

The physical examination should include checking the state of the ears and the patency of the Eustachian tubes, listening to the chest especially with the patient hyperventilating which often brings out otherwise hidden wheezes, blood pressure, reflexes, cranial nerves, and an exercise test.

The justification for chest x-rays is to detect cysts and other asymptomatic pathology which would make diving dangerous. The respiratory function tests are to detect those with a VC/FEV1% of less than 75% who are over-represented in the burst lung statistics. The audiogram is to establish a baseline in case the diver damages his or her ears at a later date and is deaf. New deafness after diving is significant.

The medical should include advice on how to clear the ears and emphasis on the need to do it every half metre (two feet for the pre-metric generation) all the way down and every time one descends that much. This is because the raised oxygen partial pressure in the gas in the middle ear increases the concentration gradient forcing oxygen into the tissues lining the middle ear and so the middle ear volume decreases faster than at the surface, leading to swelling of the middle ear lining and problems with the next dive or even on that one on the way back to the surface. Of course any other advice that the doctor thinks is necessary to enable the person to dive safely should be offered.

I believe that a diving medical is good value before learning to dive. Having done many routine medicals in the RN and the RAN, and never found more than a rise in blood pressure that had changed since the last medical, I am less convinced of the need for regular medicals. However I think that a diving medical could be good value after any illness that puts the diver to bed for more than a couple of days and if the diver develops symptoms, such as chest pain for shortness of breath on exertion, or a systemic disease such as diabetes (non-insulin dependant) or hypertension. In these cases the diver can be advised on the dangers of continuing diving or how to dive safely in the future.

OD Hickey has published a review article in Undersea Biomedical Research entitled "Outline of medical standards for divers"³ which goes into more detail than I have. It is however based on standards for commercial divers not for sports divers. It is well worth reading.

I would remind you of my opening remarks that the doctor advises the would-be sports diver of the risks and leaves it to him to decide what course he is going to follow. A brusque intimation of having failed the medical may take the budding diver back to the dive shop. There he will be told where to find a more accommodating, if less knowledgeable doctor. It is our responsibility to explain things to him so well that he stops wanting to dive.

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DIVING ACCIDENTS 1985: AN AUSTRALIAN VIEW

John Knight

By the end of October 1985 Project Stickybeak, which is run by Dr Douglas Walker, PO Box 120, Narrabeen NSW 2101, had heard of 10 diving associated deaths in Australia. Project Stickybeak is an unfunded, non-government, confidential enquiry collecting accident statistics and publishing an annual report on the deaths for Australia. The latest report appeared in the SPUMS Journal for July to September 1985.¹ Owing to great co-operation from the various coroners, police forces, justice departments and Attorneys General around Australia, the figures are reasonably complete. However, some of the details take a long time to reach Dr Walker because of legal proceedings and delayed inquests and sometimes because no one recorded what would be, to a diver, a significant fact. I must stress that the figures are provisional.

PROVISIONAL DIVING RELATED DEATHS IN AUSTRALIA

JANUARY TO OCTOBER 1985

SCUBA - 7 DEATHS

- | | |
|-----------|---|
| Male 21 | 1st dive after qualification.
35 m Low on air
20 m Out of air. Buddy breathing.
Both ran out of air. Both dropped weight belts. Buddy's vest inflated, victim's did not. |
| Male 46 | Dive to 80 feet. Problem at 10 feet.
Called for help at surface. No cause of death available. |
| Female 24 | 1st dive after qualification 35 m. Out of air on ascent. Could not drop weight belt as shifted weight had jammed buckle. Vest problem. Strong currents. |
| Male | 28 40 m dive using twin tanks. Separated from buddy who raised the alarm. Found with empty tanks. |
| Male | Sucked into pondage outlet. |
| Male | 20 Scallop dive to 20 m. Out of air. |

SNORKEL DIVERS - 4 DEATHS

- | | |
|---|--|
| 1 | Taken by shark when collecting abalone in shallow water. |
| 1 | Spearfishing. Cause of death uncertain. |
| 1 | Epileptic. |
| 1 | Washed out to sea. |

Dr Walker includes in his diving related deaths the deaths of snorkellers. Since 1 January 1985 four snorkellers have died.

The most dramatic was the death of a woman who was taking abalone with her husband in two to three metres of water. A large shark took a bite and she was

dead before she could be brought to the beach some 300 metres away. Some blamed the chumming, dumping blood and meat from boats to attract sharks, which had been carried on for most of the previous week in the next bay. This was because the weather had been rough and the organisers of a shark fishing competition had changed the venue to the large protected bay nearby and had done their best to attract sharks.

One snorkeller was carried out to sea. Poor judgement of sea conditions would have contributed to his death.

One epileptic snorkeller died as did a spearfisherman. The details of these two cases are not yet complete but it would seem reasonable to attribute the epileptic's death to a fit and the other death to hyperventilation followed by anoxia underwater.

There have been six deaths using breathing apparatus. All were using scuba.

Lack of experience obviously contributed to the deaths of the two who were on their first dives after completing their course of training. One must question whether a dive to 35 metres (116 feet) is the right one for a newly trained diver's first dive, especially if there are strong currents. The young woman's family is so convinced that this sort of dive is wrong that they have instituted court proceedings so details of this accident have been frozen until the case is complete.

The cause of death of the man who called for help on the surface, after having an unspecified problem at 10 feet, is still unknown to Project Stickybeak.

I know a bit about the after death occurrences in the case of the man, using twin tanks, who died on a 40 metre dive on a scuttled World War 1 submarine. His buddy lost him underwater and, quite properly, surfaced. The diving club was run by a dive shop which always provided an instructor as a dive leader. He kitted up and went down and searched. He found the body, dragged it back to the anchor line and then ran out of air. Also at the submarine was a boat owned by a friend of mine. He was asked to recover the body as he had not dived yet. This he did, and his wife gave the corpse mouth to mouth resuscitation without result. They sent their 12 year old daughter to the bows with instructions not to watch, but of course she did. She had nightmares for some time and her father had not dived for three months when I last saw him. One assumes that nitrogen narcosis had a lot to do with this death.

The last death was on a scallop dive. The diver was not very experienced and apparently got entangled in the line for hoisting the scallops.

Four deaths were due to running out of air, three due to inadequate monitoring of the contents gauge, and the fourth due to entanglement. One was due to dangerous diving practices, investigating the outlet of a pondage. And the sixth is unexplained.

What can we learn from this sad catalogue of deaths?

I think that the first lesson is that beginners must be comfortable in the water or they will make mistakes.

The second is that beginners must be carefully and slowly introduced to deep diving. And I call deep diving any dive over 12 metres (40 feet). I know that

the conventional wisdom is to call dives over 30 metres (100 feet) deep. But how many of us have behaved oddly at shallower depths? I know I have. At 18 metres (60 feet) in Truk lagoon I wanted to be in the film my buddy was taking of corals growing on the arm of a derrick, so I undid the buddy line and swam round to the other side of the derrick arm. By the time I got there she had finished taking the shot and was having kittens looking at the empty arm band of the buddy line. Those of you who know me know that it was quite out of character for me to do something so likely to provoke panic. I can only attribute it to nitrogen narcosis. Since then I have been very careful not to act on impulse underwater.

The third is that deep diving is much more dangerous than shallow diving.

The fourth is that one should not dive in strong currents unless one knows how to handle the situation. I am a coward and in strong currents I do not wander far from the anchor line and when I do it is up current and on the bottom hanging on to the rocks or plants.

The fifth lesson is that entanglement can be fatal and that one should always keep all lines taught and clear of oneself.

We have dealt with the visible part of the iceberg of diving accidents. Now to the less publicised part, the accidents that people survive and still need treatment in a recompression chamber for decompression sickness (DCS) or cerebral arterial gas embolism (CAGE).

RAN SCHOOL OF UNDERWATER MEDICINE CASES TREATED JULY 1984 to JULY 1985

DECOMPRESSION SICKNESS

Servicemen -	5	
Divers	1	Musculo-skeletal.
	1	Cerebral.
		Both recompression chamber dives.
Aviators	3	Musculo-skeletal
Civilians -	33	All Divers.
	12	Cerebral
	9	Spinal
		Three with residual problems.
	8	Neurological.
	3	Musculo-skeletal.
	1	Vestibular. Still has problems.

CEREBRAL ARTERIAL GAS EMBOLISM

Diver	1	Civilian
-------	---	----------

TOTAL TREATED - 39

I was not, able to gather statistics from all Australian recompression facilities before leaving for New Zealand. However, I have got the majority of the cases that have been treated in recompression chambers. The Royal Australian Navy School of Underwater Medicine at HMAS PENGUIN in Sydney treated 39 people between July 1984 and July 1985, which is a bit down on the year before but still up on five years ago, but down on 13 years ago when the figure was close to 100 a year. In those days the majority were musculo-skeletal with

spinal neurological cases as the next largest group with CAGE well represented. Now the breakdown is quite different. Cerebral DCS is the largest group in the Sydney series. However I have not been able to get hold of the figures from the Prince Henry Hospital, Little Bay, Sydney, who do treat a lot of sports divers so I am presenting a distorted (but uncertainly distorted) picture of the Sydney scene.

Spinal DCS still leaves a third of its victims with symptoms inspite of treatment. The sole person to suffer a vestibular bend, which is uncommon with air diving, was left with symptoms.

Only one case of CAGE presented at HMAS PENGUIN.

NSCA MORWELL CHAMBER

CASES TREATED JULY 1984 to JULY 1985

DECOMPRESSION SICKNESS

Servicemen - 3
 Aviators 1 Cerebral.
 2 Cerebral and Musculo-skeletal.
 Altitude chamber cases.

Abalone Divers -6
 4 Musculo-skeletal.
 1 Test of Pressure for chest pain.
 Not DCS.
 1 Symptom free buddy of DCS patient.

Sports Divers -12
 7 Musculo-skeletal.
 3 Cerebral.
 1 Cerebral and Musculo-skeletal.
 Relapsed and retreated.
 1 Spinal.

CEREBRAL ARTERIAL GAS EMBOLISM

Sports Diver - 1

TOTAL TREATED - 22

New South Wales has a population of over 5 million. Victoria has about 4 million inhabitants. New South Wales has wrecks in deeper water than Victoria so it is not surprising that the National Safety Council of Australia, Victorian Division, has treated fewer patients in the same time at its recompression facility at Morwell. Again only one case of CAGE.

Altitude chambers provided three subjects. Abalone divers required 6 treatments, one of which was symptom free, but had done the same dives as a man with symptoms. It is interesting to note that the abalone divers who dive long hours were all suffering from musculo-skeletal DCS. Test of pressure is a worthwhile manoeuvre to decided whether a person is suffering from DCS or not.

In contrast to the Sydney sports divers the Victorians provided more musculo-skeletal DCS than cerebral. Perhaps this is due to the fact that pain gets through to the altered consciousness of the bent diver, while it is his or her friends who notice the cerebral changes. One woman was sent to Morwell because her GP noticed that she was not herself when she consulted him after a weekend's diving. She was normally cheerful, chatty and extroverted, but that morning

she was quiet. In the chamber her personality changed completely and she became herself again. Her case has been reported in the SPUMS Journal.²

PRINCE HENRY'S HOSPITAL, MELBOURNE

CASES TREATED JULY 1984 to JULY 1985

DECOMPRESSION SICKNESS

Abalone Divers -2
 1 Shoulder pain.
 This man had osteoarthritis in that shoulder from dysbaric osteonecrosis.
 1 Sensorineural deafness.
 He had had multiple cerebral "hits" in the past and is a Punch Drunk Diver.
 Neither had any knowledge of decompression tables.

Sports Divers - 4
 3 CNS.
 1 CNS and Musculo-skeletal.

The final figures that I have are from the single man Vickers chamber at Prince Henry's Hospital in Melbourne. They have had a high proportion of cerebral DCS in sports divers, in fact a 100% incidence. Two of these were fit young men in their twenties who had just done the final weekend of their diving course. It was a long weekend so they did more sea dives than usual, 9 in 3 days. Both of them did a 24 metre dive as their last dive and they worked hard both before and during the dive. Again, inexperience was at work as the instructor considered it a quiet dive, but they both said that they had found the last dive hard work. Both had vague feelings of not being themselves, with skin rash in one, and returned rapidly to normal in the chamber. Both relapsed within 24 hours and needed further treatment.

Once again the complete lack of diving training in abalone divers is shown up. They invest \$250,000 and up in their licence and boat and have to earn a lot to pay off their borrowings. They can earn \$1,000 a day and most dive about 100 days a year, but financial pressure can get them into the water when the weather says "No Diving".

What can we do to avoid these problems?

I believe that the safest way to learn to dive is to be allowed to take your time to become comfortable underwater. And then slowly taken, under supervision, into deeper and deeper water. Certainly I think that the neophyte diver should work down to 35 metres over a minimum of 6 to 10 dives so that he or she knows exactly how to control their buoyancy and how to cope with a simple dive.

We must make sure that the instructors teach the wisdom of staying out of the water when the conditions are less than ideal until you are certain that you can manage those conditions. Even after 15 years diving I have no hesitation in refusing to enter the water if I feel that I am not going to enjoy the dive.

We must make it quite clear to the diving world that the decompression tables are not 100% safe. The USN tables give between 6% and 8% bends when the no decompression tables are dived to their limits in a

chamber. This is not surprising as the acceptance trials gave a 4.75% bends rate. The Bassett tables³ with built in fudge factors must be safer!

In the meantime, I suggest that we keep on reminding ourselves and other divers of how to avoid decompression sickness. The simple rules are to always do no decompression dives, to stay well within the tables, know your maximum depth, watch your time, ascend at no faster than 18 metres (60 feet) a minute and preferably slower and always do a stop at 5 metres.

If one must do a decompression dive, always decompress on a shot rope with a spare cylinder and regulator at the first and second stop depths, always decompress for the next greater depth and the next greater time and do not fly or cross mountains for at least 12 hours. This applies to no decompression dives also. I will be missing Sunday morning's dive as I have to fly to Australia on Sunday afternoon.

I am sure that better teaching of safe diving practices and publicity for the correct procedures following an accident will reduce the incidence of divers needing chamber treatment.

In 1980 at the SPUMS meeting in Singapore and Pulau Tioman, Mike Davis introduced the idea of giving divers oxygen using their own regulator. I have been pushing this hard ever since. At last a commercial adaptor which allows a diving regulator to be attached to an oxygen cylinder has reached the market. It is the Bendeez,⁴ which retails for about \$65 in Australia. It screws into a D size or larger oxygen cylinder. So your regulator can be attached to an oxygen supply. If you have an octopus you have two oxygen regulators and a contents gauge on the oxygen cylinder.

There has been a fire in a home made adaptors. Naturally the fire spread to the regulator and destroyed it. Oxygen supports combustion very well indeed. The regulator that was destroyed had been used with a Bendeez the day before without any bother. The home made adaptor was the pillar valve and tap taken from an air cylinder and mated with a bullnose to fit an oxygen cylinder. The tap was turned off when the cylinder was turned on and when it was opened the fireworks started. The likely cause of the fire was the valve seat of the tap which overheated with the sudden compression of the very small volume in that part of the adaptor when the cylinder was turned on. I believe that the risk of fire is so low using a Bendeez that there is no need to complicate one's diving by taking along a regulator dedicated to oxygen only.

A final item of safety equipment which is difficult to get hold of is a waterproof and pressure proof flare which emits orange smoke from one end or a light from the other.⁴ The flares should be available through dive shops, or yacht outfitters. If your dive shop does not stock them, the distributors are Pains-Wessex (Australia) Pty. Ltd., whose Melbourne office is at 814 Glenferrie Road, Hawthorn VIC 3122, telephone (03) 818 0786. The flares are not cheap, costing around \$40 each, but being rescued when lost at sea is beyond price. The flares depend on O rings for water tightness. So occasional maintenance is required. The flare is small enough to fit in your BC pocket along with your waterproof copy of the Bassett tables.⁶

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