

control on the gas mix is very variable and some divers know they are breathing nitrox but they have absolutely no idea what percentage.

We have now over 3,000 cases in the DAN database, and one of our major tasks which did not exist at the beginning of DAN but certainly does now, is research to try to promote diving safety and investigate pathophysiology. There are several ongoing projects in addition to analysis of the database. For instance in 1995 there were 590 accidents (DCS and CAGE). Analysis showed rapid ascents (170), buoyancy problems (90), dives outside the limits of computer or table (50) and equipment problems (77) were associated with nearly two thirds of diving accidents. There were also 35 divers who did not use a computer or tables. Adding them brings the total up to 422 divers or 71.5% with avoidable causes. Perhaps if we could change this behaviour, we might substantially reduce the number of decompression incidents.

Dick Vann is doing a project on flying after diving. A number of volunteer divers have been in our chambers, made a dive, followed by a pre-flight surface interval and then a simulated flight to an altitude of 8,000 feet. He has looked at a number of dive profiles at 60 feet as well as some 100 foot exposures. It appears that the guidelines that we currently operate under, which call for a surface interval before flight of 12 to 28 hours, seem to be correct. After 12 hours for a single dive, and beyond 22-24 hours for a multiple dive, the risk of decompression sickness is fairly low.

Dr Vann is also working on a long term project to collect depth-time profiles on enough dives to be able to assess the probability of DCI for any reasonable dive within the framework of recreational scuba. Project Dive Exploration is expected to take up to 10 years to complete and require actual recordings of about a million dives. Primary data collection is expected to start in 1998.

Other projects include field studies of blood glucose in divers with insulin-dependent diabetes mellitus, assessment of venous gas embolism in recreational divers and studies of the relationship between oral contraceptives, menstruation and the risk of DCI. These are in parallel with the statistical analysis of the ever enlarging data base.

*Figures 1 and 2 are reprinted from the 1997 DAN Report on Decompression Illness and Diving Fatalities by kind permission of the Divers Alert Network.*

*More details about the 1995 recreational scuba diving injuries and deaths reported to DAN can be found in the 1997 edition of the DAN report on Decompression Illness and Diving Fatalities which is available from DAN, the Peter B Bennett Center, 6 West Colony Place, Durham, North Carolina 27705, USA.*

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## DES AUSTRALIA EXPERIENCE

Michal Kluger

### Key Words

Accidents, decompression illness, diver emergency service, first aid, recreational diving, transport.

Australian diving accident statistics are even less well collected than the statistics in the United Kingdom and the USA. The Diver Emergency Service, usually known as DES, is primarily a phone contact for medical advice to divers who have had diving accidents. It advises divers and tells them how to contact the appropriate authorities in their area who will organise their treatment. It is also contacted by medicos wanting diving medicine advice. There is no national data base of diving accidents in Australia.

### More about DES

The Diver Emergency Service's primary function is to be the first contact in diving emergencies. Advice about diving medicine is very much less important. DES is accessed by phone. We have a free phone within Australia (1-800-088-200), which any diver can access at any time of the day or night. Outside Australia it is a user pays number (+61-8-8373-5312), which comes through to the same physicians 24 hours a day.

When a diving emergency occurs, divers phone the free phone number, or the number from outside Australia, and reach the St John's Ambulance switchboard in Adelaide. Immediately one of the five diving medicine consultants is paged. Our set up is unlike some of the other call networks around the world, as divers have immediate access to a physician, trained in anaesthesia, intensive care and diving medicine, within 3-5 minutes.

### The DES workload

In 1996 there were approximately 506 calls. Approximately, because like all reporting statistics, not all the cases which phoned were recorded. Not surprisingly, most of the calls came from heavily dived areas, such as Queensland and New South Wales. Interestingly, we got

several calls from Alice Springs, right in the middle of Australia where the only permanent water is in swimming pools, divers who had been on a round Australia tour and had flown from say, Cairns, straight to Alice Springs and developed symptoms there. As Alice Springs is 1,350 km from the nearest hyperbaric facility we often had significant problems about what to do with them.

Besides 452 Australian calls we had 52 overseas calls. We had several calls from areas that are commonly dived by Australians in the immediate vicinity, such as New Guinea, the Solomons, Vanuatu, Fiji, and Guam. However, we also got some calls which were geographically very distant such as the United States, Cyprus (this was a diver who had complications 5-6 days after a dive and who did not really know who to contact in Europe), Hong Kong (this was a patient who three weeks after a dive decided he was worried about his symptoms at 10 o'clock at night and decided to phone me, unaware of the time zone difference and at 2 in the morning decided to tell me about his nagging shoulder pain); one from the Philippines and one from the United Arab Emirates.

### Presenting symptoms

We record the presenting symptoms of all those referred to DES over the DES phone. Pain, paraesthesia, headache, fatigue, this is just all the symptoms grouped together. Marine envenomation is put separately. About two years ago the specific emergency telephone service Stinger Line stopped functioning, so now we take the primary calls for marine stingers around Australia. Not surprisingly most of the envenomations come from Queensland, although there were a couple from South Australia, and a queried account from Western Australia. Of these, 4 were *Chironex*, one a sea urchin, one a crown of thorns, one a stone fish and one was not an envenomation but was poisoning from eating fish which gave GI symptoms.

### Primary diagnoses

Twelve of the primary diagnoses made by the physicians receiving DES calls in 1996, were definite diagnoses, over the phone, of decompression illness (DCI). Another 132 were diagnoses of possible decompression illness. There are approximately 400 cases of decompression illness per year around Australia. Obviously not all of these go through the DES network. Many get referred straight to the local hyperbaric centres.

Other primary diagnoses were sinus problems, oral barotrauma or simple musculo-skeletal problems. Other included anxiety or panic, pulmonary barotrauma, which is usually manifest as subcutaneous emphysema. Another less specific subgroup, head injury, was interesting. A man who

**TABLE 1**

### ORIGIN OF CALLS

Location	Number
Australia	
Queensland	158
New South Wales	131
Victoria	66
South Australia	39
Western Australia	37
Northern Territory	7
Tasmania	7
Australian Capital Territory	7
Total Australian calls	452
Near-by Pacific Islands	
Papua New Guinea	14
Solomon Islands	12
Vanuatu	6
Fiji	5
Total near-by Pacific Island calls	37
Other overseas calls	15

**TABLE 2**

### PRESENTING SYMPTOMS

Presenting symptom	Number
Pain	189
Paraesthesia	106
Headache	97
Fatigue	82
Nausea	65
Vertigo	63
Concentration reduced	32
Weakness	28
Visual problem	17
Loss of consciousness	12
Skin rash	11

**TABLE 3**

### PRIMARY DIAGNOSES

Diagnosis	Number
Decompression illness (DCI)	112
Possible DCI	132
Aural barotrauma	34
Musculoskeletal injury	20
Not dive-related	12
Anxiety	11
Pulmonary barotrauma	9
Viral illness	8

was filming underwater on the east coast of Australia banged his head on the camera. He felt completely well, but reported it just in case it was a problem later.

### Symptoms of DCI

The symptoms follow the same pattern as the numbers from the United States and the United Kingdom. The largest group is neurological symptoms including paraesthesia and paralysis, followed by pain only and the other ones. A symptom we see commonly, and we were not sure how seriously to take it, is the excessive fatigue that divers with decompression illness often experience. This is often one of the most difficult symptoms to get rid of when treating them post-recompression.

There were a few who were unconscious and a few with visual disturbances. Twenty five out of 240 cases of definite or probable decompression illness had a past history of decompression illness. That is about 10%, again consistent with UK and USA numbers. Twenty four of these divers presented with the same symptoms as decompression illness. Of these we thought 14 had decompression illness again. We referred 113 of our callers to other hyperbaric chambers around the country.

### First aid treatment.

If first aid is bad in the United Kingdom and America, we are certainly not doing very well in Australia. Forty seven divers were given 100% oxygen and a further 26 had a variable percentage of oxygen. That is 73 (30%) of 242 cases who were given oxygen. As 70% were not given oxygen, it is clear that oxygen is not available at all dive sites. Fluid was not generally given. We can understand intravenous therapy not being commonly given, but it does seem that oral fluids have not been aggressively advocated in Australia.

### In-water oxygen

Carl Edmonds will be pleased to see that in-water oxygen was used by two divers. One was an American, sailing in Micronesia and diving off their boat. He got symptoms and phoned DES. The consultant who took the call was less than happy at in-water oxygen, but the diver went ahead and did it. The diver phoned back when he had got so much better that they continued their sailing around Micronesia. Certainly, from that case in-water oxygen seemed to have a beneficial effect. Two divers had EAR and then subsequent CPR. Anybody who has tried to do in-water EAR will recall how difficult that actually is. In fact in-water EAR is almost impossible to do in a real life situation.

**TABLE 4**

### FIRST AID AND OXYGEN USE

Treatment	Number
Oxygen (100%)	47
Oxygen (unknown percentage)	26
Oral fluids	15
Intravenous fluids	6
Supine	33
In-water oxygen	2
Expired air resuscitation (EAR)	2
Cardiopulmonary resuscitation (CPR)	2

### Deaths

Six deaths were reported through the DES desk. We had two forms which were either incomplete or illegible. Two were asking for post mortem advice. One was from Christmas Island, who said, "This diver has died, we can't get him off the island for two days. Is it okay to stick him somewhere? How about the walk-in freezer?" It seemed like a good idea to us and two days later he flown down to the Cocos Islands.

One diver died 10 days after a rapid ascent. He was completely well during that 10 day interval, but we were phoned up to see if this death could possibly be due to diving. It was difficult to make any suggestions.

The only definite death due to diving which we recorded, was a novice diver in Queensland who made an uncontrolled ascent from about 10 metres and had an acute neurological DCI and gas embolism.

### Retrievals

We recommended retrievals in 33 cases. They were Australian and international retrievals. One example, an Australian citizen, who had been snow skiing in Denver, came back via Fiji. He developed acute neurological decompression illness after a very benign dive profile, became almost quadriplegic and was put in the chamber in Suva. He was given two RN 62s and then we were phoned in Adelaide to give some advice about this diver who really wasn't doing very well. We asked, "Was the diver insured?", and he was not. So we then had to organise a retrieval. The retrieval was quoted to us as \$35,000 to get this diver from Fiji to Melbourne. A very irate father phoned me and said "Can you justify spending \$35,000 dollars. Can you assure me that this will make any difference to outcome?" Which is very difficult to do over the phone. But if one has somebody with neurological symptoms, failing to resolve

with two treatments, the Suva chamber is not the place to have them. But sometimes expectations are quite high.

### Non-emergency calls

General medical enquiries using the free phone number make up a significant proportion of DES calls. Ninety one (18%) calls were general medical enquiries and this group seems to be increasing. DES was set up to provide advice for divers involved in diving accidents. The medical service is provided free by five unpaid consultants who do this service in addition to their normal duties. DES was not set up to provide a toll free number for doctors to get advice during diving medicals. There is a phone number (08-8222-5116) available for such advice in the Hyperbaric Medical Unit at the Royal Adelaide Hospital.

Commonwealth Government funding for DES was discontinued during the past two years. Now after a period of difficulty in funding the DES phone is being funded by DAN Australia South East Pacific.

In conclusion, looking at the 1996 statistics, DES still provides a valuable service to divers in Australia and for Australian divers who are travelling overseas. We can understand why doctors find it useful for medical advice. In this user-pays world it would reduce our operating costs if doctors used the Hyperbaric Unit line for advice.

I would like to thank Steve Goble, the Senior Hyperbaric Technician at the Royal Adelaide Hospital, for his assistance in preparing the data.

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### DIVING MEDICINE COURSE

The School of Public Health and Tropical Medicine, James Cook University, Townsville, will be conducting a course in Diving Medicine from Monday 6th to Saturday 10th of October 1998.

For further details contact

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### DECOMPRESSION ILLNESS IN NEW ZEALAND DIVERS: THE 1996 EXPERIENCE

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Marie Richards

#### Key Words

Decompression illness, diver emergency services, recreational diving, sequelae, transport, treatment.

#### Introduction

Two hyperbaric units, one located at Auckland in the Royal New Zealand Navy (RNZN) Base, and one at Christchurch, previously located at Princess Margaret Hospital and now at Christchurch Hospital, provide treatment for injured divers in New Zealand. From 1967 to 1983 the average number of patients seen at the RNZN unit was less than 2 annually, but from 1984 to 1990 this rose to a mean of 15 per year.<sup>1</sup> There were 24 cases in 1990, 31 in 1991, 55 in 1992, 68 in 1993, 48 in 1994 and a record 100 cases in 1995.<sup>2</sup> The Christchurch Hyperbaric Unit (CHU), treated an average of 6 divers per year from 1979 until its temporary closure in May 1994. The unit reopened in February 1996 and its 1996 caseload is included in this review.

During the 1996 calendar year 76 cases of decompression illness (DCI) following diving were treated in New Zealand: 57 at the RNZNH Slark Hyperbaric Unit (SHU); and 19 at the CHU. Demographic data describing this patient population is presented in this review.

#### Methods

Relevant data describing patients diagnosed as having DCI and treated by recompression at both units during 1996 were entered on a Microsoft Access 2 database. One case of DCI induced by extreme altitude exposure in an unpressurised aircraft was excluded from this review. Most data was gathered prospectively by patient interview and examination, but some was obtained retrospectively from clinical records. The collection of data at the SHU was aided by use of a baseline clinical data form designed for use in a randomised prospective double blinded trial of lignocaine in the treatment of DCI which is currently underway. The relationship between incomplete recovery at discharge and a variety of putative prognostic factors was assessed using a Chi square test.

#### Results

##### SEASONAL INCIDENCE

The peak incidence of DCI was in the warmer months October to April, while there were very few cases in July.