. Now that has caught your attention, I will tell you about the experiment, and the problem.

The background comes from work begun about fifteen years ago that in the course of biologic oxidisation free radicals were formed, and that these free radicals, which were clearly known to be capable of destroying the architectural and metabolic integrity of cells, were blocked by both non-specific and specific mechanisms within the cells. They elucidated some of these specific mechanisms, with the emphasis upon superoxide dismutase, an enzyme occurring naturally in the cell that clearly prevented, under appropriate circumstances, the evolution of oxygen toxicity that would otherwise occur. They showed that in microorganisms that did not tolerate oxygen these defences were lacking, and that organisms that tolerated oxygen had these defences, and ultimately proved in a very unambiguous manner that the model for oxygen toxicity also applied in the species that do not have nucleii. Subsequently in another series of experiments, suggestive evidence accumulated gradually that free radical formations did in fact lead to oxygen toxicity in complicated mammalian systems, including man.

This work was morphometric and biochemical, to a great extent indirect. One of the very troubling features of the work was that if someone tried to prevent oxygen toxicity, be it in rats or guinea pigs, by infusing the specific defence enzymes such as superoxide dismutase and catalase into the blood, more often than not they were not able to prevent the evolution, in the shorter or longer interval, of oxygen toxicity. My colleague pointed out that these enzyme structures were very large and that cell membranes were relatively impervious and that it was not reasonable to expect to protect a complicated mammalian system from oxygen toxicity by delivering a defence mechanism outside the intracellular milieu where it was needed. And thereupon a very bright young biochemist conceived a marvellous experiment and has recently published preliminary data on it. He was quite familiar with the lysosomes. For those of you who do not know very much about them, as I did not a few months ago, lysosomes are artificial biomembranes which can be shaped like envelopes. One can put a specific enzyme or medication in these. They can be infused into the bloodstream, and when the artificial lysosome-enzyme envelopes abut against the endothelial lining of cells, they empty their contents into the cell. So a lysosome is essentially a postal service, which can supply anything one chooses to supply and deliver to cells that are within reach of the microcirculation. It is a system that overcomes the barrier to the delivery of large molecules from the extravascular compartment and the vascular compartment to the intracellular compartment.

Now, the experiment that he performed was a very simple one. We took a rat model that would die within sixty-five hours with exposure to one atmosphere of oxygen. And in which the parameters, by morphometric functional analysis and by chemical analysis had been very clearly demonstrated in both the lungs and the brain. He put into different models nothing, or superoxide dismutase or catalase or he put in superoxide dismutase and catalase. What he found was that the animals that had essentially empty lysosomes died at sixty five hours. The animals that had superoxide dismutase lysosome delivered by this postal service lived longer and had a little less injury. The animals who had either catalase alone or catalase and superoxide dismutase by the lysosome system lived considerably longer, three times as long. Now that he has improved his system in terms of technical manufacture of the delivery system he has an animal model in which these rats live indefinitely, on 100% oxygen. There is no identifiable morphometric biochemical injury in the lungs or the brain in settings where otherwise one would expect this to occur.

I find this a tremendously exciting piece of work. I do not think that you can rush out and plan to administer these things so that Royal Australian Navy divers can work to five hundred feet breathing pure oxygen without injury, but this represents a very important breakthrough in an area of science that has always interested me because it is the experiment that really, for me, ties together the relationship with free radical formation to the induction of oxygen toxicity. It is, I believe, the first specific rather than non-specific implementation of an absolute defence against oxygen toxicity in the intact animal.

Topic number three is a very quick look through intracellular oxygen availability and utilization. In the past thirty years, work has gradually progressed in the development of methodology for studying oxygen transport to the cells and aerobic metabolism. We still do not know a great deal about it because the work is technically difficult and has evolved slowly. But we know a lot more now than we did three years ago.

We have progressed over the period of a generation and a half from a capacity to study mitochondrial enzymes, the users of oxygen in the body, in the test tubes by themselves, through the capacity to study these mitochondrial enzymes in situ in the intact animal in an experimental situation, to a methodology by which one can now study elements in intracellular mitochondrial metabolism non-invasively in an intact man. So this is a very exciting area in which to work.

The kinds of parameters that can be studied include the redox state Cytochrome AA3, the relative volume of haemoglobin in the surveyed field, as an analogue of the perfusion, and the oxygenation of haemoglobin within the surveyed field, and in the invasive preparation where fluorescence techniques can be applied to actual tissue tension of oxygen.

There are three observations that came out of this work that I think are of considerable interest to diving medicine. Observation number one is that in the intact animal full oxidation of the terminal mitochondrial enzyme cannot be accomplished at sea level. In order to fully oxidise cytochrome oxidase in a series of animal models, the requirements are approximately 3.7 atm of oxygen and 3% CO2.

Observation number two is that if one delivers oxygen to the bloodstream with an oxygen pressure of perhaps 2000 mmHg, one cannot at all assume that comparable deliveries of oxygen are occurring within the cells because in the intact animal there are tremendous adaptive mechanisms, notably including in the most studied system, the brain, the capacity for the microcirculation to constrict and for perfusion to fall. So that in a model of a cat's brain studied optically by the techniques that I am alluding to, at a PO2 of 2000 mmHg in arterial blood, if the circulatory system of the brain is clamped by hypocapnia, the PO_2 measured in the tissue may be as low as 130 mmHg. If, on the other hand, the microcirculation is unclamped by inducing hypercapnia and increasing blood flow tremendously then the PO_2 in the brain tissue can rise to 1500 mmHg, with a constant arterial PO_2 of approximately 2000 mmHg.

If one thinks about these things it is not terribly surprising, but what I am describing is the methodology that has been difficult to evolve, that in the past year is on firmer ground theoretically in terms of the lack of ambiguity of the measurements than ever before. A methodology which can indeed be adapted, not only to try to answer intriguing questions that people we work with in the laboratory like to ask, but methodologies that are capable of being miniaturised and employed non-invasively by a pilot with negative G-forces coming out of a dive, or in the diver to look at oxygenation and aerobic function of the central nervous system. Of course there is much more to say on these topics but time has run out.

Question

How does one make a lysosome and how often does one have to dose the animal with this?

Dr Salzman

I do not have the technical knowledge on how to make them, but they are not hard to make, and they are biologically safe. They are in fact approved by our American FDA, Federal Drug Administration, so you could use lysosomes as a method of delivering medication, benign and approved.

Question

How often were you dosing the rats?

Dr Salzman

I think he was doing it about every 48 hours. He has published one of his experiments.

This is an edited transcript of Dr Salzman's address. Any errors are the responsibility of SPUMS editorial staff and not Dr Salzman.

OCTOPUSES KILL TWO BREATHHOLD DIVERS

A report from Kiribati, formerly the Ellis Islands, tells of the death by drowning of two spearfishermen hunting octopuses. The local method is to let the octopus cling to the diver, who then surfaces and kills it by a bite between the eyes. Apparently while attempting this procedure in the lagoon at Tarawa, the largest island, octopuses larger than usual were encountered, with a 3 to 4 metre tip to tip size. These large octopuses were able to resist the victims' attempts to surface.

Such larger animals have been labelled "killers". Mr Kirata, the Kiribati Natural Resources Minister, is quoted as saying, "We are going to have to find another way of killing octopuses."

HYPERBARIC OXYGEN THERAPY

Douglas Walker

The thrust of the Hyperbaric Oxygen Committee Report (1983 Revision) has been to establish a list of those conditions in which the use of hyperbaric oxygen (HBO) is either mandatory or ethically permissible, with the understanding that Medical Insurance Funds in the USA will accept a responsibility for reimbursing insured patients who receive such treatment. Omission of conditions from the list carries the implication that no repayments will be considered, though a number of causes of chronic ulcers are specifically listed as NOT justifying therapy by HBO.

In general terms the conditions can be broadly defined as falling into four groups, general anoxia or hypoxia from acute blood loss or poisoning of oxygen carrying capacity, local ischaemic or hypoxic causes (either widely disseminated or localised), anaerobic infections, and where the vasoconstriction effect of HBO is of value. A number of references are given to support the suggested uses, with advice that the literature on the subject is vast and that interested persons should consult the quarterly journal of abstracts, Hyperbaric Oxygen Review, published jointly by Plenum Publishing Corporation and UMS.

1. Currently Accepted Indications

Tissue Hypoxia:

General

Acute blood loss, if blood unavailable or the patient refuses to accept transfusion. Oxygen carriage poisoned by carbon monoxide or cyanide (rare).

Local

Decompression sickness (several factors operate)
Gas embolism
Osteoradionecrosis; soft tissue Radiation Necrosis
Refractory osteomyelitis
Acute traumatic ischaemia (Crush injury)
Compromised skin grafts (pre-operation).

Anaerobic Infections:

Gas gangrene
Mixed infections; Refractory mycoses.

Cerebral Oedema:

HBO produces cerebral vasoconstriction, decreasing cerebral blood flow yet providing adequate levels of brain tissue oxygenation.

2. Experimental but acceptable use

Tissue Hypoxia:

General

Acute Sickle Cell Crisis
Poisoning by carbontetrachloride, hydrogen sulphide

Local

Acute CVA (thrombotic or embolic)
Acute trauma to head or spinal cord
Bone grafts (2nd attempt)
Multiple Sclerosis (mode of action??)
Radiation myelitis, cystitis, enteritis, proctitis
Fracture healing (intermembranous bone)

Anaerobic Infections:

Intra-abdominal and intracranial abscesses
Lepromatous leprosy
N Meningitis with meningitic purpura
Pseudomembranous colitis (C difficile)
Pyoderma gangrenosa
Actinomycosis

Vasoconstriction needed:

Acute retinal artery insufficiency
Retinopathy, adjunct to scleral buckling procedures in patients with sickle cell peripheral retinopathy and retinal detachment

The Committee also mention, without giving clear guidelines, the use of HBO for thermal burns.

It is to be noted that HBO is only part of the therapeutic management, both antibiotics and surgery being essential components of the management of cases where trauma and/or anaerobic infections are present. Medical care is also necessary.

The use of HBO to produce vas<u>oconstriction</u> may appear paradoxical to some and is indicative of the Yin/Yang principle of therapy which is too frequently translated as drug action/side effects. In cases of retinal artery insufficiency, where therapy would need to be applied rapidly, HBO is thought to act by shunting blood to the ischaemic areas due to vasoconstriction of the normal portions of the artery. In acute cerebral oedema the vasoconstriction decreases the cerebral blood flow while maintaining tissue oxygenation: CAT scan and clinical evidence suggests the treatment is of value, as part of a management protocol.

The final section of the report is a reminder of the need for strict controls over the use of HBO, the need for correctly trained personnel and careful records. The many hazards of the HBO environment must be recognised and appropriate precautions taken at all times.

The Hyperbaric Oxygen Committee Report (1983 Revision) is available, price US$2.50 per copy, from

The Undersea Medical Society
9650 Rockville Pike
Bethesda, Maryland, 20814
USA

A case of retinal ischaemia following hyperbaric oxygen exposure is reported on page 32 of this issue.

MORE ABOUT ASTHMA

Carl Edmonds

Australians have the reputation for being naturally fit and rugged individuals. Apart from myself, this is not always necessarily so. I may have mentioned in a recent article that we “fail” almost 10% of the candidates for amateur diving courses, on medical grounds.

Because there has been a plethora of articles in our SPUMS Newsletter *(sic)* from OS (overseas) experts showing the arbitrary nature of their prejudices, I felt that I should respond likewise and give the Oz.(Australian) experience.

There are probably no more than 20 diving medicos in Australia and after this article I shall receive 19 protests. I guess I have faced the problem of the asthmatic would-be-diver more than most. Any diver who I believe has, or is likely to have, an asthmatic tendency is failed. If I make mistakes by “passing” someone who has sinus disorders, unilateral deafness, or other problems, then the chances are that he will live to complain about it. Not so with the asthmatic diving accident.

Only twice have the Diving Medical Centre (DMC) doctors really dissented and both were over mild asthmatics. In the first case the subject was passed because he had letters of fitness from the most eminent of our respiratory specialists. He burst his lung and developed a pneumothorax at depth. The second was failed three times by the DMC (despite flattery, cajoling and threats) and was finally given a medical certificate by his father - a professor of medicine. He died during an exercise/cold/aspiration induced asthma attack after arriving on the surface.

Asthmatics seem to have to prove themselves, and failure to pass the medical is a severe blow to their self esteem. I try and explain that, because they are susceptible to asthma, they are more likely to develop pulmonary barotrauma, a diving precipitated asthma attack and unexplained loss of consciousness.

In determining whether there is an asthmatic tendency, special attention is paid to the history of asthma, wheezing, hay fever, use of inhalants, aerosols, allergies, etc. Auscultation is performed during hyperventilation and the percentage FEV1 is performed, with Ventolin if indicated. Exercise provocation, 1200 KPM/min for 6 minutes, is used if there is any suspicion of exercise induced asthma. If, after all these studies and assessments, I am still not perfectly convinced, I will send him to a respiratory function unit for more sophisticated provocations and respiratory function testing. Fortunately, this is not often required after a comprehensive clinical examination.

Asthma treatment is also a problem. Ventolin is a cardiac stimulant, as are other sympathomimetics. I do not consider them desirable to use in the diving situation, especially with our current beliefs of the causes of the sudden death syndrome due to cardiac disease. It is also unfortunately true that all the aerosols have a patchy and variable effect on the respiratory airways and the resistances from them (certainly not to be relied upon to prevent pulmonary barotrauma). The second case referred to above was a young man who died on the surface, with an asthma attack, while he was swimming back to get another puff of his Ventolin!

The pulmonary barotrauma is explained to the candidate, with the importance of his increase in airway resistance and the greater pressure gradients that would exist along his airways, the reduced compliance of the lungs, the greater transpulmonary pressures he will develop and the larger lung volumes that he uses with his normal breathing.

When the candidate understands how these factors work in favour of him bursting his lung, I then explain how important it is at the shallow depths, as the argument he always puts forward will be “but surely I can dive as long as I don’t go deep.”

Asthma may be precipitated by exercising, breathing against the resistances associated with the diving equipment, breathing very dry air or very cold air. The dry air comes from the need to produce dry air with compressors, and it becomes cold because we are breathing in a cold environment, and because of the adiabatic expansion of gases in the first and second stages of the regulator. The exercise induction of asthma is well known, and in the underwater environment exercise may be particularly necessary, such as in swimming against a current or by trying to swim without neutral buoyancy. The production of asthma from the aspiration of small quantities of sea water is less well known, and is quite a separate entity to the salt water aspiration syndrome, which I referred to in a recent article.

The production of asthma due to aspiration while diving can perhaps be due to a number of factors, one of which is the presence of various marine proteins in the aspirant. The most interesting aetiology is that of inhalation of hypertonic saline (sea water).

Interesting work was performed by Findlay and his colleagues (OS) and Sandra Anderson and her colleagues from the Professorial Unit of a Sydney University. Dr Anderson demonstrated asthma attacks can be produced by a variety of aerosols, including distilled water and hypertonic saline (2.7% and 3.6%), in potential asthmatics (not in normals!). Isotonic saline does not have this same effect. Saline with the hypertonicity of seawater produces a drop in the FEV1 of 20% in potential and actual asthmatics. It is thought to be due to the release of a histamine from mast cells which are especially sensitive to the change of osmolality. (This response is very similar to the histamine provocation test), and is now a well validated test for detecting bronchial hyper-reactivity.

The aspiration of sea water may be due to regulator problems (eg. failure of a non-return valve to be fully functional) or inhalation of water around the regulator or after removal of the regulator on the surface.

The only way in which I believe it would be safe for an asthmatic or potential asthmatic to take up SCUBA diving would be if he guaranteed that he would never need to ascend rapidly (ie. never have buoyancy problems, never have a regulator failure, never be pulled up by his float or by other line), never have to exert himself, breath warm humidified air and swim in an isotonic ocean. The other requirement I would make is that he remains between 100 and 200 ft depth, where the volume changes are much less, and never come to the surface.

Unfortunately the asthmatic often still wishes to dive. I then fall back on my "soft sell" approach and ask if he is married, the names, ages and sex of his children, whether his life insurance policy covers them adequately, and if it specifically covers them for a fatality during SCUBA diving, especially when the recipient is medically unfit for it?

By this time he is losing a bit of the savoir faire and starts listening, and reconsidering the whole project. I then ask to speak to the spouse/parent and if this fails I ask for written permission for autopsy in the event of an accident "to further our knowledge of diving medicine, for the sake of future patients." The last trump card usually wins, as the subject recoils in horror, clutches his chest and glares with a "he-is-after-my body" stare. Only one patient complied with my request for autopsy permission and still proceeded to dive. I did not actually have the heart to attend the autopsy when it finally eventuated.

I often need repeated consultations to effectively get across the full message about the contraindications of diving with asthma. I sometimes try to encourage the asthmatic to go to any other field, and become the Australian champion. The only qualifications I make are that the field should not be SCUBA diving, working dark, damp, underground caissons, or becoming an astronaut.

I do not try to explain the cases of loss of consciousness, as I do not understand them myself. Perhaps they are related to CO_2 toxicity combined with nitrogen narcosis.

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PROJECT STICKYBEAK

This project is an ongoing investigation seeking to document all types and severities of diving-related incidents. Information, all of which is treated as being CONFIDENTIAL in regards to identifying details, is utilised in reports and case reports on non-fatal cases. Such reports can be freely used by any interested person or organization to increase diving safety through better awareness of critical factors. Information may be sent (in confidence) to:

Dr D Walker
PO Box 120
NARRABEEN NSW 2101

MEET DES

NEW DIVER EMERGENCY SERVICE APPROVED BY GOVERNMENT

The Minister of Defence, through his Minister Assisting, has agreed to an approach by the Australian Underwater Federation, that the RAN School of Underwater Medicine accept the responsibility of a National Co-ordination point for assistance in the event of Diving Emergencies.

Now, to obtain assistance in a Diving Emergency, there is Australia-wide a single telephone number to call. That phone (02 960 0321), manned 24 hours a day, seven days a week, will provide access to the doctors of the RAN School of Underwater Medicine for immediate advice on treatment and to provide advice on future transport or further treatment that may be needed.

Mr Frank Poole, the National Director of Coaching for the AUF, was quick to point out, that this in no way lessens the importance of the several professionally serviced recompression chambers available around our coast. Divers tend to be very migratory. Now there would be a single telephone contact and a simple reporting procedure instead of a multiplicity of reporting numbers and differing procedures. The Navy would normally utilise the closest appropriate facility to the accident and provide advice on first aid and subsequent treatment and on arranging transport to move the patient to the facility. The Navy's willingness to assist with Service expertise will be a major factor in improving the safety of diving in Australia, Mr Poole said.

If you have a DIVING EMERGENCY, call "DES"

Ring: 02-9600 321

State: "This is a diving emergency"

Ask: That they contact the duty Doctor of the School of Underwater Medicine.

Give: Details of the incident:-

1. Exact location of patient
2. Telephone number where someone can be contacted, including STD code. Make sure that someone stays at the phone and that the phone is not used.
3. Details of the accident or incident and of the patient's condition.
4. Current first aid being applied.
5. Contact's name.
6. Have any emergency, medical or police services been notified? If so, when.

Check: That the following have been correctly recorded

1. Location
2. Telephone number
3. Dive details
4. Signs and symptoms
5. Contact name

by having them repeated back to you.

MODIFIED BUDDY BREATHING PROCEDURE

Jenny Garmendia, Henrik Nimb and Peter Oei

THE PROBLEM

Several years ago during a discussion and analysis of diving accidents as reported by the University of Rhode Island (URI),[1,2,3] we were struck by the following reoccurring problem with buddy breathing, as noted on page 22 of the "United States Underwater Fatality Statistics 1975":2

> "... the accident description leaves little doubt that the usual 'two breaths then pass' requirement for shared breathing was not followed. Typically, the victim finds two breaths entirely insufficient and is reluctant to give up the regulator at all. Alternately, the victim breathes rapidly several times from the shared regulator and then rises as rapidly as possible, embolizing on the way up."

The URI also stated in the same report on page 16, that:

> "... the possession of one's own regulator is decisive in an air-lack emergency. Seldom does the person with his own regulator die."

CONCLUSION

It seemed clear to us upon analysis that the initial two breaths are insufficient for the victim to regain self control. Initiating an immediate ascent prior to the victim's getting his breathing under control only serves to worsen the situation. The victim's buddy, as noted time and again by the URI, was usually able to make it to the surface even if he never recovered his own regulator because he was not "out of control" at the beginning of the problem. Thus a typical buddy breathing failure begins as follows:

> When a victim runs out of air, usually he/she has not paid attention to either pressure gauge or breathing resistance and normally notices the problem only after exhaling a "good breath" and attempting to take in and getting "no air". The victim must then work against anxiety to swim over to his/her buddy (hopefully not far) and give an out of air signal before getting air. At this point it becomes obvious that the victim cannot regain control of his breathing in just two breaths. However, if the victim keeps the regulator for additional breaths, this immediately causes the other buddy great anxiety and the procedure is doomed to failure from that point on.

SOLUTION

The answer then is to:

(1) give the victim a means of regaining self control;

(2) make an established procedure so the victim's buddy is prepared: and

(3) give both victim and buddy a chance to get the procedure under control before surfacing.

All these can be accomplished in a matter of seconds if an established procedure (as follows) is used.

There are mainly two differences between this and the "old" buddy breathing procedure. First, when a diver runs out of air and signals such to his buddy, the buddy passes the regulator and allows the out-of-air diver to take four quick breaths. This procedure was also suggested by Donovan S Conley and Peter J Carrol in 1978.[4] This has several advantages. The out-of-air diver gets the necessary additional air to regain self control. The buddy is expecting the out-of-air diver to take several breaths and, not being anxious, is easily able to wait for the air. Secondly, the buddy pair then start the two-breaths-then-pass cycle and at <u>least two passes are made prior to the start of the ascent</u>. This ensures that both divers have regained the self control, within a matter of a few seconds, which is essential for the success of the procedure, and both divers are in correct position and able to execute a calm ascending manoeuvre.

TRAINING PROCEDURE

Obviously training is based with the emphasis on proper monitoring of air pressure so that an out-of-air situation does not occur. Octopus breathing should be presented as the first option. However, buddy breathing should be taught as a procedure which can work, provided that:

(1) it is learnt correctly, and

(2) it is taught as a skill that must be practiced from time to time in order to maintain proficiency, and

(3) it should be part of the pre-dive buddy check that every time both partners are not using an octopus, the buddies should go through the correct hand position of being donor and recipient prior to the final okay to start the dive.

The procedure and positioning should first be tried on land, then in the shallow end, then in the deep end, etc. The important steps in training are as follows:

(1) Give the correct signals ("out-of-air" followed by "share air").

(2) The donor immediately passes the regulator with the right hand, holding the regulator in such a way (depending on the make) as to allow the recipient clear access to the purge. The donor always holds the regulator with the right hand and passes it as if it was a regulator with an exhaust valve below the mouthpiece regardless of whether it is one with a side exhaust. Trainees must become conditioned to do this in order to avoid inadvertently giving an out-of-air victim a regulator upside down, causing the victim to be unable to purge the water from the second stage.

(3) Both donor and recipient maintain a hold on the second stage at all times while sharing air, and exhale a continuous stream of bubbles anytime the regulator is out of the mouth.

(4) The recipient begins by taking four quick breaths. This is easy for all to remember as it is the same life-saving procedure as used at the start of giving mouth-to-mouth resuscitation (in the USJ). The normal two-breaths-then-pass sequence is then started.

(5) The donor must have a firm hold of the recipient's tank strap or buoyancy compensator with the left hand. The recipient must have hold of the donor's tank strap or buoyancy compensator with the right hand. This ensures that they are in correct position and using the correct hands to pass the regulator.

(6) The buddies pass the regulator between them twice before commencing their ascent in order to establish both self control and control of the procedure.

(7) The pair swim up at a normal rate of ascent with both buddies kicking slowly and continuously (do not stop kicking while inhaling!) for the surface.

Two other points should be made to the instructor regarding the teaching of buddy breathing. Dr Glen Egstrom stated in his "UCLA-Diving Safety Research Program"[5] that:

> "... error free behaviour and continued progress throughout the sequence (of buddy breathing) were not seen until the eighth or ninth trial period."

This means that a few practices in the pool and once in the ocean are entirely insufficient! Buddy breathing practice should be initiated in the early pool session (second session) and practiced several times in every session thereafter. It should also be performed at least four times in the open water (allowing for the adjustment necessary due to the change in the environment), on at least two separate dives. This should ensure that each buddy is comfortable both as donor and recipient and should give a total of 12-16 separate buddy breathing practices to get the trainees beyond the limit described by Dr Egstrom.

The effect of slowed reaction times due to depth, cold, anxiety, etc., should also be emphasized.[6,7] This can be pointed out during the classroom lecture on the effects of nitrogen narcosis and can effectively demonstrate both the danger of narcosis and the need for conditioning buddy breathing reactions, by the following role playing:

> Act out that as an out-of-air victim at 100 feet, it takes you "about" 10 seconds to realize that you have run out of air (I've run out of air ... I've run out ... of air? out of air? I'VE RUN OUT OF AIR!!!! etc., taking 10 seconds). Then "swim" over to one of the students who will take 10 seconds to understand that you have run out of air. ("Hand across the throat ... means ... run out of air. You've run out of air? ... You've run out of air?! YOU'VE RUN OUT OF AIR !!!! etc). This amusing demonstration reinforces the need to be completely familiar with Buddy Breathing. It is also very successful in demonstrating the need for an octopus regulator.

PRACTICAL TESTING

We have done extensive testing of this procedure over the past four and a half years and have found it extraordinarily successful. It cannot be emphasized strongly enough how important both the victim's first four quick breaths, and the following exchange of the regulator twice first before initiating their ascent, are towards the successful use of buddy breathing. This method has proven successful not only in tests, but also in a number of actual buddy breathing situations.

We would urge the diving community to try this procedure to realize the potential for improving the success rate of buddy breathing. Until octopus regulators becomes standard equipment adoption of this method could lower the number of cases of buddy breathing failures reported so tragically often in the URI reports of diving fatalities.

One simple initial test which instructors can try for themselves. Have one person sit at one end of a pool (back turned) at least 30 yards away from the "victim". The person playing the victim removes his regulator and swims towards his "buddy", exhaling continuously (to simulate an out-of-air victim without full lung volume). Upon reaching the buddy, get his attention, give the correct signals, and then begin buddy breathing. The difference between the old "two-breaths-then-pass-and-start-up-right-away" and the "four-quick-breaths-and-pass-twice-before-starting-up" method will immediately be clear. In fact, it will be found by most people that two breaths to start with are "not enough" ... something that many out-of-air victims discovered for real.

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US UNDERWATER DIVING FATALITY STATISTICS, 1970-80

Douglas Walker

This is the most recent of the series of reports prepared by John McAniff, Director of the National Underwater Accident Data Centre, University of Rhode Island. Two up-dates are reportedly due for publication shortly.

The number of identified diving-related deaths has shown a tendency to remain constant for the last four years reviewed, which represents a reduction in the incidence rate because of the increased number of divers "at risk". In America, as elsewhere, problems are experienced in obtaining adequate information but "late cases" are added in as discovered, so numbers quoted in all the tables are as accurate as the most recently available information allows.

those making their first-ever dive or on a very early sea dive. There is an important comment made about the importance of the instructor never withdrawing attention from any pupil even when the exercise is completed and at the surface. The potential for irretrievable disaster is ever present. Verily the Sword of Damocles hangs over every instructor while in the water.

No report can be expected to please everybody, there being limitations of time, money and available information to circumscribe the author's efforts. This is, as clearly stated in its title, a statistical report and has the limitations of such an approach in dealing with circumstances where almost invariably there are a number of factors operating to influence the course of events. The Tables deal in single factors, events in multiples. Many persons dive without a buoyancy aid, separate from their companion(s), or are grossly ignorant, yet survive. It is a combination of adverse factors which makes survival problematical when something goes wrong. It is for such reasons that brief case reports are so valuable. Unfortunately few are supplied. It is by such reports that diver readers begin to identify with the victim's troubles and (hopefully) learn the principles of safer diving. It is such vignettes as the following which bring home forgotten dangers.

TABLE 1

Annual Diving-related Fatalities by type and year

	1970	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**
SCUBA, sport	110	112	119	125	144	131	147	102	116	130	109
Snorkel, sport	19	17	16	22	27	17	14	19	16	12	20
Commercial	9	4	4	4	16	13	14	23	12	8	20
TOTAL	138	133	139	151	187	161	175	144	144	150	149

The imprecision of information, a bane to anyone seeking to extract more from a fatality report than the compilers thought necessary to include, is highlighted in the discussion on "Personal Floatation Devices". As has been noted in other reports, there are many types of such devices and without the victim's equipment being described in exact terms it is frequently impossible to be certain what methods of inflation were available to the wearer. The omission of any autopsy in 27% of the 1980 cases seems rather high, and the suggestion by the author that such an examination would have resulted in 20 of the 60 cases of "asphyxia or drowning" being diagnosed as "lung over-pressure" may be thought over optimistic. Even had the medical examiners followed Dr Kindwall's protocol it is possible that they would have required the presence of gross lung damage before admitting the diagnosis of Cerebral Arterial Gas Embolism (CAGE) unless they found air in the ventricles. Few pathologists take account of the circumstances of diving when giving their opinions, otherwise such terms as "asphyxia" would not be presented without explanation of the supposed mechanism of causation. As it is accepted clinically that CAGE is diagnosed and treated on the basis of the history in the common absence of evidence of lung damage, so too should an informed pathologist make the diagnosis on the basis of probability. Perhaps the pathologist should talk to some live divers before starting the autopsy!

It should come as no surprise that the inexperienced figure so prominently in the deaths. This group is composed of

An "experienced diver" was diving from a boat in a mountain lake and made a back-roll entry into the water after attaching a line to his weight belt. It had been his intent to don his fins, left in the boat, after entering the water but in practice he immediately sank to the lake floor, 125-150 feet deep. Pulling on the line produced the belt but not the diver. When recovered he was still retaining the snorkel in his mouth. No Table could adequately teach readers the several lessons of this tragedy, viz: he was greatly overweighted, so presumably not experienced in fresh water diving, and had failed to check his equipment, the tank feed to his buoyancy vest being unattached. Entering the water without fins is never a sensible option when otherwise fully equipped, though had he held his regulator in his mouth on entry he might have survived, albeit with very sore ears. The retention of the snorkel in his mouth suggests the possibility of an imperative reflex respiratory response to sudden immersion in cold water, with inhalation and sudden death. Tables give valuable data, but action replays give impact.

The dedicated work by John McAniff and his colleagues is of great value to all divers, not merely those in the USA. As is true also of efforts in Australia and New Zealand, the scheme also collects non-fatal Incident Reports. These will be co-ordinated with the DAN records to gradually build up a significant data store. It is hoped that future reports will seek to close one gap in the present tables of information, the depth of the incident. It has been shown in both Australia and New Zealand that many fatalities occur at or near the surface, the water/dive depth not necessarily being a critical factor.

Please support your local Incident Scheme. Something you report could save a life.

TABLE 2

Stated Experience of Scuba Diving Fatalities

	1970	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**
Inexperienced	48	47	33	43	54	39	45	37	44	47	52
"Experienced"	52	63	67	46	46	61	55	63	56	63	48
Not Stated	10	2	9	36	44	31	47	2	16	20	9
TOTAL	110	112	119	125	144	131	147	102	116	130	109

HYPOXIA IN OUT-OF-AIR ASCENTS
A PRELIMINARY REPORT

GAD Harpur and R Suke
Tobermory Hyperbaric Facility Tobermory, Canada

In December 1977 the Undersea Medical Society (UMS) convened a workshop on Emergency Ascent Training in Bethesda, Maryland, supported by a National Oceanic and Atmospheric Administration (NOAA) grant. At the conclusion of the workshop, it was found that rather than answering many of the questions, the conference had served rather to define those areas requiring further investigation.

It was suggested by one of the participants that critical levels of hypoxia were likely to occur in the course of any emergency ascent arising as a result of an out of air situation and that this hazard might well rank with that of air embolism. Surveys of deaths occurring while scuba diving reveal variable numbers of drownings. The Rhode Island survey (2) shows 70% of scuba deaths due to drowning, our own statistics in Ontario (3) indicate a lower figure of 66%. Detailed examination of these reveals that many drownings are secondary to embolism. Others may have been secondary to this or other difficulty but missed due to improper autopsy technique, or no autopsy, but there remain a number of these deaths which may well be due to hypoxia before the surface is reached. Whatever the cause, failure to reach the surface has been uniformly fatal in our experience. (Table 1)

The majority of the participants were sceptical, but the concept appeared to merit further investigation and this paper is devoted to an initial hypothetical analysis of this problem and a preliminary report of a series of experimental ascents to test the hypothesis.

TABLE I

OUTCOME OF 37 SERIOUS DIVING ACCIDENTS

TOBERMORY 1974 - 1982

	Deaths	Survivors
Failed to surface	12	0
Surfaced	3	22
Totals	15	22

These cases include cerebral air embolism (CAE) and carbon monoxide (CO) poisoning.

PROBLEM ANALYSIS

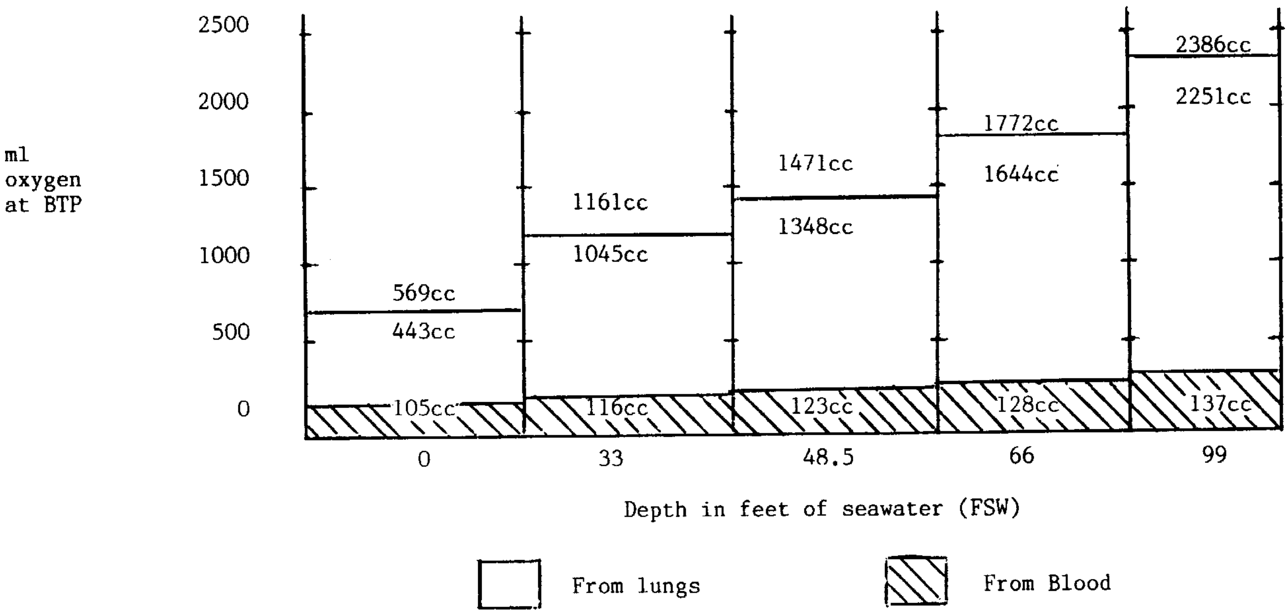
If we analyse the situation which exists when a diver runs out of air, we can derive his available oxygen (O2), the projected O2 cost of the ascent and then predict the course of his PaO2. Certain conditions must be assumed for this exercise and we have selected the following.

Our diver is an 80 kilo man, reasonably fit with a vital capacity predicted for 184 cm height and 32 years of age, 5.7 litres.(4) We have further assumed that he has a haemoglobin (Hb) of 15.0 gm% and a total blood volume of approximately 6 litres represented by 2042 ml oxygenated blood and the balance mixed venous.(5)

The out of air emergency is assumed to occur while the diver is swimming actively at a level which has produced a steady state and that the lack of air is discovered by the diver, when he attempts to breathe in following a normal expiration. He is assumed to be in standard sport diving dress (wet suit and fins).

TABLE II

OXYGEN AVAILABLE AT VARIOUS DEPTHS



Oxygen available has been calculated using a starting PaO2 of 116 and assuming lung volume to be FRC (2.9 litres).

The diver is presumed to respond to this emergency within 3 seconds by initiating an ascent remaining neutrally buoyant throughout. Whatever breathing routine is employed during the ascent, the hypothetical diver unloads sufficient gas to stay at his FRC (2.9 litres).(4) We neglect the decrease in this value which has been shown to occur with head up immersion due to the chest wall pressure gradient. Most authors have shown this to be of the order of 30%.(6)

Table II outlines the oxygen (O2) available on the bottom for the depth or pressures indicated.

Work by Lamphier (9) and other authors has shown that the optimum swimming rate for a diver with fins is approximately 90 feet/min, and that at this rate the O2 consumption equals 1.5 litres/minute.

Using the total O2 figures from Table II, less the amount lost in expired gas as the diver ascends, we can calculate the depth at which the diver's PaO2 will cross the critical value of 40mm which in most of us would result in abrupt loss of consciousness during such as ascent.(Table III) It is at once apparent from this bar graph that the critical situation will always arise close to the surface but that in all cases where the ascent is commenced from depth of more than 45 feet sea water, it takes place before the diver can hope to breathe surface air.

One of the conditions we assumed for this ascent at its outset was neutral buoyancy, so if the hypothetical diver loses consciousness he will not continue to ascend, rather he will lose his regulator and take in water, thereby simultaneously drowning and becoming negatively buoyant making effective rescue and survival improbable.

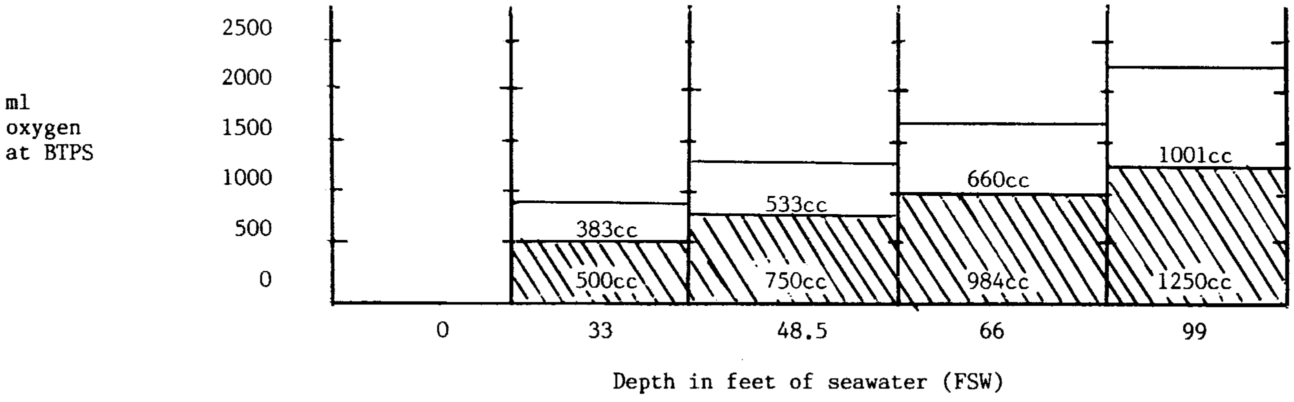
METHOD

To test this theoretical case, two divers were subjected to repeated ascents in circumstances as close to those specified as it was possible to approach with reasonable safety.

Employing a double lock chamber the divers were in turn taken to the test depth where they worked on a bicycle ergometer for a period of 5 minutes at light load to achieve steady state. The load selected was comparable to swimming at 75 ft/min and was a comfortable one. At a prearranged signal the diver was switched to a very limited volume partial rebreathing circuit (see Figure 1) and 3 seconds later the ascent commenced at as near 99 ft/ min as possible. When the ascent began the diver increased his exertion to a level which had been determined by closed circuit spirometry to represent an O2 consumption equal to the cost of ascent while neutrally buoyant.(7) There is great merit in the argument that in this situation the diver would be attempting considerably greater speed but we selected this speed because it is the most efficient with regard to time and O2 cost. O2 cost becomes increasingly exponential with speeds above 100 ft/min and thus the effect would be to bring on critical hypoxia at greater depth albeit more rapidly. During the ascent the diver had two simple tasks, first to keep his output or speed constant and second, to produce a regular repetitive tapping with a metallic object.

TABLE III

OXYGEN COST OF ASCENT



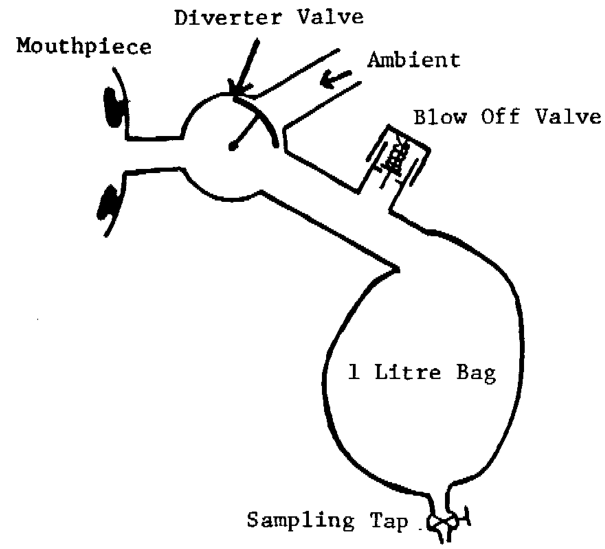
Depth of Exhaustion	0	0	0	2.5	16.0
Depth PO_2 = 40 mmHg	0	N/A	6.0	11.0	27.2
Depth PO_2 = 70 mmHg	0	N/A	11.0	16.0	31.0

Lung Volume assumed to be FRC (2.9 litres)

(hatched box) O_2 consumed — (open box) O_2 lost to expansion

Failure or irregularity in the performance of either of these tasks was noted against depth by an outside observer while the tender in the lock was prepared to close the valve on the rebreather bag to retain an expired gas sample at the failure point and administer O2 if necessary.

FIGURE 1



The partial rebreathing circuit was employed because of the potential for embolization due to small airway closure if continuous exhaling routines were used. It also served to provide a source of expired gas samples, which due to the rapid rebreathing could safely be considered to represent an end expired gas sample essentially in equilibrium with alveolar gas tensions, and consequently gas levels, with only a slight lag.(8)

In addition to direct equipment and physician availability, the main lock of the chamber was held at 200 feet throughout so that a very speedy dive to 165 feet could be effected if required.

Unlike the theoretical diver the subjects had the advantage of retaining 1.0 litre of their expired gas and being able to rebreathe it. It is difficult to calculate accurately how great this advantage was in ml O2, but it essentially increases the FRC by 1.0 litre and consequently reduced the loss due to expansion during the ascent. It gave the experimental subject a significant edge over the hypothetical diver.

When the end point was reached, as determined by complete failure of one or other of the primary tasks or in one case, because of unconsciousness, the tender would trap the last expired gas sample in the rebreather bag by closing the valve and the gas was then analysed at the surface for O2 by Ohio O2 meter model No 601 with modified scale expansion and for CO2 by modified Campbell Haldane apparatus. The results, corrected for depth and BTP, are

TABLE IV

RESULTS OF TEST RUNS

(Average of 3 runs at each depth)

Starting depth and subjects	30R&H	45R	45H	60R	60H	90R	90H
Depth difficulty began	N/A	10	15	20	21	34	7
Depth terminated	0	4	7	12	8	9*	10
pO_2 mmHg at termination	N/A	48	48.4	60	55	47	56
pCO_2 mmHg at termination	N/A	47.7	53.5	72	81	71	58

* went unconscious

Subjects H & R

shown in Table IV.

DISCUSSION

Although the number of ascents and subjects is small, the results showed that the subjects became critically hypoxic before reaching the surface in all cases starting deeper than 45 feet and that the depth at which this occurred, moved down slightly with deeper dives in accordance with the prediction. We made no attempt to predict the course of the CO_2 and were surprised at its marked rise in many of the ascents. This rising CO_2 would enhance O_2 release from the haemoglobin, but would add to the cerebral dysfunction caused by the hypoxia.

The subjects were aware of fixation of purpose during the latter phases of all runs and this parallels reports by divers who made such ascents. Some of these have reported amnesia for the final portion of the ascent consistent with critically low O_2 levels.

Fortunately most sport divers at this time are using buoyancy compensators or other flotation devices which will passively expand as the diver ascends, eventually resulting in buoyancy assistance during the ascent without specific action on the part of the diver. This fact has probably saved more than a few lives.

Unfortunately it is required that the diver accomplish some variable portion of the ascent for this to occur and hypoxia comes on without warning so that there may be no opportunity for the diver to take action to alter his buoyancy at the critical instant.

The O_2 cost of the same ascents, accomplished at the same speed by buoyancy alone, is much less.

The surplus O_2 provided by this method is an obvious advantage which must be weighed against increased risk of air embolism or decompression sickness due to uncontrolled ascent or inappropriate techniques. We believe training can minimize these.(9)

CONCLUSION

This information clearly needs to be taken into account when devising responses for the out of air situation. The diver needs to ensure that he has the ability to render himself positively buoyant in any ascent which may result in hypoxia or loss of consciousness from any cause. This has been borne out by the statistics in our experience.(Table 1)

Alterations in the amount of O_2 available can be achieved by increasing the lung volume during ascent, decreasing exertion, and use of alternate air supplies. We feel that further study is needed in this area to clarify the issues involved. Ascents from depth to 120 feet are planned with a refined protocol.

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This paper has been in the hands of the SPUMS J since March 1983. A letter in September 1984, asking Dr Harpur whether the long interval had altered his views and whether he had any objections to its being published produced the following reply.

Tobermory Medical Clinic
PO Box 220 - NOH 2 RO
Tobermory, Ontario

17 September 1984

To answer your questions quite simply, no, I have not encountered anything which would persuade me to alter my views since that paper was completed, and no, I do not have any objection to it being published. Our experience since that time, has if anything reinforced the views expressed, and I am happy to report to you that whether entirely due to the adoption of the principles outlined in the Ascent Protocol you published earlier (SPUMS J 1982 Oct-Dec: 32-38), or to improved instruction, we have seen a drastic reduction in diving accidents and fatalities in our particular region over the past three years. We were reluctant at first to call this a definite trend, but it has been consistent enough that we are now quite certain it is. This has had the somewhat unfortunate effect of reducing our opportunities for expanding clinical experience, as the bulk of the difficulty now encountered centres around sinus and ear squeeze.

Yours sincerely

GD Harpur

We are sure that all our readers would like to be able to quote similar statistics for their region!

Dr Harpur recommended (SPUMS J 1982 Oct-Dec: 32-38) a continuous breathing cycle for out of air ascents. The points are

1. DO NOT remove the regulator from your mouth unless you have another to replace it with, or in cases of entanglement. *The regulator provides a safety valve and a possible source of air.*

2. Continue to attempt to breathe in and out at all times even if out of air or without your regulator. *This ensures an open glottis and larynx and minimises the chance of small airway closure.*

3. Make certain you are positively buoyant by inflating your buoyancy compensator or dropping the weight belt or both. *This guarantees that you will reach the surface despite hypoxia.*

Dr Harpur also emphasised that CPR training was the most critical factor, *in the accidents in the Tobermory region*, in determining the outcome if the diver surfaced. Good dive organisation ensured rapid response and prevented incidents from becoming complicated.

DAN (DIVERS ALERT NETWORK) AUSTRALIA

Robert Sands

The DAN organisation provides a valuable service in the United States of America. It arranges transport for injured divers, coordinates evacuation procedures, and gives state of the art advice to Medical personnel when emergencies do occur.

As well, the service collects accident details and statistics and after considering the material makes observations and gives advice to relevant authorities in a non judgmental manner. It also works to keep the keen diver educated in diving safety and first aid techniques.

As this service consumes a large amount of money to operate it and is no longer funded by the Federal Government it looks to individuals, organisations and business corporations for the funds.

Because the makers of the Bendeez Adaptor are considering becoming a corporate sponsor in the United States and the Directors of Paracel Holdings Pty Limited (the makers of Bendeez) were impressed with the DAN organisation they offered to conduct a small survey to find whether a similar organisation was indeed possible in Australia. It was suggested that if so, it would have an association (non-profit) with the US DAN for mutual benefit (data exchange etc).

The survey conducted was at a number of levels. For example, Diving Medical Specialists with a high media profile were contacted and their views sought on DAN's viability and their own participation if DAN was set up in Australia.

As well, the Instructors from the major teaching groups were asked their opinion and their participation. So too were dive store owners and finally ordinary divers were asked whether they would subscribe to DAN in a similar fashion to their American 'cousins'

It is significant also that a number of very large Australian companies indicated that they would support an Australian DAN.

The findings of this small survey are presented here. The collator of this material, Robert Sands, has endeavoured to be objective in his presentation and does point out that there is no personal gain to be made from his assessments or observations.

DIVING MEDICAL SPECIALISTS

Five diving doctors were contacted. All appeared to agree that an Australian DAN could be of use to the diving community.

Dr Douglas Walker who has done all the hard slogging in Australia's "PROJECT STICKYBEAK" would be best suited to continue this work if DAN is set up in Australia. Dr Walker's findings are considered most useful in the diving community and are held in high regard by the three teaching groups. His statistics are often quoted. Paradoxically these same instructors are the ones who never bare their souls and provide the information needed to compile "Stickybeak". Unfortunately with State and Federal legislation looming the instructional bodies fear that these statistics will only add to the case for regulation. Dr Walker would continue with his work. He would urgently need funding assistance to put existing data into a computer system for easy retrieval. Interestingly, during the survey a large international company indicated that they would consider with providing a computer for DAN.

HYPERBARIC FACILITIES IN AUSTRALIA

Australian Institute of Marine Sciences (AIMS)

Located in Townsville this facility bears the brunt of casualties from the North Queensland area. It is expected that with the increase of tourists there will be an increase in patients recompressed at this chamber. A great deal of the work at this facility is done by volunteers. That is not to indicate that specialised attention is not available to the patient. It would appear that the personnel of this facility are devoted and have a high morale even though the facility is said to need more staff and funds.

HMAS PENGUIN School of Underwater Medicine

Located in Sydney, casualties are transported from all over Australia and the Pacific Basin for treatment at this facility. With the new multichamber facility nearing completion it is expected that this facility will become even more prominent as a research and treatment facility. This facility obviously has no manning problems and is available to civilian casualties around the clock.

Hyperbaric Unit, Royal Prince Henry Hospital

Located in Sydney this multi-chamber facility is often used when the Navy's present small chamber is in use. This facility appears to have been under-used over the years. Recent rumours reported in State Newspapers and on city televisions that the State Government intends to close this entire hospital complex, including the recompression chamber, has caused some comment amongst Instructors. It would be expected that when the new complex opens at HMAS Penguin the chamber at Prince Henry will be rarely used.

The National Safety Council of Australia (Victorian Division)

This organisation is slick, efficient and well funded with helicopters equipped with Forward Looking Infra-Red Radar (FLIRR) and a transportable two-man chamber with support facilities including a modified aircraft and truck to transport the Duocom chamber.

Other Chambers

A smaller recompression facility exists in Victoria at Mallacoota operated by the Fishermen's Cooperative. As well, recompression chambers are available to civilians in South Australia, Tasmania and Western Australia (HMAS STIRLING).

INSTRUCTORS AND INSTRUCTIONAL AGENCIES*

PADI is believed to have the largest number of instructors in Australia although the numerical advantage is probably only slight. The PADI Instructors spoken to by and large were indifferent to the idea of a DAN in Australia. However none expressed negative views on such an organisation. The majority taught their students to consult the Navy in a diving emergency.

FAUI runs a close second to PADI in the numbers of Instructors and Students certified each year. It claims to be superior in teaching diving first aid and the fact that all students must be taught CPR techniques as part of basic training does indicate their feelings towards the safety aspect of diving. A competitive situation exists between FAUI and PADI (FAUI is home-grown) and a deep distrust of anything imported from the USA seems inbuilt in many of the FAUI Instructors when an Australian DAN was discussed with them.

NAUI is represented by a small group of instructors in Australia. Those instructors who commented on DAN in Australia, like their PADI counterparts had no hang-ups about an organisation with origins overseas but were also indifferent feeling that over the years the Navy had provided and would continue to provide an adequate service.

BASIC AND ADVANCED DIVERS

It would appear that a similar situation exists with divers as with those who are conscious of safety procedures and would purchase safety equipment such as the Bendeez Adaptor.

When the student finishes his basic certification he is highly aware of the need of safety procedures and he has had his appetite wetted with lectures on physiology and diving first aid. This awareness drops away with the passage of time and the apparent uneventfulness of his diving life. For those that continue with their education into the advanced category, the awareness level and need for education rises. So it is the opinion of the writer that with proper support and encouragement from instructors and a good marketing approach, a fair percentage of

* The writer has teaching status with both PADI and FAUI.

Australian divers would pay their annual subscription to DAN. The support from the instructors would be vital and would only be forthcoming if it could be demonstrated that DAN was serving a useful role in the diving community.

Finally it appears that with the recent advent of the DES service in Australia a DAN would have to augment this service in other ways, perhaps the dissemination of medical knowledge to divers and/or the acquiring of data (upgrade "Stickybeak") and the making of this data available to divers and instructors.

THE SPONGE DIVERS OF KALYMNOS

Bev Biggs and John Hayman

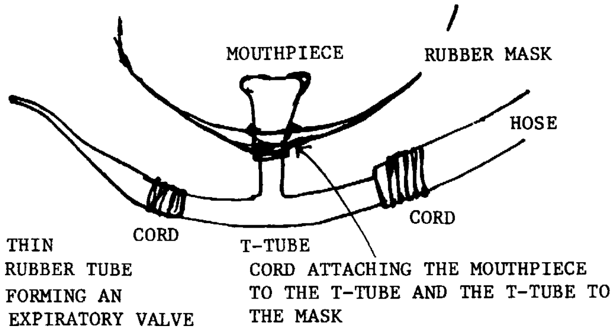
The Greek Island of Kalymnos is in the south east Aegean, 30 km from the Turkish coast. It is a precipitous and mostly barren island, with an area of only 11,000 sq km. Of the population of 14,000, 11,000 live in the port town of the same name. Since Phoenician times the Kalymnians have been seafarers, traders, fishermen and gatherers of sponges.

The history of sponge collection goes back thousands of years. Sponges have been used as padding for armour, contraceptive pessaries, and for more familiar purposes, such as domestic cleaning, since Roman times. Originally sponges could be hooked directly from a boat in the waters adjacent to the island, but they have become progressively more difficult to obtain. Today the sponge divers are at sea for months at a time, travelling to the coast of Libya where most of the sponges are gathered. The sponges are cleansed and processed in several small sponge factories on the island, and exported throughout the world. As well as sponges collected by the local fleet, considerable quantities of sponges are imported in a raw state from Cuba and the Caribbean, processed in the local factories, and exported with the local product.

It seems that sponge collection has always been a hazardous occupation. Diving outfits discarded by the French and British Navies have now been replaced by soft rubber masks and wet suits, but the diving facilities are still primitive. Divers use "hookah" type gear, with compressor and hose. The compressors are in the hold of the boat, driven by the boat's small diesel engine and mounted beside it, with no external air intake. The compression line leads to a reserve tank, which in turn has one or two diving hoses connected to it. These consist of 100 to 120 metres of what appears to be simply better quality garden hose. This hose connects to a mouth piece through a T tube, with a third arm of the T tube forming a primitive valve, sealed off with soft bicycle tubing (see Figure). No regulators are apparent and the apparatus functions with exhaled air and surplus air, if any, being blown off through the primitive valve closing the third limb of the T tube. The mouth-piece is fitted through the rubber of the face mask, with both this and the valve being tied in place with cord. Obvious hazards are carbon monoxide poisoning, if the air being compressed is contaminated by exhaust fumes, and carbon dioxide retention if the diver is forced to inhale previously expired air when insufficient compressed air reaches him.

Two divers working from one compressor, with only a small shared reserve supply, would mean that any "buddy" system would be of very limited value. Using this type of equipment, divers work in depths of 20 to 40 metres, 4 to 6 hours a day, diving every day. The better, more valuable sponges are found at greater depths, so there is a financial incentive for divers to dive deeper and stay down longer.

DIAGRAM OF SPONGE DIVERS' BREATHING APPARATUS



There are several diving fleets operating from the island, each boat carries 2 or 3 divers with up to 50 divers in a fleet. The boats generally leave in April or May each year and return in August or September, at the end of the season, although some boats may come back earlier to unload their collections and then return to the sponge beds. Each year there are one or two diving fatalities, and a much larger number of divers suffer neurological damage from decompression sickness.

There are some 16 doctors practicing on the island, which has a small hospital equipped with a recompression chamber. These facilities, however, are not of much value to divers working sponge beds off the Libyan coast. However, conditions are improving for divers and many divers are now given training in Marseilles. A team from the Massachusetts Institute of Technology visits the island annually and surveys the divers, but there is no record of post-mortem examination after any of these fatal accidents.

A large proportion of the island's residential adult male population suffers effects from "the bends" and has been forced to retire from diving. Most of the workers in the sponge factories are retired divers with varying degrees of disability. We stayed on the tiny adjoining island of Telentos, and here almost all the adult males seem to have neurological problems.

Kalymnos may be reached by twice weekly ferries from the neighbouring island of Kos, which has an international airport and a regular air service to Athens. There are frequent ferries to and from Rhodes, Leros, Samos, Patmos and Piraeus. Motor cycles are freely available on the island and a small boat runs continuously between the township of Massouri on the west coast and Telentos. Our host on Telentos has his taverna and serviced rooms on the waterfront, just north of this boat-landing. An "I love Australia" sticker should be on the wall behind the bar.

The remains of an Italian ship sunk by the British in World War II can be seen with mask and snorkel in the little harbour of Vathis on the east coast. Scuba gear is not available for hire on the island and the use of a boat with hookah apparatus is not recommended. Rhodes is the only island among those mentioned where Scuba gear is available.

Telentos is separated from the main island by a narrow channel, no more than one kilometre wide. The small township lies along the beach with a single huge granite mountain rising behind. Ruins of previous settlements can be found on the lower slopes and the remains of a sunken city can still be found beneath the waters of the channel. Our host on the island, Nikalaos Ellhaus, was a retired diver in his forties with severe spastic paraparesis as the result of a diving accident when he was seventeen. As well as this neurological disability he had arthritic deformity in both knees. Despite these problems he was in good spirits and a very convivial host. Like almost everyone we met in Kalymnos, he had numerous relatives in Australia, mostly in Darwin, and was pleased to meet Australians. His small taverna on the waterfront in Telentos is a place where Greek food and Greek hospitality may be enjoyed.

Kalymnos is an island where the morbidity associated with diving can be seen and studied. Scuba diving facilities are not available, and are generally hard to find on the Greek Islands. However the water is clear and usually calm and there are many rocky coves and inlets where much can be seen with use of a mask and snorkel.

FURTHER READING:

Grosvenor MB, Parkes W and Grosvenor ES. The Islands of Greece. National *Geographic*. 1972; 142(2): 147-193.

BOOK REVIEW

MARINE ANIMAL INJURIES TO MAN
Dr Carl Edmonds
Wednell Publishing
54 Shutt Street
Melbourne
Price: $11.95 (paperback)

This book is the sequel to "Dangerous Marine Animals of the Indo-Pacific Region" and presents a wealth of information in an interesting and eminently readable form. It has everything one can imagine needing to know about the multitude of creatures who have good reason to regard us as intruders in their living space, and who we contact at our disadvantage. The subjects start with those which can eat us (in whole or in part), progressing through those who lap us in various ways until we reach those whose Pathian shot hits after we have eaten them. The illustrations are excellent, even though some of the subjects are far from photogenic, and add greatly to the temptation to read on and on beyond the item of initial interest. In many instances a photograph is much to be preferred to too intimate a contact with the subject, as the author notes in relation to the dental structure of barracuda after showing the fish at a respectful distance.

Detailed advice is given on both the immediate first-aid and the definitive management, as would be expected in a book intended as far more than a library companion. The reader is reminded that it is rare for the animal concerned to be seeking out the diver or swimmer or person wading, though this nice ethical point is of little interest to the victim at the time. Scattered through the text are a number of aphorisms, including the possibly tongue-in-cheek advice to "Handle Old Wives with care". There is only one statement which this reviewer believes few will entirely follow, for the author suggests that the book "should accompany the patient and be given to the medical practitioner who is responsible for management." Shown ... Yes, loaned ... just possibly, but given ... that stretches generosity too far. But perhaps it could be regarded as a gift from a grateful patient, who would then promptly buy a new copy for himself (or herself).

"THERE'S NAUGHT SO QUEER AS FOLK"

Anon

A case report from the
Project Stickybeak Non-Fatal Incidents File

It was over the Christmas holidays when I took a man and his wife on my diving boat to an island from which they, and others, intended to dive. He impressed me as being an alert and healthy man about 40 years old, a smart and successful businessman. While the other divers made their first scuba dives of the trip he was observed spearfishing and seemed to be very efficient in the water. Following lunch we intended to dive again and after he described past diving in another state I agreed to give him the loan of my equipment. Before he swam off with the other three divers I checked him out. I remained on the boat.

The plan was for the four of them to surface swim the 40 m to the chosen dive area, but after swimming a little less than half way he became separated from the other three. I saw him lift his head from the water, take his mask off and start struggling, then heard him calling for help. He was about 40 m from me and by the time I'd put on my fins and swam to his position he was 10 ft underwater and going down. He had neither inflated his (Fenzy) vest nor dropped his weight belt, though he had removed his scuba tank and had it over one arm. I inflated his vest and got him to the surface, where he fortunately started to breath again. I towed him to the tailboard of the boat, where he coughed and spluttered for some time before recovering fully.

Discussion afterwards revealed some remarkable and somewhat unexpected additional facts. First, the other divers admitted that they had indeed heard the cries for help. They could not explain their failure to respond. All three were experienced and had no reason to fear for their personal safety had they responded. A possible suggestion is that they did not expect or believe in the possibility of a serious misadventure occurring in such good circumstances (there was only a slight slop) so they never really "registered" the significance of the calls for help. Second, discussion with the victim revealed that his scuba diving experience had been 20 years previously. He had also omitted to reveal that in the past three years he had become a chronic asthmatic, a fact he endeavoured to conceal from everyone whenever possible. His surface problem apparently resulted from this cause. Incidentally, his wife had observed everything which had occurred and even so remained reluctant to reveal this important fact.

Now I have learned to not only ask about the dates of the diving experience of those who seek to borrow my equipment, I ask about their health most carefully!

RETINAL ISCHAEMIA DUE TO HYPERBARIC OXYGEN

Karin Herbstein and John Murchland

There has been a recent resurgence of interest in the use of oxygen at increased partial pressures, both by divers and for medical conditions, including the treatment of Multiple Sclerosis by medical and non-medical persons.

It has been assumed that the conventional pressures and times at which divers or patients breathe 100% oxygen are safe.

For 100% oxygen the maximum recommended safe pressure (to avoid CNS oxygen toxicity) according to Edmonds, Lowry and Pennefather, and other authorities, is 10 metres or 203 kPa (2 atm) absolute pressure.[1,2] The time element is of course also relevant.

Complications have been reported but mainly when breathing hyperbaric oxygen beyond recommended safety limits.

However as demonstrated in this case report, and more extensively described in another recent article,[3] a healthy diver developed retinal ischaemia at a “safe” level of hyperbaric oxygen. Review of the literature suggests that this complication could proceed to a more permanent loss of vision.

As there is the notorious variability of susceptibility to nitrogen narcosis and decompression sickness, not only between different divers but for the same person on different occasions, similarly there is great variability to the vaso-constrictive influence of hyperbaric oxygen.2 Also the young[4] and the healthy with no vascular disease[5] and migraine sufferers[6] are more susceptible to vaso-constriction.

Case Report

The patient was a fit healthy man aged 44, a Scuba-diver, who had accompanied multiple sclerosis patients during their one hour treatment at 2ATA in a chamber. He did this on ten consecutive days, on two occasions using a spare oxygen mask and so became exposed to 2 ATA oxygen for two one hour periods. Several days later he became aware of a visual defect in his left eye. This was found to be due to a retinal “cotton-wool spot”, whose position in the eye was consistent with the field defect that was plotted.

Discussion

A "cotton-wool spot” is an ischaemic area in the retina. The greater the partial pressure of oxygen inhaled the greater the vasoconstriction. The retinal vasculature is the most sensitive to the vasoconstrictive influence of hyperbaric oxygen.[5] Paradoxically therefore, hyperbaric oxygen, instead of causing increased tissue oxygenation, may cause ischaemia due to vasoconstriction. Ischaemia, a temporary state due to hypoxia due to decreased blood flow, may progress to infarction, or death of the tissue, if sufficiently severe or prolonged vasoconstriction occurs. Blindness has been reported from vaso-constriction due to migraine.[6] Bilateral blindness has also been reported after prolonged inhalation of 80% oxygen at normal atmosphere pressure due to a central retinal artery occlusion.[8]

Oxygen toxicity, both from pulmonary and CNS effects, is well documented. It is for this reason that rebreather units using 100% oxygen are not advised for use below 25-30 feet of seawater, the dangers being increased by adverse factors such as cold, fatigue, raised CO_2 tension, or anxiety. Pulmonary considerations limit the therapeutic use of oxygen, though the inclusion of "air breaks” is believed to reduce the risks. For chamber therapeutic use 3 ATA is the usual maximum, while in-water use at 1.8 ATA (9m) is allowed. The growing availability of apparatus allowing 100% oxygen at 1 ATA (on land or in a boat) as an initial management option may not be totally devoid of risk, apart from the possibility of fire or explosion. There has been an increase in use of 100% oxygen at 2 ATM, for medical and non-medical treatment, with no reported complications at these concentrations and pressures.

We emphasise, as illustrated by this case, that due to the exquisite sensitivity of retinal vessels to the vaso-constrictive influence of hyperbaric oxygen and due to the possibility of a paradoxical situation of ischaemia secondary to this vasoconstriction, there is a need for caution and awareness of the possible ocular complications of high oxygen concentrations especially at increased atmospheric pressures, even within the recommended “safety” limits, and especially in the young and healthy and in migraine sufferers.

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EDITOR'S NOTE

The authors made a MEDLARS search of the literature before writing their paper and were unable to discover any medically reported cases (as contrasted with medico-legal cases, where a judge decides) of blindness following hyperbaric oxygen therapy. Any readers who know of cases of blindness following short term hyperbaric oxygen therapy in adults are asked to communicate with the authors.

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AN UNRECOGNISED BEND

A case report and comments based on the records of the New Zealand Underwater Association

Douglas Walker

The victim was a 38 year old male who had spent several days diving to 20-30 feet, undertaking 2-3 dives a day, on the East coast of the North Island. On the morning in question he had dived at 30 feet for about 90 minutes. He then surfaced and went by boat to a spot where he had been told the depth was 70 feet. He dived to a depth he felt was in excess of 100 feet for about 10 minutes but he had neither watch nor depth gauge. He then made a rapid ascent to 15 feet where he spent a few minutes before surfacing.

Later that day he drove to an inland town which was at an altitude of 1200 feet. On arrival he noticed some numbness and tingling in his feet and felt cold. The next day he returned to the coast and had a shallow dive, to 20 feet. However his symptoms persisted, so he consulted a local doctor. The doctor told him he had "A touch of the benz" and should come back if he felt dizzy.

He then returned home, where he sought the advice of another doctor. This practitioner told him he had "a bit of a bend" and he was reassured that he would get better. He then advised the victim to go for a deep dive in the nearby Lake Taupo, to go to 100 feet and come up in stages. Six days after the initial onset of symptoms the victim carried out a decompression dive, using a marked line, in fresh water to 100 feet. There was no improvement in his condition.

Several days later his employer, himself a diver, contacted the medical team on duty at the Devonport Naval Base. Their opinion was that it was unlikely to be decompression sickness (DCS) and that recompression would be of no value to him at this late stage even had the problem been DCS. He again consulted his own doctor and fourteen days after the onset of his symptoms he was referred to a Base Hospital for investigation. Subsequent neurological investigations were stated to reveal that he was suffering from a condition which is not related to diving and that his problems were not therefore caused by decompression sickness.

COMMENT

This report is submitted for several reasons, the most important being to remind divers of the critical importance of safe diving procedures. Such includes an intelligent awareness of the diving related problems which can occur, married to a (cynical?) awareness that THEY (the divers) may have to both make and defend any diving medicine diagnosis. The following Critical Points in the story are identified as a basis for consideration:-

1. The diver was careless in having neither watch nor depth gauge and nevertheless diving in an unknown-depth area. There is nowhere any mention of a buddy and the probability arises of this being an "experienced" but "can do" type of diver. A rapid ascent increases the risk of DCS.

2. The onset of symptoms after arriving at altitude was significant.

3. The doctor told him he had "benz". It was HIS (the diver's) responsibility to get informed advice as the symptoms indicated the possibility of spinal DCS. As every diver knows, recompression is the specific therapy. Like most divers he did not apply this information to himself.

4. The second doctor told him his symptoms would get better and that he should treat himself by a "therapeutic" dive to 100 feet in the lake. The diver should have been aware, even if the doctor was not, that such attempts at treatment almost invariably worsen the problem. He should at this stage have been completely aware of the need to contact Devonport Naval Base and done so on his own initiative. He does not seem to have discussed his troubles with any other divers.

5. His employer was the first to take the correct course of action. It is not known what tale the victim presented to the Naval Base over the phone but many diving doctors would advise a trial of recompression even at such a late stage for a possible spinal bend.

6. Neurological investigations would reveal the results of spinal cord damage, not the actual cause. With respect to the neurologist, unless he was aware of diving-related CNS problems his opinion on such matters would be secondary to the history-supported probability of DCS.

DEATH OF A DIVER

A case history

Douglas Walker

He was a trained, experienced and very safety conscious diver aged 20 and had been passed as "Medically Fit to Dive" nine months previously. His only known deviation from perfect health has been occasional chest, or epigastric pains over the past 18 months and these had usually responded to taking food. He was a highly respected and well-liked member of the diving club with which he was now visiting a famous sink-hole and had a Category 2 special diving qualification for such diving. The dive was carefully planned and was to show some friends the wonders of diving in such calm clear waters.

The dive profile, which was carefully followed, called for a maximum depth of 120 feet with ascent starting after 25 minutes. The dive was without incident and the ascent to the decompression stop occupied 3 minutes. Because the water was cold the stop was increased from 6 to 10 minutes at 10 feet. He mentioned after surfacing that he had suffered some mild soreness of his ears but this did not recur when, a short time later, he made a short (8 minutes), shallow dive (10 feet) in a small cave nearby.

This dive was followed by a club picnic lunch, though he personally took little or nothing to eat for himself and had apparently taken little food over the previous 24 hours. He did not seem to be unduly fatigued. There was to be another dive in the afternoon and he decided to take advantage of the fact that one of the morning party was not to dive again to borrow that diver's back-pack buoyancy vest in order to decide whether to change to such a type himself. While putting it on he mentioned that it felt tight across his chest and that he could not make himself completely comfortable in it. The dive was planned to be maximum depth of 140 feet with bottom time of 13 minutes which they considered to be a very safe dive (SI 5 hours 10 minutes, Residual Nitrogen 7 minutes). They descended to the planned depth and swam slowly to conserve their energy but the 15° chill was still felt severely. The decompression stop at 10 feet was increased from the Table requirement of 6 minutes to an actual 13 minutes because of this cold factor. Although he was still apparently feeling some tightness in his chest, his buddy did not observe anything amiss with his behaviour during the dive.

While resting at the surface after the dive, discussing what they had seen, he coughed a little and said something like "That was blood", a circumstance which his buddies thought strange after an uneventful dive but assumed to be the result of a mild sinus barotrauma. After leaving the water, as he was taking off his wet suit, he complained of chest pains. These quickly became severe and his friends decided to rush to the nearest hospital, though they did not understand how he could have contracted decompression sickness from such carefully calculated and executed dives. During the car ride he could barely remain seated because of the agonising nature of the pain he was experiencing in the centre of his chest at the level of the xiphisternum. He was a bit breathless, found exhalation difficult, and found it difficult to sit and almost impossible to lie down. A nurse friend examined him prior to his being taken to the hospital and saw that there was no joint pains, no shoulder tip pains, no symptoms of cerebral or visual nature or apparent asymmetry of his chest or altered power or sensation in his limbs. The abdomen was normal. There was some cyanosis observed and the pulse was rapid, though regular.

It was while he was at the hospital that he reported the previous episodes of (lesser severity) similar pains, one episode having been particularly severe and incapacitating. The pains had not been associated with diving. He ascribed such episodes to indigestion and suggested, hopefully, that the present pain was due to a muscle strain, but nobody accepted this latter suggestion as likely to be true.

At the instigation of some medical friends in the diving party he was given some oxygen, but he soon discarded this as it gave no relief. He found it difficult to lie flat to allow the medical examination. No clinical findings were seemingly noted as being significant and he was given some pain tablets and advised to go home (to the camp site the club was using) to rest. As he left the hospital he experienced a severe spasm of pain so his friends returned him to the hospital and made plain their belief that admission was mandatory. He was kept for observation, and finally, was admitted, and had X-rays taken but no abnormality was noted. He was given more pain tablets and an injection and admitted for observation. At 2300 hours, 4 hours after his first attendance at the hospital, he began to complain of nausea and asked the nurse to bring a bowl. When she returned she found that he had suffered a cardiac arrest. This failed to respond to medical attention.

At the autopsy a dissecting aneurism of the aorta, with a left haemothorax was found. There was no history of previous trauma or any known family predisposition of such a condition to explain its occurrence in such a young, active and apparently fit person. In retrospect the episodes of the "indigestion" were almost certainly symptoms of the dissecting process.

This report is presented to draw attention to the fact that divers may suffer from any of the medical or surgical conditions to which any person is liable, even to extremely rare conditions. The dive history here was so well documented and vouched for by a number of reliable witnesses, and the story of pain so definite, that the existence of a non-diving emergency should have been considered. It is not known why it was not. Possibly there was a diagnostic programme fault in that the absence of a clear "diving-medicine" diagnosis in a diver (eg. pulmonary barotrauma or air embolism) led to the erroneous conclusion that there was therefore "Nil Disease". This pitfall is not usually given critical awareness. It is probable that even had the correct "spot diagnosis" been made the outcome would have been exactly the same.

Doctors should remember that a diver without a clear diving-related cause for his illness may have a non-diving problem requiring attention, and needs the appropriate therapy. This could save lives.

SPUMS SCIENTIFIC MEETING 1984

HYPERBARIC FACILITIES IN VICTORIA

John Knight

The SPUMS scientific meeting in 1983 was introduced to the National Safety Council of Australia (Victorian Division) venture into hyperbaric facilities. The unit has now treated three people suffering from decompression sickness as well as featuring on ABC TV when Bob Cumberland and Paul Butler, who were with us in Fiji, rescued a "bent" diver from Piccaninny Ponds, called the NSCA and had him picked up from Mt Gambier, pressurised in a Dräger Duocom, and taken to Morwell where he was decanted, still under pressure into the large chamber where Dr Geoff Macfarlane "treated" him with excellent results.

Paul Butler told us about the neonate. I want to tell you about the infant and its older relatives.

The simplest way to catalogue the available chambers is to start in the North-East of the State and come south and west to Melbourne and then east again to Morwell. Following the Princes Highway south we first come to the turn-off for Mallacoota where the Abalone Fishermen's Co-op has a small two compartment chamber which has been used to treat many cases of decompression sickness. Recently one man was flown to Morwell for treatment in the NSCA facility.

Then in Bass Strait there are the chambers on the oil rigs and drilling and construction barges and ships. These are purely for the divers employed on the job. That is not quite true as early in 1982 a scuba diver, who had been to more than 200 feet on air, spent a week in the chamber on a barge. This case has been reported in the SPUMS Journal (April-June 1983, 13(2): 38-39).

The only multiman chamber in Melbourne is the Melbourne Metropolitan Board of Works (MMBW) chamber at Braeside which was installed to care for men working in compressed air digging sewerage tunnels. It is a large two compartment chamber with a limited depth capacity. It is operational when there is work going on in compressed air. At other times it is on a care and maintenance basis but can be activated at short notice. It is not available to other than MMBW employees except by express permission of the Secretary of the board

The other chamber in Melbourne is the one man Vickers oxygen chamber at Prince Henry's Hospital. This is mostly used for gas gangrene and other cases needing hyperbaric oxygen, but occasionally cases of decompression sickness are treated there. The present policy is to limit treatment at Prince Henry's to pain only bends and send the neurological bends to Morwell to the NSCA Multiman chamber.

The NSCA (Victorian Division) has two Dräger Duocoms and a two compartment multiman chamber (4m x 1.8m), which is mounted on a semi-trailer giving it complete mobility, with its own generator, compressors and air banks (Figure l). The chamber has an entrance lock and a medical lock. It started life as the property of a firm of diving contractors which went bankrupt. It was built with no regard for noise pollution, the inlet pipes just opened into the interior and blowing down was deafening. Even with the dispersers fitted now it is very noisy. It is rated to 50m (6 ATA).

The trailer carries a 10 KVA diesel generator for use when situated away from a mains supply. 50 m of electricity supply cable connects to the mains when this is possible. The compressor is an Ingersol Rand of 98 cfm capacity at 150 psi (10.2 atmospheres gauge) with appropriate filters. The banks of high pressure cylinders are G size. There are 30 cylinders (192,000L) of air, 10 (76,000L) of medical oxygen and 15 (106,500L) of heliox (80:20). The compressor is the normal source of pressure with the air cylinders as back up in case of failure.

The built in breathing system (BIBS) has two outlets equipped with Scott Aviation masks with overboard dump. An oxygen monitor is used to check that the overboard dumps work properly. There is a hull penetration for ECG recording. The main compartment is 2.7 m long, which gives plenty of space for two cot cases, one on each bunk.

Those in the chamber are constantly on show as two video cameras peer into two of the portholes. There is no lighting in the chamber and lights shine in through two portholes. Voice communications are by two helium unscramblers (Aqua Air Helium Voice Processor).

The control panel is in the crew room of the semitrailer. Beside it is the television monitor, and the communication with the chamber. Also available are radio communications with the NSCA base at Morwell and a telephone which can be plugged in up to 50 m away. In the event of the trailer being outside a hospital this could be plugged into the hospital telephone system giving the treatment team access to the hospital switchboard and all extensions. The creature comforts of the crew have not been forgotten. A table with a well padded bench, fridge, electric urn, and a microwave oven allow for a proper Australian diet of pie and tomato sauce washed down with tea. There is even a sink to wash the dishes in.

The chamber has been mounted under cover with side screens to keep off the sun and wind. The chamber shell has been covered with insulation (a layer of foam covered by a reflective layer). Chambers heat up during compression and cool with decompression. In hot climates, and Victoria is hot occasionally, the metal heats up considerably unless adequately shaded and cooled. The chamber at Nauru, which is just below the equator, was inside a building and so out of the sun. Even so those inside sweated heavily all through the treatment and in spite of unlimited fluids lost up to 4 kg in weight. Such dehydration must alter haemodynamics, as must the skin vasodilation which accompanies a hot environment, and not necessarily in ways that increase the elimination of an inert gas load. Conversely in cold, wet and windy conditions an unprotected chamber can get very cold indeed.

Climate control in the chamber is achieved by "blowing through", changing the atmosphere by venting and filling

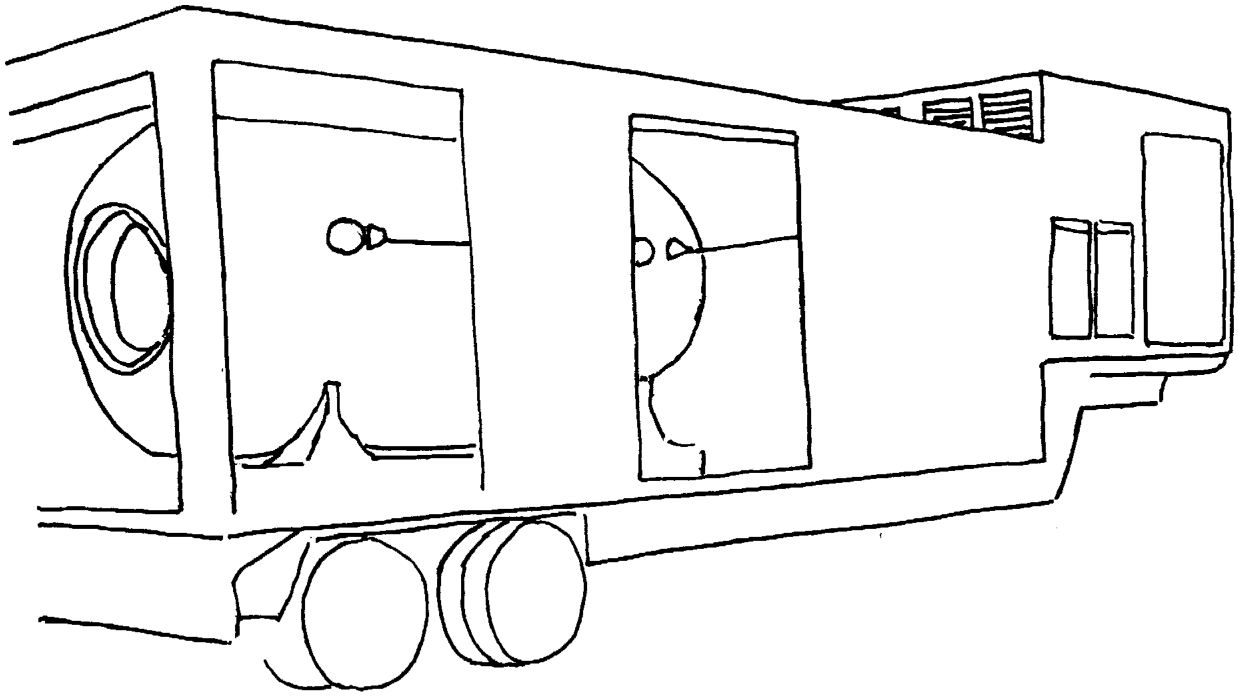

FIGURE 1

DIAGRAM OF NSCA MOBILE CHAMBER

The entrance is to the left. The left hand porthole looks into the entry lock. The compartment to the right of the chamber is the control room. The compressor and high pressure gas cylinders are in the compartment over the trailer's turntable.

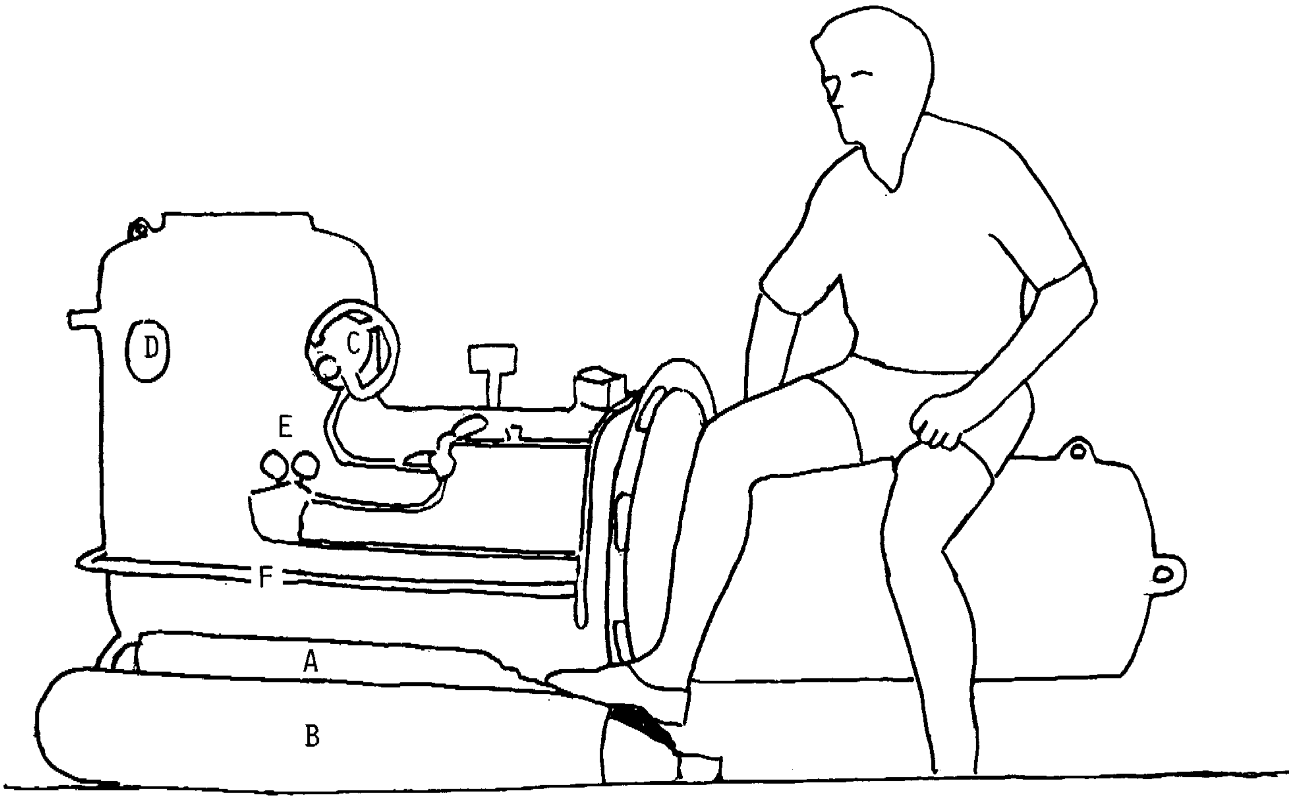

FIGURE 2

DRÄGER DUOCOM

The drawing gives an idea of the size of this portable chamber. The man is 1.8 m tall. A. Cylinder mounted on the chamber. B. E size spare cylinder. C. Medical Lock. D. Porthole. E. Gauges. F. Lifting rail.

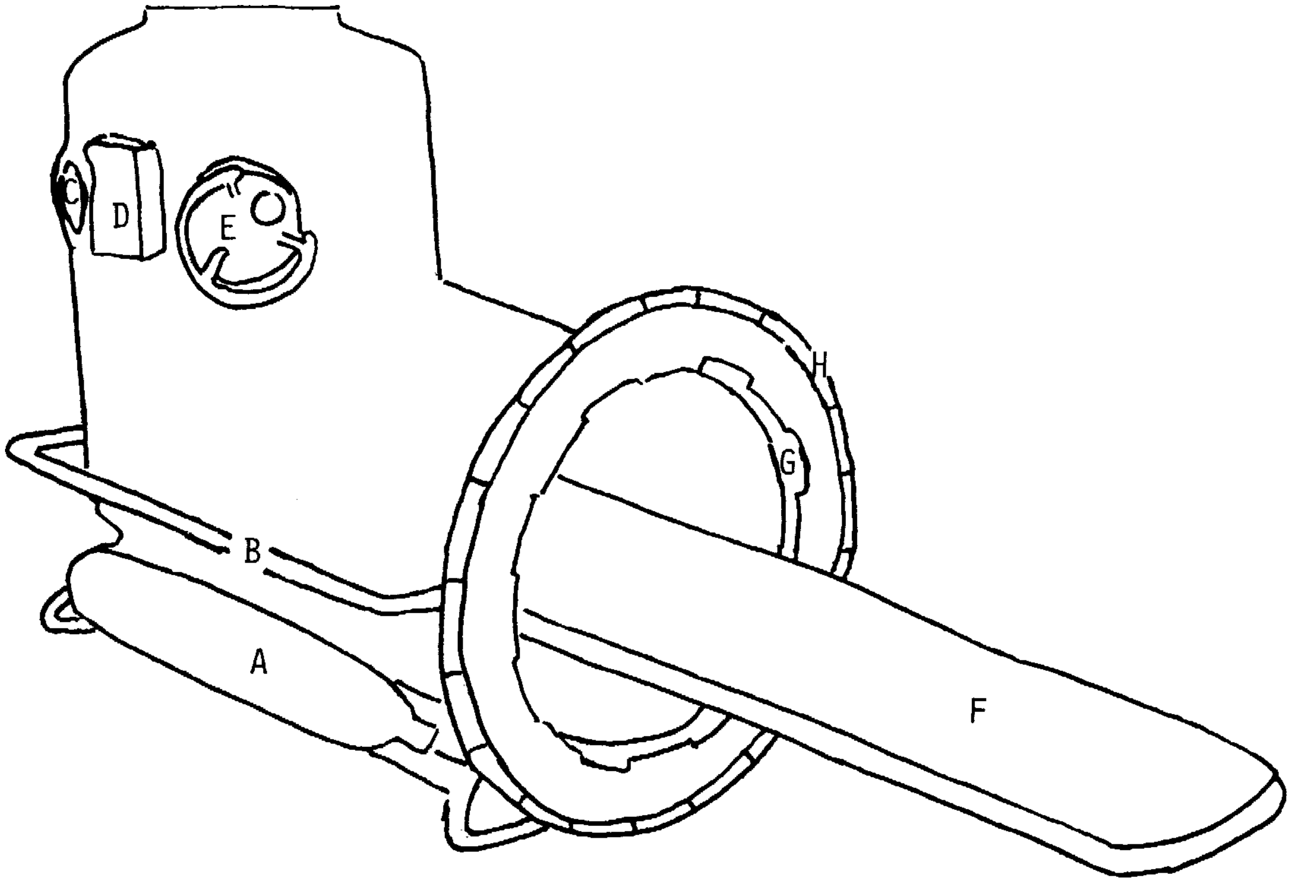

FIGURE 3

DRÄGER DUOCOM OPEN

A. Cylinder mounted on the chamber. B. Lifting rail. C. Porthole. D. Communications. E. Medical lock. F. Stretcher. G. Bayonet lock for the other half of the chamber. H. Bayonet lock for a larger chamber.

at the same time and at the same rate, without altering the pressure. Using air as the compressing gas saturation, if needed to treat refractory spinal problems, is possible (if a little smelly).

The hatch to the outer lock has been modified to accept the Dräger Duocom portable 2 man chamber. By partly rotating the Duocom the bayonet fitting engages forming an air tight seal allowing the victim to be transferred under pressure from the small to the large chamber.

The Duocom is a boot-shaped chamber (Figure 2). It comes apart at the "tarso-metatarsal joint" as it were (Figure 3). Once apart the attendant gets in and sits with his head and body up the "ankle" and his feet out straight. The patient, on a stretcher is slid in, on rails fixed above the attendant's legs, so that his head is in the attendant's lap. The "forefoot" is lifted over the end of the stretcher and rotated to lock. The chamber can then be pressurised. It is fitted with 2 BIBS for oxygen, although usually only the patient breathes oxygen. The Duocom has its own air and oxygen cylinders attached to it and larger cylinders can also be connected. The chamber can be manhandled into larger helicopters (such as the Bell 212) and light aircraft (such as the Beechcraft King Air) and flown to Morwell where the patient is transferred, still under pressure, to the large chamber.

This system of retrieval and transfer has been in use in Switzerland, using Duocoms and helicopters, for some years. I believe that it is also well suited to Australian conditions. The helicopters have a range of 400 km at 100 knots while the King Air has a range of 1920 km at 250 knots.

It is hoped to obtain an extra chamber to add to the hyperbaric complex at the Underwater Training Centre, also at Morwell and also run by the NSCA, so that the Duocom can be locked on to the deep (200m) chamber. This chamber was made by Comex and has Comex's small hatches, which will not accept the Duocom. When the extra chamber is added to the deep system the NSCA (Victorian Division) will have the only system, available to civilians in Australia, that enables the patient to be taken deeper than 50 m in stand-up comfort.

Since this paper was presented more patients have been treated in the NSCA chambers, including one who required saturation therapy. The extra chamber mentioned in the last paragraph has been added to the complex.

BONE SCINTIGRAPHY

Peter Valk

Bone scintigraphy is actually better known as bone scanning. It occurred to me that it might be an interesting topic to discuss at a SPUMS meeting. I discovered, with quite some surprise, last year that Australian professional divers are required by regulation to have annual X-rays of their long bones. Annual seems a bit frequent. If you are going to look for bone necrosis X-rays are not ideal. Those of us who have been working with general medical and surgical patients in hospital know that when looking for bone necrosis in other conditions scintigraphy is much more sensitive and picks up lesions much earlier than X-rays.

Bone scintigraphy is basically the injection of a radioactive substance, a radiopharmaceutical, intravenously and then, at various times after the injection, a gamma camera is used to collect data which gives a two dimensional display of radioactivity. In the case of bone scintigraphy this is a picture of the skeleton. The radiopharmaceutical now used for bone imaging is one form or another of a Technetium 99 m phosphate complex and various phosphates have been used. When these compounds are circulating through bone they are absorbed through the bone surface, particularly if it is recently mineralised or mineralising bone, and to a lesser extent there is actual binding of the phosphate to calcium in hydroxyapatite. That is the mechanism by which the radiopharmaceuticals stick to the bone. What determines how much is going to end up in a particular area of bone is the functional status of that bone.

That is one thing that makes scintigraphy significantly different from radiography. Radiography looks at shadows cast by different amounts of calcium that happen to be present. What can be seen with scintigraphy is two things. One is the blood flow to the bone, because obviously a piece of bone cannot take any up unless the radiopharmaceutical gets there via the blood stream. Secondly, the level of osteoblastic activity. This will determine what fraction of the radioactivity that goes through the bone will be fixed and what fraction will move on. Obviously a decrease in either of these factors can lead to decreased and finally absent up-take. As far as any increase is concerned, the most important factor is bone blood flow because this can be increased up to 20 or 30 times, whereas with normal bone extraction efficiency is about 50%. So there will only be a 2 to 1 increase in uptake by an increase in osteoblastic activity.

Having discussed how this tracer binds to bone, let us look at what happens in a case of avascular necrosis. First the blood supply to the marrow in the bone is cut off, and instantly there is an absence of up-take of tracer in that part of the bone. Within 24 hours the marrow dies and then gradually over a couple of weeks the osteoblasts of the bone die. At any time during this period bone scintigraphy shows a cold area where the infarct is located. Subsequently, to varying degrees, there is revascularisation of the marrow from adjacent areas, there is reabsorption of dead bone and there is a laying down of new bone. At this stage as the perfusion increases and osteoblastic activity increases the uptake within the pathological area becomes greater than in normal bone. It becomes a hot spot. Then subsequently as the acute bone formation reduces, one may end up with bone that scintigraphically looks perfectly normal. In the end there is an area of dead bone and marrow surrounded by a fibrous capsule and outside this capsule there will also be calcification of the dead marrow. It is this calcification that produces the appearance seen on X-rays. However it takes months for the X-ray changes to develop.

What do these changes mean? In the shafts of the long bones, the osteonecrotic lesions probably mean very little because they seem to have no functional importance. It is very different with the juxta-articular lesions, which are mainly in the heads of the humerus and femur as these lead to joint damage. Gradually patches of dead bone develop under the joint surface. Dead bone is not as strong as living bone so the joint surface is inadequately supported leading to break up of the joint surface and eventually loss of joint function. Juxta-articular lesions have some importance, clinically speaking.

There are two ways of looking at the uptake of radio isotopes. Studies soon after injection reflect the rate of bone blood flow, or one can do late pictures, two or three hours after the injection which is what I usually deal with clinically.

At this point Dr Valk showed numerous slides of bone scans in patients with various forms of osteonecrosis. Common causes include fractured neck of femur, steroid therapy, chronic renal failure. A rare case he presented was the bone scan of a black patient after an acute crisis of sickle cell disease. These patients, after an acute crisis, have extensive revascularisation throughout the skeleton.

The most sensitive way of picking up bone necrosis is by bone scintigraphy. Why one wants to pick up bone necrosis is another question, but if one wants to spot osteonecrosis then this is the test one ought to be doing.

A CASE OF CEREBRAL GAS EMBOLISM

Chris Acott

This is the story of a 31 year old diver who had been diving for six months. He was NAUI qualified, holding a C card. He had had no medical examination before learning to dive, however when I examined him there was nothing of note in his past medical history.

He and his buddy went diving on a Sunday. Their first dive was to 30 feet for about 40 minutes. This depth was verified by his buddy, but he was equally uncertain about the time. However I know the area involved and the maximum depth could only have been 30 feet. The surface interval was not accurately timed, but it was probably about 40 minutes. They then went diving again. The patient only had about 700 psi in his tank. So it is not surprising that he ran out of air about 20 minutes later. He made a free ascent from 25-30 feet, breaking the surface about 5 seconds after lift off. The patient admits that everything that occurred after that is uncertain. His buddy told me that there was enough air in his tank to inflate his ABLJ (adjustable buoyancy life jacket or buoyancy compensator). They then swam back to the boat. When they were on shore they bad a few beers. His buddy remarked that there did not appear to be anything wrong with the patient at that time.

The patient, although confused, could remember a right sided headache occurring later that night which slowly got worse over the next few days. As this happened he began to get more confused, according to his wife, until finally on the Wednesday he was totally confused. He was unable to maintain his balance effectively, had slurred speech and had been engaging in repetitive behaviour. He was taken to the Yeppoon Hospital, where he was kept in overnight and given 100% oxygen to breathe. They rang me next day about him, and he was transferred to the Rockhampton Base Hospital that day.

When I saw him he was conscious, slightly confused and very unsteady on his feet. Examination revealed some slight barotrauma of both tympanic membranes. He admitted to some difficulty with clearing his ears on descent on the first dive. He was totally unco-ordinated, unable to perform the finger to nose test, as well as the knee to toe test. When asked to perform the Romberg test, he fell over immediately. I thought that there was some decreased power in his left arm. His fundi were normal. His visual fields, to my crude testing, appeared normal. Nothing else was noted in his clinical examination.

I telephoned the Townsville General Hospital to alert the Australian Institute of Marine Science (AIMS) chamber and I also spoke to Dr Des Gorman at HMAS PENGUIN. The patient was sent to Townsville in our pressurized twin engine Queensland Air Ambulance aeroplane. He was given IV frusemide, IV dexamethazone, IV methyl prednisolone, and of course oxygen.

When he reached the chamber he was recompressed on Table 62. It was noted that the patient suddenly became lucid and admitted that for the first time since the dive he could think clearly and remember events clearly. He deteriorated later that day and had two further treatments in the chamber with only minor improvement.

POST SCRIPT

The patient intends setting up a diving business on Great Keppel Island taking tourists for a quick dive!

PRESS RELEASE

CMAS RECOGNITION OF SCHOOLS

(Printed as received)

There has recently been the most important development in the history of sport diving.

The World Underwater Federation (CMAS) has established a procedure which allows diving centres (schools) to teach its international standards directly. In the past, this has not been possible as schools have first been required to teach their national standard and then equate it internationally.

The importance of this direct link between schools and the World Underwater Federation cannot be overstressed. Diving is an international activity enjoyed by people from all countries and all walks of life.

In order to participate and experience the wide variety of different and exciting environments which are available, divers must travel between countries and mix with divers of other nationalities. Misunderstanding of qualifications which might lead to an inexperienced diver being exposed to water conditions which exceeded the limits of his competence, are a perpetual hazard.

Equally, while fascinating and enjoyable, diving nevertheless takes place in an unusual environment and adequate safety standards are vital as with any similar activity. The alignment of procedures, which this new scheme, will therefore contribute effectively and unobtrusively to the ease with which divers may pursue their activities.

In order to obtain the World Federation's authority to teach the international standards, schools must undertake to teach only the CMAS standards, and to provide adequate instructional staff and facilities, and of course pay an appropriate levy.

Customers-divers can therefore be certain of obtaining reliable and safe training as well as having a good deal of fun in an international centre. They will also be able to walk away from their holiday-course as they qualify with a certificate which is recognised all over the world.

Schools have an opportunity to feed their knowledge back into the appropriate committee of the World Federation (OCC commission) and the benefit of their huge experience will therefore not be lost but used to update and improve standards of safety and enjoyment.

KAI ESTRUP
President
OCC COMMISSION.

EDITOR

Publication of this CMAS Press Release does not in any way imply support for the proposal to by-pass the development and developing organisations involved in training and assisting Sport Divers.

There is difficulty at the present time in enforcing standards and it would be naive to believe that CMAS could exert effective control of the day to day actions of a multitude of independent dive shops.

SPUMS ANNUAL SCIENTIFIC MEETING 1985

This will be held on Bandos Island in the Maldives from Thursday April 18th to Wednesday April 24th 1985.

SPUMS ANNUAL SCIENTIFIC MEETING 1985

This will be held on Bandos Island in the Maldives from Thursday April 18th to Wednesday April 24th. The two guest speakers are Dr Struan Sutherland of the Commonwealth Serum Laboratories and Dr Carl Edmonds, founding President of SPUMS.

The registration brochure should have reached you before this issue of the Journal. For further travel information, and copies of the brochure contact:

Allways Travel Service
168 High Street
ASHBURTON VIC 3147

Telephone: (03) 25-8818

SPUMS NOTICE

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UNUSUAL INCIDENTS FROM THE PAST

Number 6, 1964

Eye Injury from Explosion of Gauge

A nasty accident occurred early in April at North Head, near the Quarantine Station.

The "Down Under" Club was out fishing when two of their members got into trouble.

Using a Heinki lung with gauge attached, they transferred the gauge from one set to a full 72 bottle.

The two boys, Rod Crockford and Bob Pike, then turned on the cylinder and watched the gauge. The gauge immediately blew out in their faces, filling both the boys' eyes with glass. The divers left the water and rushed the vessel back to Manly Wharf where a car was stopped and off to Manly Hospital. After some delay a lady eye specialist was found, who removed the glass fragments from Bob Pike's eyes and he was allowed to go home.

Rod, however, was not so lucky and had an emergency operation to remove a large piece of glass embedded in the cornea. The operation was a success and Rod is now recuperating. These boys don't know how lucky they were as Joan Riley lost the sight of her right eye in a similar broken glass accident.

Australian Skindivers Magazine. May l964

CONFERENCES

THE 4TH WORLD CONGRESS ON INTENSIVE AND CRITICAL CARE MEDICINE

Will be held in Jerusalem from 23 to 28 June 1985.

It will be followed by:

AN INTERNATIONAL SATELLITE SYMPOSIUM

ON

HYPERBARIC OXYGEN IN CRITICAL CARE MEDICINE

to be held in Eilat from 30 June to 2 July 1985.

The Chairman, Scientific Programme, will be:

Dr Yehuda Melamed,
Director, Israeli Naval Hyperbaric Institute
PO Box 8040
31080 Haifa
Israel

TOPICS

- MECHANISM OF HYPERBARIC MEDICINE
- CRITICAL CARE IN THE MULTIPLACE AND MONOPLACE CHAMBER
- GAS GANGRENE
- BRAIN INJURY, ISCHAEMIC AND TRAUMATIC
- CARBON MONOXIDE AND OTHER TOXICITIES
- CURRENT USES OF HYPERBARIC OXYGEN IN EMERGENCY MEDICINE
- ACUTE PERIPHERAL ISCHAEMIA
- POLYTRAUMA
- THE CRITICAL CARE OF SEVERE DIVING ACCIDENTS
- SURGICAL AIR EMBOLI
- FUTURE PROSPECTS

SECOND ANNUAL HYPERBARIC MEDICINE COURSE

FOR DOCTORS AND NURSES

Prince Henry Hospital, Sydney.
Friday 1 March - 3 Sunday 1985.

For further information:

Course Secretary,
Hyperbaric Unit,
Prince Henry Hospital,
Box 233,
MATRAVILLE NSW 2036.