

develop in many standard dives and probably would occur in most of the liberal diving and flying programs. The importance of "silent bubbles" has not been firmly established, but they may have long term significance. At any rate the current goal in decompression research is to reduce the incidence of "silent bubbles".

What is the average diver to do? Consider that most commercial and military agencies are moving toward conservative policies; ie. 8-12 hours after "no decompression" dives before flying. Saturation divers may be kept at sea level for up to a week before being allowed to fly. Remember also that 7% of decompression cases develop after six hours on the surface. A plane trip shortly after a dive would aggravate an already developing case of decompression sickness.

There is one way to safely shorten the time between diving and flying: breathe pure oxygen. But this is not usually practical and would be inadvisable over a long period.

The prudent diver plans his diving vacation carefully by putting the heaviest diving days in the middle of the vacation. This provides a day or two for familiarization of the dive site and gives time for maximum nitrogen elimination.

Save snorkelling and shopping for the last day. Remember that the low incidence of decompression sickness in flying divers is due more to the blessing of inefficient travel connections than to any safety factor. The risk is genuine.

1. Any mode of altitude change can be dangerous as demonstrated by divers who got decompression sickness during a post-dive bus trip.

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## Epilepsy and Diving

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It is estimated that since the mid 1950's, more than two and a half million people have been trained in scuba diving in the United States of America, with probably somewhere under a million of these remaining as active divers from year to year. The popularity of the sport indicates that at some stage a physician may come in contact with a person who wishes to dive. Although there has been a wealth of knowledge produced in the fields of hyperbaric medicine and physiology, in an effort to delineate the stresses and limits of man's exposure to pressure, there has not been a concomitant dissemination of knowledge of diving medicine amongst the general medical profession.

Some of the stresses which face the diver include the consequence of inadequate medical and physical fitness; the effects of changes in ambient pressure on gas-filled body space and on density of breathing pressure of inert gas, oxygen, or contaminants, such as carbon monoxide; the effects of too rapid a reduction of ambient pressure; immersion in cold water and excessive heat loss; and psychological disturbances due to confinement, isolation, darkness and danger.

In the diving manuals of most Navy and civilian

organisations, the importance of medical fitness to dive is always stressed. Perhaps the first step in ascertaining "fitness to dive" is that of ensuring the absence of the various diseases which are incompatible to diving. These conditions may not prevent participation in any other sport, but are especially relevant in diving because of the changes in ambient pressure involved. Also, any disease state which may produce unconsciousness or incapacitation is potentially fatal under water. Although the various Navies of the world have long demanded stringent medical assessments of their prospective and active divers, and most commercial diving organisations are realising their importance, this has not been so in the sport diving field.

Some sport divers may find themselves in the situation where they are more aware of the special medical problems of diving than their medical attendant. It is therefore, of obvious importance that the medical examination should be carried out by a doctor familiar with the medical aspects of diving. There are no doubt, instances of diving fatalities and accidents, which would not have occurred had the victims been assessed medically and advised against diving.

Meckelnburg (1978) states that in the USA all nationally recognised training organisations now require physical examinations of prospective divers before they are allowed to undertake scuba training. Commercial training is even more difficult, and since 1977, regulations promulgated in the Federal Register by the Department of Labour have controlled standards in the diving industry. These regulations produced various reactions amongst different groups - some American diving contractors claimed that to follow the restrictions would put them out of business. The university scientist and scuba shop salesman claimed that it did not relate to them. It thus became obvious that standards may vary with the type of diver.

The population at risk is perhaps difficult to estimate exactly. Apart from commercially employed divers, there are probably large numbers of self-employed semi-professional people or even rank amateurs engaged in underwater work. Such work may vary from harvesting sea life such as abalone to the extremely deep, hazardous, complex off shore diving related to oil exploration.

The problems are enhanced when a person previously self employed as an abalone diver with perhaps little or no training, who may have disqualifying defects, decides that he wants to work for a commercial firm as a qualified diver. Prior to the introduction of more stringent regulations, some of these people could well have been employed by commercial diving companies, and these people could be asked to perform tasks beyond their professional and technical abilities without any consideration of their physical capacity to tolerate the new stresses involved.

Obviously, off shore oil exploration poses the greatest area of risk as many of these diving operations are carried out hundreds of miles from shore where medical and support facilities are lacking and weather conditions may present problems when medical attention is necessary or a casualty occurs. Experience in the North Sea oil fields and from the Gulf of Mexico oil fields indicate that for the year 1974, the fatality rate for off shore diving was 111 fatalities per 10,000 persons per year. This contrasts to an approximate 2.6 fatalities per year per 10,000 persons engaged in general construction industry and mining industry.

In Australia, standards have been laid down by the Standards Association of Australia, Code CZ18 1972. Underwater air breathing - Appendix A - Medical Standards

for Divers. This document places special emphasis on the absence of pathology in respiratory, cardio vascular, special senses (visual and auditory) and the nervous system. Table A5 in this document relates to neurological conditions as follows:-

“No serious signs or symptoms are acceptable. Migraine is acceptable, but this may be precipitated more frequently by diving. A history of epileptic episodes and syncopal attacks are an absolute bar to diving. Almost any neurological disease makes diving inadvisable.”

Meckelnburg lists the following neurological conditions which are absolutely disqualifying:

- a. Any reason to have sudden loss of consciousness.
- b. Seizures after the age of five and unassociated with febrile episode.
- c. Any central nervous system disease such as neurosyphilis, multiple sclerosis, etc.
- d. Psychosis.
- e. Brain tumour.
- f. Meniere's disease.
- g. Severe migraine.
- h. Head injuries present a series of variables that have to be assessed carefully. Head injuries which are absolutely disqualifying are:
  1. Unconsciousness for a period greater than forty eight hours.
  2. Depressed skull fracture.
  3. Known brain laceration.
  4. Sub-dural or epidural haemorrhage.
  5. Intracerebral haemorrhage.
  6. Post traumatic meningitis.
  7. Rhinorrhoea or otorrhoea persisting far more than seven days.
  8. Seizure at the time of a head injury.
  9. Any persistent neurological defect after head injury.
  10. Any persistent EEG change.
  11. A persistent higher intellectual defect.

Individuals would be disqualified for up to two years who have normal EEG and normal physical examination, but who are unconscious for a period of two to twenty four hours with or without a linear skull fracture. Included in this group would be people with post traumatic amnesia for greater than twenty four hours and a post traumatic syndrome with memory loss, personality changes, and disequilibrium for a period up to two months.

A diver with a head injury could be returned to diving after a period of three months if he had the following qualifications:-

1. A linear skull fracture with fifteen minutes of unconsciousness or less.
2. Loss of consciousness ranging from fifteen minutes to two hours, but no fracture.
3. Cerebro spinal fluid, rhinorrhoea or otorrhoea lasting less than seven days.

Divers suffering neurological bends with a spinal cord lesion or brain lesion could be returned to work if the neurological deficit clears completely, but in the face

of persistent neurological deficit, such a diver should be disqualified.

Whatever the cause of a seizure occurring underwater, a fatal outcome can rapidly follow, and it is because of this that standards of fitness to dive have been laid down by various authorities. Current British Naval practice does not accept an individual with an EEG suggestive of epilepsy, even if the patient has never had a fit. United States Navy regulations state that “Organic brain disease, seizure disorders of any sort ... shall be disqualifying”. In Britain, the memorandum for medical officers who have been approved by the Secretary of State, Department of Energy to undertake the medical examination of commercial divers in the North Sea states that epilepsy is among the conditions which disqualifies a man from diving. The British Sub-Aqua Club has recently decided to exclude from diving those with a history of epilepsy.

In France, a medical examination of fitness for diving sometimes includes an electroencephalogram examination for professional divers. Corriol et al. (1976) studied ninety professional divers of whom thirty seven displayed EEG patterns susceptible of being interpreted as falling outside the limits of strict normalcy. Previously such patterns have sometimes been considered incompatible with diving, or even pathological by other authors. They proposed a general guideline which placed subjects into three groups fit, unfit, and questionable. In the latter group, a final decision was taken in each individual case in relationship to other medical examinations and was also related to the type of diving being considered. Their article details explicit EEG criteria, of definitive or temporary fitness and unfitness. In line with the recommendations of the British and United States Navies, any subject possessing clear EEG patterns of epilepsy of any kind, was eliminated from further consideration even in the absence of clinical seizures. They did not regard moderate photosensitivity (spike and wave evoked only by photo stimulation) without other evidence of epilepsy as being incompatible with recreational diving provided that regular medical observation took place.

#### SUMMARY

Because of the large number of people engaged in diving, either commercially or for sport, various regulations have been drawn up by different institutions to govern the health standards of people engaged in this activity. All authorities agree that epilepsy is an absolute bar to diving.

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