ii: 384-388
11 James CCM. Late bone changes in caisson disease. Three cases in submarine personnel. *Lancet* 1945; ii: 6-8
12 Pearson RR, Macleod MA, McEwan AJB and Houston AS. Bone scintigraphy as an investigation aid for dysbaric osteonecrosis in divers. *J Roy Nav Med Serv* 1982; 68: 61-68
13 Kawashima M. Aseptic Bone Necrosis in Japanese Divers. *Bull Tokyo Med Dent Univ* 1976; 23: 71-92
14 Kitano M, Iwasaki H, Yoh SS, Kuroda K and Hayashi K. Malignant fibrous histiocytoma at site of bone infarction in association with decompression sickness. *Undersea Biomed Res* 1984; 11: 305-314
15 Neubauer RA, Kagen RL and Gottlieb SE. The use of hyperbaric oxygen for the treatment of aseptic bone necrosis. A case study. *J Hyperbaric Med* 1989; 4: 69-76.

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## ROYAL ADELAIDE HOSPITAL HYPERBARIC MEDICINE UNIT

1/5/1992 - 30/4/1993

**A Progress Report**

John Williamson

### Introduction

The Hyperbaric Medicine Unit (HMU), within the Department of Anaesthesia and Intensive Care at the Royal Adelaide Hospital (RAH) is now 9 years old. It was founded by Dr J (Fred) Gilligan, currently Director of Retrievals and Resuscitation at the RAH, and Dr Des Gorman, the inaugural Director (until 1990), currently Director of Medical Services, Royal New Zealand Navy. They were ably supported by the longstanding efforts of Dr Tony Swain, and Dr Robert Ritson, Member of the Legislative Council.

The medical staff consists of a full time Medical Director, a visiting diving medical senior consultant, and 4 part-time medical consultants with senior anaesthesia, resuscitation, and diving and hyperbaric medical qualifications and experience. Two have recreational diving instructor qualifications. Another two senior anaesthesia and intensive care consultants contribute upon request and an honorary senior visiting sports physician with hyperbaric expertise visits and contributes weekly. The Unit has a 6 months training appointment for a provisional year Fellow of the Australian and New Zealand College of Anaesthetists.

The nursing staff comprises a full time clinical nurse consultant with hyperbaric nursing qualifications and experience, a full time clinical nurse and one part time registered nurse with hyperbaric nursing training and experience. These three have intensive care (IC) training and qualifications; supplementing them is a pool of in-house-trained hyperbaric nurses (including some with IC qualifications).

There are two senior hyperbaric technical officers full time, and 1 casual on-call technician. They have extensive international off-shore and in-shore commercial diving, recompression chamber (RCC) operation, and diving supervision experience and qualifications. One is a former Royal Naval clearance diver and diving supervisor, and two are qualified open water diving instructors with commercial experience in recreational diving. A technical research officer participates part time in research trials.

A full time, highly skilled secretary handles correspondence, phone calls, manuscripts, visitors to the Unit, and coordinates advertising, applications and finances for the 3 diver medical technician (DMT) and 2 diving medical officer courses conducted each year. Assisted by one of the hyperbaric technicians she also co-ordinates the other diving and oxygen courses regularly conducted by the Unit.

The Unit fulfils the following general functions nationally and internationally in collaboration with other Australian and New Zealand HMUs; clinical patient care, 24 hour manning of DES/DAN (Divers Alert Network) Australia, research, teaching (including the 5 annual national courses), public education and voluntary work.

### Clinical patient care

Ninety-six patients were treated in the recompression chamber (RCC) during the 12 month period from May 1st 1992 to April 30th 1993. The respective diagnoses affecting these patients are shown in Table 1.

*Results*

There were 2 deaths in the series (post-cardiopulmonary bypass in whom cerebral arterial gas embolism probably occurred during surgery, and post-traumatic cerebral oedema).

At least one of the carbon monoxide (CO) poisoned patients (who had a cardiac arrest at the CO exposure site) was left with severe neurological problems. Only 20 of the 34 CO poisoned patients presented for follow up at 6 to 12 weeks post-treatment. Of these 15 were classed as normal

**Figure 1**. Some members of the Royal Adelaide Hospital Hyperbaric Medicine Unit at the control panel of the Unit's Multi-place Chamber. Fom left, Bob Ramsay (Senior Technician), Dr Lindsay Barker (Senior Registrar), Andrea Jones (Unit Acting Clinical Nurse Consultant) and Debbie Lombardi (Unit Secretary).

on neuropsychological assessment. Two of the remaining five sought further medical consultation for continuing subjective symptoms but investigations proved normal. A third severely poisoned patient, who presented moribund, is back at University studies, but has undergone a personality change. A fourth, who received cardiopulmonary resuscitation at the CO exposure site, has permanent memory impairment and has lost his job. The fifth patient had a significant pre-existing neurological deficit from a childhood head injury, but now has significant further neuropsychological decrement following her CO poisoning. The other 14 CO poisoned patients were lost to follow up.

Of the 23 decompression illness (DCI) patients, at least 5 were lost to follow up. The remainder made neurological recovery, as nearly as could be determined (including neuropsychological screening at 6 weeks after treatment in 8 cases), back to their pre-illness state. This recovery sometimes took up to 12 months.

All osteradionecrosis patients responded well to therapy. All the patients treated prophylactically before dental and/or maxillofacial surgery healed following surgery.

The single case of unilateral sudden deafness in a healthy young adult recovered completely during HBO. No results are yet available (May 1993) for the burns research patients.

Since 1990 the Unit has had success with both gas gangrene and necrotising fasciomyositis patients, working in close collaboration with other specialist colleagues. Of the 4 cases which occurred during the 12 month period covered by this report there were no deaths. However one patient reuired amputation of the leg.

The treatment failures were 2 of the 3 chronic osteomyelitis cases and the patients with global cerebral hypoperfusion and with spinal cord vascular paraparesis. The patient with a non-healing leg ulcer had her first HBO treatment on the last day of the 12 month period covered by this report and the outcome of the patient with advanced orbital mucormycosis is unknown.

*Hyperbaric exposures*

These 96 patients involved 796 patient treatments in the RCC, using 552 chamber runs. Total RCC treatment time was 1100.6 hours. The number of RCC treatments for the different diagnoses is shown in Table 2.

**TABLE 1**

**PRINCIPAL DIAGNOSES OF PATIENTS TREATED WITH HYPERBARIC OXYGEN MAY 1992 TO APRIL 1993**

| Diagnosis | Number |
|---|---|
| Carbon monoxide poisoning | 34 |
| Decompression illness | 23 |
| Osteoradionecrosis of mandible | 11 |
| Thermal burns | 5 |
| Gas gangrene | 3 |
| Chronic osteomyelitis | 3 |
| Cerebral. arterial gas embolism | 3 |
| Post operative cerebral vasospasm | 2 |
| Compromised graft or flap | 2 |
| Non-healing ulcer | 1 |
| Global cerebral hypoperfusion | 1 |
| Post-traumatic cerebral oedema | 1 |
| Compartment syndrome | 1 |
| Necrotising soft tissue infection | 1 |
| Idiopathic hearing loss | 1 |
| Paraparesis (spinal vascular malformation?) | 1 |
| Orbital mucormycosis | 1 |
| Mixed anaerobic infection | 1 |
| Prophylaxis for Clostridial wound contamination | 1 |
| **Total** | **96** |

**TABLE 2**

**THE NUMBER OF RECOMPRESSIONS FOR EACH CONDITION TREATED MAY 1992 TO APRIL 1993**

| Diagnosis | Treatments | Patients |
|---|---|---|
| Osteoradionecrosis of mandible | 275 | 11 |
| CO Poisoning and smoke inhalation | 178 | 34 |
| Decompression illness | 104 | 23 |
| Chronic osteomyelitis | 103 | 3 |
| Burns | 28 | 5 |
| Idiopathic hearing loss | 17 | 1 |
| Cerebral arterial gas embolism | 14 | 3 |
| Gas gangrene | 14 | 3 |
| Postoperative cerebral vasospasm | 13 | 2 |
| Compromised graft or flap | 10 | 2 |
| Mixed anaerobic infection | 10 | 1 |
| Necrotizing soft tissue infection | 8 | 1 |
| Compartment syndrome | 7 | 1 |
| Global cerebral hypoperfusion | 5 | 1 |
| Prophylaxis for clostridial contamination | 5 | 1 |
| Post traumatic erebral oedema | 2 | 1 |
| Non-healing ulcers | 1 | 1 |
| Paraparesis, from vascular malformation ? | 1 | 1 |
| Mucomycosis | 1 | 1 |
| **Total** | **796** | **96** |

*Complications*

The most common complication in this series was middle ear barotrauma. Among the 796 compressions during the 12 month period there were 49 occasions when ear pain (all during descent) occurred in patients, an incidence of 6%. A minority involved the same patient on separate recompressions, and all responded to pre- and intra-chamber instruction, combined where necessary with standard medications. Seventeen of the 96 patients had barotrauma more severe than Grade 2 on otoscopy. Seven of these (7%) required the insertion of ear grommets. Among the attendants there were 5 occasions when ear pain occurred and 2 of these sustained Grade 3 barotrauma.

There were no cases of oxygen convulsions during the 12 month period. However in 3 patients preventative in-chamber action was taken due to possible warning symptoms and signs. The incidence of convulsions from acute central nervous oxygen toxicity in the RAH HMU during the period 1990-1993 inclusive is 0.4% of patient hyperbaric exposures, and will be the subject of a future publication.

*Hyperbaric outpatient attendances*

The Unit conducts a half-day Hyperbaric Outpatient session twice a week. Attendance is by appointment. The work involves follow-up reviews of hyperbaric patients, diving medical examinations, and referrals from medical colleagues for diving or hyperbaric assessment or opinion. During the 12 months 389 outpatients (210 diving medical examinations and 179 hyperbaric reviews) attended. Two of these involved serious pathology from marine envenomations (1 stonefish, 1 coral cut).

Postal and telephone consultations (excluding DES/DAN Australia) are numerous and are increasing in number and scope. Advice and consultation from the Unit's clerical, medical, nursing and technical staff is sought nationwide, with some international calls. There is an increasing medico-legal component of this work with plaintiffs or defendants seeking expert opinion related to diving and hyperbaric medical matters.

**24 hour a day manning of DES/DAN Australia**

DES/DAN (Divers Alert Network) Australia is the name for the former DES (Diver Emergency Service), which is operated by the RAH HMU. This name change is part of a coordinated international move to standardise diving emergency telephone facilities around the world with "International Divers Alert Network", or IDAN. Coun-

tries participating at present include Australia, Germany, Israel, Italy, Japan, New Zealand, Russia, Spain, Switzerland and the U.S.A. Apart from a Telecom change of 008 to 1-800 there is no change in the telephone numbers for DES/DAN Australia, which are

**Within Australia 1-800-088 200 (user free)**
**Outside Australia 61-8-223 2855 (user pays)**

This service is also increasing in activity and scope and is now an integral part of diving safety in Australia and its immediate environs. During the period of this report 415 calls were received. The busiest month (January 1993) recorded 52 calls. Just under half of all calls involved diving problems in the field, including emergencies, and the remainder were calls from doctors concerning diving medical examinations. There is a small but increasing number of calls related to marine envenomations involving snorkellers and divers. For the first time since the inception of this emergency telephone service in 1986, there was recently a spate of hoax and obscene phone calls. Diving training affiliations and the police were notified and tracing by Telecom Australia located the offenders.

Divers are invited to use DES/DAN Australia for marine envenomation matters as well, as two of the RAH Hyperbaric Medicine Unit's medical consultants are actively involved in marine envenomation studies.

DES/DAN Australia usage provides regular clinical and some logistic interface with Australia's other HMUs. The communications system for DES/DAN Australia involves the round-the-clock first response by the Communications Room of St John Ambulance in Adelaide and is very successful. Tribute must be paid to the officers of this service by all the divers and diving doctors of Australia. The system guarantees connection with an experienced diving medical physician within minutes, 24 hours a day, 7 days a week.

A report of the usage of the Diver Emergency Service (DES) to December 1990 has already been published.[1] A data base of the usage of DES/DAN Australia since that time is being compiled for future submission to the SPUMS Journal.

**Clinical research activities**

*Hyperbaric Oxygen Therapy (HBO) and burns*

This is a randomised, controlled study of the treatment of adult burns with HBO.[2] In May 1993 there were 21 patients in this trial, 10 controls and 11 treatment patients. There has been no mortality. No clear trends are yet apparent. Evaluation is by mortality, and morbidity which includes duration of hospital stay, incidence of infection and antibiotic usage, area of grafting, total intravenous fluids, analgesic requirements, theatre visits and long-term cosmesis where possible. This is a potentially important study which will take a further 4-5 years to accrue sufficient numbers. It is hoped that other centres may join this trial, and perhaps extend the investigation to include a treatment group at 1 ATA $O_2$. Control of the possible influence of CO poisoning upon burns has presented a major protocol design challenge. Based upon current understanding the RAH HMU and Human Ethics Committee no longer regard the withholding of HBO from CO poisoned patients as ethically acceptable.

*HBO and xerostomia*

The preliminary results from our pilot study[3] support uncontrolled observations[4] that HBO can ameliorate post-irradiation xerostomia. A controlled, randomised, international multi-centre study involving European, American and Australian units is in the planning stages.

*Dysbaric exposure and Doppler studies*

Ultrasonic Doppler studies of hyperbaric RCC attendants, hypobaric-exposed healthy personnel, and recreational divers in the field are in progress, but it is too early for meaningful results. A review of the subject formed a thesis of the inaugural Fellow appointed to the Unit in 1992, and is being prepared for submission. A pleasing aspect of these studies is the collaboration of civilian hyperbaric and Royal Australian Air Force hypobaric teams. The results of this work should enable a more objective choice of the safe frequency of dysbaric exposure of RCC attendants in therapeutic Units. These studies have the approval of the Australian Defence Forces Human Ethics Committee.

*Carbon monoxide (CO) poisoning*

Carbon monoxide (CO) off-gassing measurements on CO-poisoned patients[5] and on controls, both at atmospheric and hyperbaric ambient pressures of 100% oxygen have been carried out and analysis of the data is proceeding. The prominence of CO poisoned patients (Table 1) and of research into CO poisoning in the RAH Department of Anaesthesia reflects both the frequency, and the current international uncertainty concerning the optimal management, of this important poisoning.[6-10] Most of the patients presenting to the Unit are attempted suicides. Present indications are that the extent of CO tissue deposition (as opposed to tissue toxicity) is not reflected necessarily by either the presenting clinical state[5] or the carboxyhaemoglobin levels.[6] The correlation of the level of tissue deposits of CO with delayed neurological sequelae also remains unclear. Data from the Unit and elsewhere suggests that the best current treatment for CO poisoning, in addition to normal supportive management, is early and repeated HBO.[6-8,10] Much more work is needed.

*Osteoradionecrosis*

A retrospective analysis of the long-term outcome of patients treated by the Unit for osteoradionecrosis of the mandible is nearing completion and a prospective study has begun with the Department of Maxillofacial and Oral

Surgery in the University of Adelaide.

*Neuropsychological screening*

A major collaborative research program with the Adelaide University Department of Psychology (Professor Douglas Vickers) has just begun to develop and evaluate neuropsychological screening tests for CO poisoned and for DCI patients.

*The Diving Incident Monitoring Study (DIMS)*

The increasingly significant national Diving Incident Monitoring Study (DIMS)[11-14] data is accumulating within the Unit. Plans to centralise diving incidents, morbidity and mortality data at the RAH Hyperbaric Unit are commencing, with the co-operation of Dr Douglas Walker of Project Stickybeak. A progress report of DIMS has been presented.[15]

*In-flight resuscitation*

A study of in-flight resuscitation capability in the Black Hawk helicopter has been completed.[16]

Ethics Committee approval for all these studies has been obtained. Approval has been obtained for a conjoint, randomised, controlled study of the treatment of unresponsive decompression illness with the Royal New Zealand Navy where the study was initiated.[17]

## Other research activities

A pilot study of endogenous catecholamine response during hyperbaric oxygen therapy has recently been completed.[18] This study did not confirm the Russian finding that HBO could suppress endogenous catecholamine production, offering possible anti-arrhythmic advantages to cardiac patients.[19] Further studies are justified.

In keeping with the major incident reporting work current in the RAH Department of Anaesthesia and Intensive Care[20] and the existing interests in the Unit,[21] a newly developed national Hyperbaric Incident Reporting Study (HIMS) is gathering strength. International epidemiology of jellyfish, and other marine envenomations is being published.[22-29]

Studies and development of demand-flow 100% oxygen equipment for first aid use are in progress,[30] and a project studying cardiac arrhythmias during recreational diving has commenced. Performance specifications of oxygen apparatus are also being conducted in the Unit's oxygen apparatus testing laboratory.

Co-ordinating with clinical activities,[31] laboratory animal research relating to cerebral arterial gas embolism (CAGE)[32] occurs.

## Other clinical studies

*Necrotising soft tissue infections*

The 12 months period covered by this report does not reflect the true incidence of life threatening soft tissue infections treated by the Unit over the past 3 years. In the 10 cases of necrotising fascio-myositis and 8 cases of Clostridial gas gangrene treated during the 3 years, in which limbs were at risk in all and lives in some, there was zero mortality. These cases included 2 cases of Clostridial gas gangrene complicated by renal failure. The relentless application of surgical debridement, close microbiological supervision, high quality intensive care and hyperbaric oxygen therapy appears to be one recipe for success.

*Co-ordinating role of the HMU within the RAH*

It is apparent that the Unit, as do most HMUs, fills a valuable role in bringing together, at appropriate times, the different clinical disciplines. For example when treating chronic non-responding osteomyelitis, orthopaedic surgery, microbiology, radiology, pain clinic, district nursing, drug dependency specialists, psychiatry, rehabilitation medicine and hyperbaric medicine are all involved. Often the specialties have never met about the patient previously, even after years of treatment, and solutions to long-standing problems can become quickly apparent. This experience parallels the earlier evolution of pain clinics.

## The future

The RAH HMU has operated to date in cramped and relatively remote quarters within the Hospital, with its clinical care and administrative areas widely separated. It is hoped that the Unit will soon be relocated to larger facilities which will include a second larger RCC, closer to the critical care patient areas within the hospital. This would enable, not only less hazardous transport of patients on life support to and from the RCC, but also greater therapeutic attention to, and studies of, conditions such as chronic, non-healing ulcers. An increase in the number of randomised controlled clinical studies in HBO would also be possible and this is urgently required.

It seems possible to predict that hyperbaric and diving medicine may be forced to re-evaluate, albeit in a calm and scientifically objective manner, its traditional "no-diving stance" with respect to some diseases. Advances in the understanding and management of reactive small airways disease, diabetes mellitus, haemophilia, and intra-thoracic surgery and clean trauma, for example, may cause interesting debates in the future.[33-35] The RAH HMU looks forward to participating in these challenges, for as Xavier Herbert has remarked, "There is only one thing I enjoy more than a good laugh and that's the truth!"

**References**


1 Williamson J, Acott C, Webb R, Capps R, Gilligan F and Gorman D. Australia's Diver Emergency Service (DES) 008-088-200: analysis of recorded usage over a 35 month period during 1987-1990. *SPUMS J* 1991; 21: 14-20

2 Williamson JA, Webb RK, Leitch IO, Pirone C, Gorman DF, Rowland R and Jones A. Preliminary report: a prospective, randomised, controlled trial of hyperbaric oxygen therapy in the management of adult thermal burns. *Undersea Hyperbaric Med* 1993; 20 (Suppl): 24-25

3 Roveda SIL, Williamson JA, Goss AN, Bromson K, Webb RK, Fallowfield T, McIntyre J, Wigg D and Finn B. A multi-centre, non-randomised, internally controlled pilot trial: hyperbaric oxygen therapy (HBO) for post-irradiation xerostomia in patients with head and neck neoplasia. *Undersea Hyperbaric Med* 1993; 20 (Suppl.): 24

4 Fontanesi J, Golden EB and Cianci P. Hyperbaric oxygen therapy can reverse radiation-induced xerostomia. *J Hyperbaric Med* 1991; 6: 215-221

5 Langston PG, Ramsay R, Frye JNR, Williamson JA and Russell WJ. Carbon monoxide off-gassing of patients poisoned by CO and treated with 2.8 ATA hyperbaric pressure: a prospective clinical series. *Undersea Biomed Res* 1992;19 (Suppl): 49

6 Gorman DF and Runciman WB. Carbon monoxide poisoning. *Anaesth Intens Care* 1991; 19: 506-511

7 Mark PD. Carbon monoxide poisoning: a review. *SPUMS J* 1992; 22: 127-135

8 Gorman DF, Clayton D, Gilligan JE and Webb RK. A longitudinal study of 100 consecutive admissions for carbon monoxide poisoning to the Royal Adelaide Hospital. *Anaesth Intens Care* 1992; 20: 311-316

9 Ludbrook GL, Helps SC, Gorman DF et al. The relative effects of hypoxic hypoxia and carbon monoxide on brain function in rabbits. *Toxicology* 1992; 75: 71-80

10 Runciman WB and Gorman DF. Carbon monoxide poisoning: from old dogma to new uncertainties. *Med J Aust* 1993; 158: 439-440

11 Acott C, Sutherland A and Williamson J. Anonymous reporting of diving incidents: a pilot study. *SPUMS J* 1989; 19: 18-22

12 Acott CJ. Incident reporting. Its application in scuba diving safety. *Undersea Biomed Res* 1991; 18 (Suppl): 47-48

13 Acott C. Scuba diving incident reporting: the first 125 incident reports. *SPUMS J* 1992; 22: 214-221

14 Acott C. Scuba diving incident reporting, in Eds Wilkes J, Knight J, and Lippmann J *Scuba Safety in Australia*. Melbourne: J.L. Publications, 1993: 76-84

15 Acott C. DIMS update 1993. SPUMS J 1994; 24 (1) in press

16 Williamson JA, Capps RA, Griggs WM, Black RB, Wangel HG, Babu SC, Matthey P and Tonkin L. Forward area aeromedical evacuation, and cardiopulmonary resuscitation: assessment of the suitability of the S-70A-9 Black Hawk helicopter, with an evaluation of three ADF stretchers. *Aust Defence Force J* 1993 (in press)

17 Drewry A and Gorman DF. A preliminary report on a prospective randomised double-blind controlled study of oxygen and oxygen-helium in the treatment of air diving decompression illness. *Undersea Hyperbaric Med* 1993; 20: 19-20

18 Terylene KP, Williamson JA, Frewin DB and Russell WJ. Plasma catecholamine levels during exposure to an environment of hyperbaric oxygen. *Clin Autonomic Res* 1993; 3: 91-93

19 Golikov AP, Isakov IV, Tretiakova NG and Ustinova EZ. Hyperbaric oxygenation in paroxysmal and extrasystolic disorders of cardiac rhythm. *Kardiologiia* 1983; 23: 35-39

20 Australian Patient Safety Foundation, Inc. An analysis of 2000 incident reports. *Anaesth Intens Care* 1993; 21: 495-695

21 Pirone C. Occupational health and safety for the hyperbaric nurse/attendant. *Undersea Biomed Res* 1992; 19 (Suppl): 110

22 Acott CJ. Sea snake envenomation. *Undersea Biomed Res* 1991;18 (Suppl): 105-106

23 Williamson JA. Current challenges in marine envenomation: an overview. *J Wilderness Med* 1992; 3:422-431.

24 Fenner PJ, Williamson JA, Burnett JW and Rifkin J. First aid treatment of jellyfish stings in Australia: response to a newly differentiated species. *Med J Aust* 1993; 158: 498-501

25 Rifkin J, Williamson J. Fenner P and Burnett J. Disarming the box-jellyfish. *Med J Aust* 1993; 158: 647-648

26 Fenner PJ and Williamson JA. Acute chest pain on a tropical beach: myocardial ischaemia or "Irukandji syndrome"? *Scientific Program, "The Spark of Life". Melbourne, 30 April-1 May 1993.* Melbourne: Australian Resuscitation Council, 1993: 66

27 Fenner PJ, Williamson JA and Burnett JW. Prevention of marine envenomation fatalities in Australian waters. *Scientific Program, "The Spark of Life". Melbourne, 30 April-1 May 1993.* Melbourne: Australian Resuscitation Council, 1993: 145

28 Williamson JA, Fenner PJ, Burnett JW, Alam JM, Yakovlev YM and Vaskovsky VE. Jellyfish venoms and the diver: lessons for diving medicine. *Undersea Hyperbaric Med* 1993; 20 (Suppl.): 78

29 Rifkin JF, Fenner PJ and Williamson JAH. First aid treatment for the sting from the hydroid *Lytocarpus philippinus*: the structure of, and *in vitro* discharge experiments with its nematocysts. *J Wilderness Med* 1993; 4: 252-260

30 Ramsay R. Administration of demand flow 100% oxygen to the co-operative, spontaneously breathing patient. *Scientific Program, "The Spark of Life". Melbourne, 30 April-1 May 1993.* Melbourne: Australian Resuscitation Council, 1993: 67
31 Drewry A and Gorman DF. Lidocaine as an adjunct to hyperbaric therapy in decompression illness: a case report. *Undersea Biomed Res* 1992; 19: 187-190
32 Helps SC and Gorman DF. Air embolism of the brain in rabbits pretreated with mechlorethamine. *Stroke* 1991; 22: 351-354
33 Jenkins C, Anderson SD, Wong R and Veale A. Compressed air diving and respiratory disease: a discussion document of the Thoracic Society of Australia and New Zealand. *Med J Aust* 1993; 158: 275-279
34 Davies D. SPUMS statement of diabetes. *SPUMS J* 1992; 22: 31-32
35 Sullivan MJ. Scuba diving and diabetes - anaesthetist replies to critical letter. Diabetes *Conquest* 1993; Autumn: 31-32

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## DIVING INCIDENT MONITORING STUDY UPDATE 1993

Chris Acott

### Introduction

The Diving Incident Monitoring Study (DIMS) has been an ongoing project since 1989. Completed forms were initially received on a sporadic basis, but slowly the study has gathered momentum.

Up to the end of 1992, 553 reports had been received. Twenty reports have been rejected for analysis because they contained inadequate information or failed to describe an actual incident. None of the information in these reports has been used. Analysis of the 533 useable reports is presented here.

So far there has been no duplication of incident reports. 57% of those received have been divers reporting their own incidents, 13% reporting their buddy's, while 30% were reports of somebody else's. As more reports are received and more information gathered previous reports have to be reviewed and constantly upgraded. In this way similar incidents can be identified and re-checked.

**TABLE 1**

**INCIDENTS ANALYSED**

| Year | Number |
|---|---|
| 1989 | 48 |
| 1990 | 79 |
| 1991 | 162 |
| 1992 | 244 |
| **Total** | **533** |

These 533 incident reports: gather details of incidents; identify common errors made; give insight into current diving practice and behaviour; identify "equipment faults" either due to design or problems associated with diver usage of his or her equipment, or "pure" equipment malfunction.

Why use incident monitoring and not analysis of diving fatalities and accidents?

Firstly, counting the dead is a poor measure of how well "things are going".

Secondly, when a coroner or other official body is involved, the reports of the event tend to be what should have happened rather than what did happen. Unfortunately, the "blame-model" still operates in recreational diving.

Thirdly, most accidents have multiple components and it is difficult to identify and apportion responsibility to these various components.

Fourthly and most importantly, there are not enough accidents and deaths to make statistical "sense" of the data. For each accident there are at least 1,000 incidents. Incident monitoring is a powerful mechanism and gives considerable insight into the "COCK - UP CASCADE" (Table 2).

The ratio of male to female of 3:1 was constant throughout the reports received. This may well reflect the general ratio of male to female divers. The ratio of male to female divers presenting for treatment of diving related disorders at the Royal Adelaide Hospital (RAH) Hyperbaric Chamber is, on average, 3:1 (one abnormal year of 17:1 has been disregarded!)

### Morbidity

Table 3 displays the 233 cases of morbidity (44%) reported in the 533 incidents under review.