

the medical and instructor organisation arms of the diving community. The power of the legal system to subpoena incident reports and confidential medical records has, naturally, played an important part in perpetuating the habit of avoiding a written record of misadventures. We hope that some day the Law will recognise the value of research to identify and reduce dangers and seek to reward safety efforts rather than hamper them.

What is the answer to this potential problem? The same one that was required when the hyperbaric world was put in turmoil by the paper which questioned the claims that hyperbaric oxygen therapy was useful, or even an effective, modality. Only then was it realised for the first time that clinical impressions might be a good guide but lacked conviction without a sufficiency of hard facts to back them up. Indeed the situation can best be managed by the diving community taking seriously, and actively supporting, the creation of a diving data bank with input from all the various groups involved in recreational and commercial diving. It would be nice if this proposal could be implemented before someone or some organisation is called upon to appear in a Court to face a well prepared

legal cross examination concerning the factual basis for some long held and cherished beliefs, and on the documentation and data justifying past actions and opinions.

References

- 1 Americans with Disabilities Act. 29 CFR Pat 1630 et seq. 1992
- 2 Miniclier PC. The Americans with disabilities act: the disabled diver in commercial diving. *Pressure* 1993; 22 (2): 1,3,5,6
- 3 Low back X-rays and diving fitness. *SPUMS J* 1980; 10 (4): 4-8
- 4 BS-AC on trial. *SPUMS J* 1981; 11 (4): 10-11
- 5 BS-AC medical standards. BS-AC, 1990

Dr Douglas Walker is the founder of Project Stickybeak, from which the Provisional reports on Australian diving-related deaths, which appear regularly in the Journal, are compiled. His address is PO Box 120 Narrabeen, New South Wales 2101, Australia.

DIVING DOCTOR'S DIARY

DIAGNOSIS OF A DIZZY DIVER

Carl Edmonds

Case report

A 30-year old male, of artistic nature, but also a gentleman adventurer, took up diving in 1994. He completed 16 non-decompression dives in 5 months. He was also an aviator, sky diver, hang glider, snorkeller, swimmer and sailor.

One month previously, in calm seas, he performed two beach dives on the one day, both to a maximum of 10-15 m and with a surface interval of 90 minutes. He was nowhere near decompression requirements. The total time of each dive was about 35 minutes, of which the last third would have been spent at depths of less than 5 m.

He felt a slight tendency to unsteadiness after the first dive, but only in retrospect. On the second he felt nauseated and vomited after he ascended, whilst swimming back to shore. He made the interesting observation that, if his eyes were closed and he tilted his head, he would notice a spinning sensation. The dizziness only lasted for an hour or more, but he then felt tired and exhausted.¹

He was seen by a general practitioner who observed haemorrhage on the tympanic membrane, and noted the presence of nystagmus. Despite the relatively minor dive exposure, it was felt prudent to dispatch the diver to a recompression chamber, and a full course of treatment was given, presumably because of the possibility of decompression sickness (DCS) causing generalised and cerebral symptoms.²

A month later he returned to his diving and descended to 12 m for 35 minutes. Again, about a third of this would have been spent doing a very slow ascent. On the surface swim, when returning to shore, he noted that if he looked to his left he would become dizzy. He then observed that he was unsteady while walking. The dizziness increased if he closed his eyes. "This was not my normal balance, and it stayed like that for an hour or so". His hearing felt "not clear", and muffled.³ He was also aware of a high-pitched continuous sound on the left side. He then slept for hours, being tired and exhausted. By the next morning the tinnitus had gone.

He took aspirin,⁴ on medical advice, and stayed in bed.

When he was seen two days later, he had decided not to undergo another proposed recompression treatment, as the previous one didn't seem to do much good. He then

visited the Diving Medical Centre.

On examination, apart from the Grade I - II middle ear barotrauma effects, there was no abnormality to be detected at the time I examined the diver, and he was quite capable of performing the Sharpened Romberg test.⁵ One would have been forgiven for assuming that this was a fairly simple case of middle ear barotrauma, as there was only objective evidence of Grade II barotrauma of the left ear, Grade I on the right.

Unfortunately the pure tone audiogram revealed the following.

Hz	500	1000	2000	4000	6000	8000
Right	15	10	10	15	10	10
Left	10	10	5	10	25	30

Why did we not compare the pre-incident (pre-diving) audiogram, which should have been performed during his recreational diving medical, that same year ?

Unfortunately the original audiogram, as recommended (**should** was used rather than **shall**, which in Australian Standards implies **must be done**) in the Australian Standard 4005.1, was not performed. Another one of the Mickey Mouse Diving Doctor examinations characteristic of North Queensland!

The treatment, seeing him two days after his second diving accident, was to

- 1 avoid all medications including aspirin, and middle ear equalisation manoeuvres,
- 2 avoid any exercise or activity, straining (defecating, coughing, sneezing, sexual activity etc.)
- 3 spend most of the next week in a sitting up position, optimal for the repair of a possible round window fistula,
- 4 repeat pure tone audiograms to ensue that the hearing loss did not progress.

The pure tone audiogram performed a week later appeared to have improved considerably, so that even the presumed high frequency hearing loss had disappeared, suggesting that it was a temporary threshold shift, and thus indicative of inner ear damage.

The diver was sent to one of the top vestibular function laboratories in Sydney and the results showed no evidence of spontaneous nystagmus (verifying the observation that he had compensated for the damage, or inhibited it). Caloric stimulation showed no response to hot or cold water on the left side, and a slightly impaired response on the right. Iced water calorics produced exactly the same negative result.

Diagnosis: Vestibular damage especially affecting (L) side.

Prognosis and advice

WHAT TO DO WITH HIM AS A SCUBA DIVER?

Well he is obviously one of those people who are not particularly sensitive to the effects of middle ear barotrauma. On closer questioning it did appear as if there had been evidence of muffled hearing after diving, and occasionally he would notice pressure on his ears during descent. He certainly descended slower than most of his companions.⁷

The diagnosis was inner ear barotrauma. He has now had two episodes, and he is likely to have many more with diving, with the main initial threat being vertigo and vomiting and the delayed effects the recurrence and persistence of tinnitus and possible high frequency hearing loss. As he is a musician, this can be catastrophic to his occupational future. Cease scuba diving.

FREE DIVING?

This is likely to cause more problems than scuba diving. Unfortunately with snorkel or free diving it is easy to not notice lesser priorities, such as middle ear pressures and the need for auto-inflation, when larger priorities such as the need to descend, dominate the diver's attention. Many free divers do not even attempt middle ear auto-inflation whilst diving, and most of them are not aware of the importance and value of a positive pressure middle ear auto-inflation technique such as the Valsalva, employed before the descent. There is no problem with surface swimming or snorkelling.

HIS ACTIVITY AS A PILOT?

This is somewhat hairy. If you have one vestibular system inactive, then expansion of the middle ear space during ascent is likely to produce a "alternobaric vertigo", which could be catastrophic. I would certainly advise these people not to pilot a plane, even though there is no clinical evidence of vestibular dysfunction (without provocation tests). Even though he has no vertigo or nystagmus normally, the inequality is seen with the ENG during the caloric tests. It can also become evident during ascent in recompression chambers and aeroplanes. I do not want to be a passenger in the plane if he is a pilot.

SKY DIVING?

This could be a problem. As he so much loves this sport, I have assured him that he could use a nasal decongestant before he enters the plane. He should also forcefully equalise his middle ear spaces, using a Valsalva technique, before the jump. This will ensure that he starts off his jump with the middle ear fully inflated and the tympanic membrane protruding. He was also advised to attempt middle ear auto-inflation during descent, and probably as soon as he lands. Considering most of the jumps

are from a height of 10,000 feet, this should probably be adequate to prevent further middle and inner ear damage.

PARACHUTING?

No problem, if similar restrictions and advice are applied as with sky diving.

LEGAL IMPLICATIONS?

One would hope that the diver would not take action against the physician who did the diving medical examination. Certainly, if he were to do so, the patient would probably win. Not only did the examining doctor not perform the pure tone audiogram, as required, but also he did not ensure that the diving candidate could equalise his middle ear spaces. A very good case could be made for the incompetence of this doctor. Certainly, if the diver had been advised of his physiological inadequacies, then he would have been much more reluctant to expose himself to the hazards of inner ear barotrauma, with its complications regarding his occupational and recreational activities, which are extremely important to him.

Footnotes

1 Vertigo induced by eye closure and head tilting strongly implies a peripheral (vestibular) more than a central (brain) lesion.

All diving physicians are aware that tiredness and exhaustion are manifestations of DCS. They are also very, very common manifestations of a vestibular disorder. It takes a lot of effort to maintain one's balance in the presence of a vestibular abnormality.

Also associated with vestibular disease is a feeling of disorientation and other psychological reactions such as irritability and depression. People with vestibular disease also find it hard to concentrate. They do not have to have DCS for this to be so.

2 I would have thought the signs and symptoms were much more consistent with ear disease due to barotrauma, than DCS. But often it is very difficult to send a diver away from the chamber, while he still has symptoms.

If middle ear barotrauma is observed, the possibility of inner ear barotrauma (with damage to the cochlea in 40% of the cases, vestibule in 10% and both in 50%) is to be considered. Tinnitus is, however, often the major symptomatology.

3 The history of muffled sound, followed by cracklings as the gas bubbles mixed with the middle ear effusion and are affected by jaw movements, is also

fairly common in middle ear barotrauma. Tinnitus, high frequency hearing loss (a temporary or permanent threshold shift) and/or unilateral ENG verified vestibular dysfunction all point to a peripheral lesion of the 8th nerve, not usually a brain lesion

4 The pathology of inner ear barotrauma can be either a round window fistula (not rare, but certainly not the commonest), inner ear haemorrhage, air bubbles traversing the stretched round window and entering the perilymph, or possibly some internal membrane rupture within the inner ear. One thing for certain, aspirin with its haemorrhagic complications is not a recommended form of treatment. Nor are vasodilators, but thank heavens people have stopped using them.

5 I am worried that the Sharpened Romberg is too often used as an investigation of exclusion. This is not valid. It is quite possible for the diver to have received damage, which was more or less being compensated by him allowing a normal Sharpened Romberg assessment. This test does not exclude vestibular damage.

6 This is the most dubious of all results. By any normal standards, the pure tone audiogram was acceptable, but if the left side had originally been the same as the right, as it usually is, then he may have lost 15 to 20 decibels in the high frequencies (6000 - 8000 Hz), consistent with inner ear barotrauma.

7 This is a very common feature with people who have Eustachian tube insufficiency. They descend slowly so that their middle ear effusion can replace the gas space contraction due to Boyle's law. The muffled hearing, and occasional crackling sounds in the middle ear, following the dive is evidence of this middle ear effusion.

Dr Carl Edmonds address is Diving Medical Centre, 66 Pacific Highway, St Leonards, New South Wales 2065, Australia.

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problems in diving. An up to date list of the names, addresses and telephone numbers of these doctors can be found on the back of the Medical Form.

Dr Sandra Domizio is the Secretary of the UK Diving Medicine Committee.

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