Chest x-ray was normal. Her haematocrit was 0.43 (normal 0.36-0.47). Over the previous 24 hours she had been allowed a normal oral intake as well as receiving one litre of cystalloid intravenously. She had been kept on 50% oxygen for this time.

It was decided to use hyperbaric oxygen treatment, with table RN 62, as DCS was possible. At the end of the second oxygen period, she still complained of knee pains and headhache but these vanished during the third oxygen period.

Symptoms did not recur and the patient was discharged four days after her dives, and reviewed a week later. Negative results for RA latex, Epstein-Barr virus, Ross River virus, and an autoantibody screen were obtained.

Discussion

The symptoms in this case are consistent with DCS, and did resolve with hyperbaric oxygen, even though the dive does not support this diagnosis. However, no evidence was obtained to support the alternatives of ciguatera, marine envenomation and unrelated polyarthritis. Current theories of DCS support the concept of "silent bubble" formation possibly occuring with any decompression, both intravascularly and in the tissues. The safe depth of 10 msw merely refers to the development of symptoms. It is to be expected that some people will either produce more bubbles, or suffer symptoms with fewer bubbles, than most of the population. This assumption predicts that occasional victims of DCS will be extremely susceptible and reinforces the statistical nature of the dive table. It is impossible to produce a dive table and say DCS will be eliminated by following its guidelines.

Bubble formation in tissues presumably causes symptoms by compression and ischaemia. Intravenous bubble formation (asymptomatic) has been reported after 18% of dives (depths ranging from 6-39 msw), but after 25% of dives deeper than 25 msw.[2] These bubbles are not sufficient to cause symptoms of gas embolisation, however they do cause complement activation in a proportion of the population.[3] The rise in right atrial pressure which follows immersion would encourage transfer of these venous bubbles to the arterial side of the circulation.[4] 37% of a sample of divers with DCS showed right to left shunting through a patent foramen ovale as against 5% of the normal population.[5]

It is apparent that anatomical and physiological factors predispose some divers to the development of DCS and these people should be very cautious about continuing their diving careers.

In spite of resistance from the patient, her family, and the local diving fraternity, she has been advised to accept the diagnosis of DCS and told that in her case, it is not possible to state a time after which further diving will be safe.

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REVIEW OF 1000 SPORTS DIVING MEDICALS

John Parker

Introduction

A diving medical is a medical examination which concludes in a professional opinion whether a person, by reason of their present medical state, is in danger of adversely affecting their health if they scuba dive.

Being a professional opinion it can be challenged. A doctor must be able to justify his decision in light of current medical knowledge and opinion.

No mortality or serious injury is acceptable in diving. Should a person be placed in any risk of this by their present medical state, they must fail.

Should a person be more liable to suffer a minor injury because of their medical state, then they must be forewarned of the dangers and instructed how to avoid such an injury.

The diving medical is necessary to protect:

1. The diver who may be totally unaware of the dangers of scuba diving and needs to be protected from putting his life at unnecessary risk;

2. The diving operators who need to know that the people that they are taking diving are medically fit and not a medical liability.

I have reviewed my most recent 1,000 initial sports diving medicals to identify the common problems encountered, to define the local diving population around the Whitsundays, to provide a baseline for future trends and to consider ways of improving diving medical services.

Unfortunately, my records cannot be considered representative of the whole of the Whitsundays, as my surgery is mainland based. Many divers, especially American and Japanese tourists, fly directly to the islands where they have a diving medical.

The Whitsundays is an area on the coast of central Queensland with 74 islands extending 32 km off shore. The adjoining section of the Great Barrier Reef is 64 km off shore. The islands and adjacent mainland host many tourist resorts and facilities. The local harbour, Shute Harbour, is the second busiest passenger port in Australia. The area has 11 diving centres run by eight independent diving companies. It is becoming a well-known and well-visited centre for scuba diving.

The Diving Population

The majority of divers were in their twenties. The average age was 25. 10% were over 30 and 6% were under 20. Only 3% were over 40.

Males predominated, but only in the proportion 60:40.

Surprisingly, only 22% were Australian, and British was the most common nationality (see Table One).

The low number of Japanese is not representative of the area but the other nationalities are probably representative. The vast majority of our divers are young tourists from overseas wishing to dive the reef as an adventure in the same way they will go white water rafting on the Tully River and four wheel driving in Cape York. It would be interesting to find out how many of them continue diving.

Discussion with other doctors in North Queensland strongly suggest that my figures are representative of the North Queensland area as a whole, from the Whitsundays to Port Douglas, where each week several hundred divers are taught.

TABLE 1

COUNTRY OF NATIONALITY OF DIVERS

United Kingdom	327
Australia	222
Canada	83
Germany	61
USA	57
Sweden	54
Switzerland	49
New Zealand	31
Holland	24
Ireland	22
Austria	14
France	13
Denmark	12
Finland	7
South Africa	5
Norway	5
Israel	5
Japan	4
Zimbabwe	2
Portugal	1
Spain	1
Malaysia	1

If one assumes that the vast majority of these divers will rarely dive again, then the estimated diving population of Australia, quoted by the diving instructor bodies based on dive course numbers and a higher retention rate, may be exaggerated.

The Medical

The diving medical consisted of a completion of a comprehensive questionnaire, a full physical examination and a spirometric measurement of the forced vital capacity (FVC) and the forced expiratory volume of one second (FEV_1). A chest X-ray was taken with any past medical history of lung disease or infection, or a family history of TB. An audiogram was performed if there was any history or clinical suggestion of middle or inner ear disease or hearing loss. Any candidate 45 years or older had an electrocardiograph.

The Failures

A total of 84 divers failed their initial medical, 27 of them provisionally and 57 permanently (see Table Two).

Despite all the dive schools screening their students, the commonest reason for failure is asthma. My present

policy on asthma is that anyone with an asthmatic history will fail unless they have been free of all attacks or the suggestion of an attack since the age of 12 and for at least ten years.

Two divers were found to be asthmatic who did not know they had it. Some tried to hide it but were identified clinically, whilst other were mild asthmatics and thought they should dive.

TABLE 2

REASONS FOR FAILURE

Asthma	39
No demonstrable ear equalisation	7*
Acute chest infection	5*
Severe scarring of ear drum	5
History of pneumothorax	4
Upper respiratory infection	4*
Middle ear effusion	3*
Impacted wax in ear	3*
Otitis media	2*
Severe Otitis externa	1*
Acute sinusitis	1*
Insulin dependent diabetic	1
Acutely infected wisdom tooth	1*
History of reconstructive maxillary surgery for congenital cleft lip and palate	1
Chronic active Hepatitis	1
Recent use of Bleomycin	1
History of chest surgery	1
Pleural adhesions from old chest infection	1
History of stapedectomy	1
Chronic bronchitis	1
Sarcoidosis	1

* provisional failures

The next most common reason for failing was the inability of the diver to demonstrate Eustachian Tube (ET) function by the Valsalva (blowing with the nose and mouth closed) or Toynbee (swallowing with the mouth and nose closed) manoeuvres despite full instruction and numerous attempts, yet with no obvious pathology. In the novice diver, this is a dilemma. It may be only technique and lack of practice, but to pass them would expose them to likely early aural barotrauma and possible future hearing loss, and failure to complete their diving course with considerable financial loss.

Only one of the seven who could not autoinflate returned able to demonstrate normal ET function. The other six either continued to have no function or moved on in their travels or to another medical examiner !

I recorded the incidence of some of the commoner conditions and problems significant to diving (see Table 3).

A diver's ears were only syringed if the external canal was occluded with wax or debris, making it impossible to view the ear drum adequately. For the diver to dive with such a blocked ear may cause external ear infections (especially in the tropics) and a possible danger of reverse squeeze (external ear barotrauma of descent) if water cannot enter the ear canal to the tympanic membrane.

TABLE 3

INCIDENCE OF COMMON PROBLEMS

History of hay fever	98
Previous chest infections	69
Migraine history	74
Glycosuria found (none found to be diabetic)	5
Heart murmur at examination	29
Needed to have ears syringed	72
Smokers	311

Discussion

Sports diving medical standards still vary immensely from doctor to doctor. Only after attending the diving medical courses at both HMAS PENGUIN and the Royal Adelaide Hospital's Hyperbaric Medical Unit, have I discovered that there are certain absolute contraindications and many relative contraindications. The relative contraindications are open to much interpretation.

There is a need for a Diving Medical Standards handbook where the medical standards for sport diving are actually defined in much the same way as aviation medical standards. This will allow medicals to be more consistent, more credible and more acceptable. Too long has it been possible to fail a medical then go down the road and pass.

I am now in the process of writing such a handbook for use in my practice. It is a teaching process in itself, making oneself justify each decision, researching the evidence and opinion in diving medicine.

A controversial subject in diving medicine is the prospective diver with a borderline history of asthma or a history of childhood asthma who has not had an asthma attack for many years. In the city they may be referred to a respiratory laboratory for full assessment. In country areas this is not practical. I have found it necessary therefore to set up histamine and hypertonic saline provocation tests in my

surgery. Another very useful tool is the impedance tympanometer for assessing the tympanic membrane, the ossicular chain and middle ear function.

Conclusion

There has been little information published on the results of sports diving medicals. By reviewing my last 1,000 sports diving medicals I have attempted to highlight interesting points, identify problems and shortfalls in medicals, with possible solutions and, hopefully, create further discussion on the needs of diving doctors and the diving industry. Only by showing how diving medicals help the diving industry will they become totally accepted and supported.

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PAPERS FROM THE SPUMS 1989 ANNUAL SCIENTIFIC MEETING

PROBLEMS WITH LESS THAN 2 ATA EXPOSURES

Jimmy How

Introduction

Diving and working in compressed air tunneling are similar in many respects. After noticing the 10 cases of decompression sickness (DCS) arising from compressed air work at less than 1 bar gauge pressure, it brings to mind that sports diving, even at shallow depths can carry risks of DCS. Aside from DCS, the commonest diving accidents and deaths that are seen in Singapore result from divers experiencing problems at shallow depths. I will discuss:

(a) DCS at shallow depths
(b) Medical problems in diving
(c) Diving in unfamiliar situations

Brief Historical Background

People have been diving for food, pearls, sponges for thousands of years. Divers have been known to be in existence during the time of the ancient Greeks and the Trojan War.

Breath-hold diving was the earliest form of diving that evolved. Breath-hold divers are still in abundance everywhere where shallow, calm and warm waters provide the recreational diver a chance to immerse himself amongst the abundant marine flora and fauna found in the tropical and subtropical regions of the world.

It is noteworthy that breath-hold diving for commercial gain still exists among the natives in the Pacific Islands and among certain traditional occupations in Japan and Korea.

Sports diving with self contained equipment only became popular after 1943 when Jacques-Yves Cousteau and Emile Gagnan developed the modern demand intake valve. Today, there are thousands of recreational divers who venture out into the sea daily. With the explosion of the sport in the 70s and the 80s, diving physicians are concerned about the safety of the medical selection and diving training provided by various diving operators. Inexperience among the new entrants to the sport and the overconfidence of the experienced diver have resulted in unnecessary fatalities.

Surface supply equipment is another method of diving commonly practiced. Many of the cases of decompression sickness treated in Singapore in the late 1970s and the early 1980s were fisherman divers suffering from DCS who had used surface supply equipment. Abalone divers in Australia use surface supply equipment. Based on our experience with the Singapore Mass Rapid Transit (MRT) Project, it may even be possible to suffer from DCS at shallow depths of less than 10 metres.

I will discuss the problems that may be encountered by the sports diver at less than 1 bar gauge (or 10 metres sea water) exposures and highlight certain diving related problems that can arise either through ignorance or overconfidence. But first I will discuss the 10 cases of DCS arising in compressed air workers during the MRT project.

Decompression sickness after less than 2 ATA exposures

Decompression sickness occurring at pressures of less than 1 bar gauge or (14.7 psig) is very unusual. A literature search revealed that probably only Behnke[1] has ever reported instances of cases of DCS at less than 1 bar gauge exposures for compressed air workers. In his report, he noted 9 cases of DCS occurring in less than 1 bar exposures of compressed air workers at the Bay Area Rapid Transit (BART) Project in San Francisco, California.