The Editor encourages readers to join him in subscribing to the Historical Diving Society. If this issue is typical there is a lot to learn about the past.

John Knight

OCEAN REALM

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Key Words

Environment, general interest.

Among the Editor's mail was an unsolicited copy of the Autumn 1996 issue of Ocean Realm. It is a 112 page diving magazine, printed on high quality paper with excellent articles and photographs. It is aim is "To present a catholic selection of timely marine environmental topics to a broad audience of concerned individuals".

Certainly this aim is well fulfilled in this issue. There are articles on the overfishing of reefs using cyanide to provide large, live, reef fish for Asian restaurants, where the diners choose their fish from those swimming in the tank. The size of the desirable fish means that they require high concentrations of cyanide to capture. Not all recover from the cyanide, and the concentrations are so high that the small reef fish die from the poison.

Another paper covers the life of the Bluefin tuna, the world's most valuable animal, as seen from Port Lincoln. It lists the good and the bad about tuna farming, but there is no mention of the workload put on the Royal Adelaide Hospital Hyperbaric Unit.

Later on there is an article on the various by-catches, many more tons than the desired fishes provide, of ocean fisheries. Other offerings are 16 pages of magnificent photographs of whales and dolphins, and 7 pages on the ecology and conservation of the Hawksbill turtle. There are many other interesting articles, but not the usual dive travelogues that provide the staple diet of most diving magazines.

Ocean Realm is aimed at the same readership as National Geographic (USA), Australian Geographic and Australian Nature Magazine (published by the Australian Museum). It is strongly recommended reading for anyone interested in the sea and its animals.

John Knight

SPUMS ANNUAL SCIENTIFIC MEETING 1996

IN-WATER OXYGEN DECOMPRESSION AS AN EXAMPLE OF LIVING AND WORKING WITH RISK

Des Gorman

Key Words

Accident, injury, oxygen, risk, safety, tables

Introduction

The process of risk management is central to activity-related health and should be a central feature of all diving practice. However, such management is not widespread and most divers adhere to a naive concept of safe versus unsafe diving practice; an essential reliance on a mythical practical threshold of inevitably favourable outcome. Indeed, many recreational diving instructor groups and individual schools market themselves as "teachers of safe diving". It is possible that this safe-diving faith-system results in a stigma of fault and hence denial in the event of a diving accident. This phenomenon is one of the major reasons why divers suffering from DCI in Australasia take more than a day from the onset of their symptoms to report for treatment.[1]

The process of risk management is now well defined and readily applicable to diving.

In-water oxygen decompression is frequently used in deep diving to avoid dilutional hypoxia and to accelerate inert gas elimination. There are however real risks in using oxygen in this way and hence the decision to undertake oxygen decompression in the water should only ever be made in the context of a risk-benefit analysis and a consequent risk management system.

The process of risk management

In the context of health and safety practice, the process of risk management is based on the following steps.

The identification of the relevant hazards.

The assessment of the risks involved (This is often very difficult unless there is a comprehensive database.).

The development of control measures. (These measures should be, and in some countries must be, introduced in the following sequence;

the elimination of the hazard,

the substitution of the hazard,

the minimisation of the hazard,

the protection of the individual from the hazard, and finally,

compensation for the person who is exposed to the hazard.).

Communication and acceptance of the net risk(s).

An audit of the ongoing process and a refinement of the control measures.

A diving task

An Insurance Company wants a container retrieved from a flooded mine shaft. The container is at a depth of 90 m. The nature of the shaft precludes the use of any diving stage or bell and the visibility is so poor as to render both manned and un-manned submersibles useless.

You are asked to oversee a diving recovery of the container. Initial inquiries show that the container is reasonably accessible, such that the diver(s) will be able to reach the container within the length of your 120 m umbilical (so that surface supplied gas is possible). The entire dive should take about 30 minutes.

Your review of available decompression schedules shows that all of those with established rates of decompression illness of less than 1% include in-water oxygen decompression.

You decide to use a mixture of 16% oxygen and 84% helium to avoid oxygen toxicity during the dive and because air will be too dense to breathe and severely narcotic.[2]

In-water oxygen decompression

The decision to use in-water oxygen decompression in general is based on the need to avoid dilutional hypoxia and to accelerate decompression. The dive planned here is such that some in-water oxygen decompression is not only an invariable feature of all the established decompression schedules, but also will be needed if the dive is undertaken or the diver is almost certain to become unconscious from hypoxia during the latter stages of the decompression. Clearly a diver may elect not to accept the risks associated with such an activity and withdraw from the diving team.

The first stage of a risk related approach to in-water oxygen decompression is the identification of the associated risks (shown in Table 1 as a comparison of the advantages and disadvantages of in-water oxygen decompression) and a determination of the actual level of risk involved.

TABLE 1

ADVANTAGES AND RISKS OF IN WATER OXYGEN DECOMPRESSION TO THE DIVER

Advantages	**Disadvantages (risks)**
Avoid hypoxia	Oxygen toxicity
Accelerate decompression	Fire risk
Increase thermal comfort	Gas handling and switching
Improve communications	
Decrease costs	

It is quickly apparent that the major risk in this context is oxygen toxicity, and especially central nervous system toxicity.[2] For your specific undertaking, reference to standard databases[2] shows that the planned oxygen exposure has a real risk of an oxygen convulsion, although this probably is much less than a 1% risk if the time of exposure is brief and other factors (carbon dioxide tension, activity, anxiety, body temperature etc.) are controlled.

The second stage of a risk related approach is to identify the appropriate control measures. To avoid hypoxia, it is not possible to eliminate or substitute oxygen (or a progressively enriched oxygen-mixture) breathing during the decompression. It is nevertheless possible to minimise the risk and to protect the divers by using the following practices;

equipping the divers with full face masks (such that they will not drown if they become unconscious), underwater communications, lines and shot ropes that will prevent them from getting lost and will enable the decompression to be controlled;

choosing a decompression schedule that uses oxygen-enriched mixtures during the early phase of the decompression and only introduces 100% oxygen late in the decompression;

controlling the carbon dioxide levels to prevent hypercarbia;

allowing the divers to rest during the in-water oxygen decompression;

controlling the diver's body temperature;

ensuring adequate gas supplies;

providing an on-site recompression chamber to treat episodes of omitted decompression.

As the final phase of this risk related approach these risks and the adequacy of the control measures now need to be explained to your prospective divers so that they can make a decision about whether they will undertake the dive. Careful dive logging is needed to ensure that both the diving practice and outcome can be audited.

Summary

The management of risk is the central process in most human occupations. The established techniques in this context are directly applicable to diving.

References

1 Gorman DF and Harden M. Outcome after treatment for decompression illness in Australasia. *SPUMS J* 1993; 23 (3): 165-168
2 Donald K. *Oxygen and the diver*. Hanley Swan: The SPA Ltd., 1992

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TREATMENT OF DECOMPRESSION ILLNESS FOLLOWING MIXED GAS RECREATIONAL DIVES

David Elliott

Key Words

Decompression illness, hyperbaric oxygen, mixed gas, recreational, treatment.

Introduction

In 1995 the Undersea and Hyperbaric Medical Society held a two-day workshop jointly with the Aerospace Medical Association on the "Treatment of Decompression Illness". Three weeks after the 1996 Annual Meeting of SPUMS, there will be a two-day conference in Marseilles on "Decompression accidents among amateur scuba divers" organised by the European Committee for Hyperbaric Medicine and later in 1996 there will be a further workshop on "Decompression illness in recreational diving" at the International Joint Meeting on Hyperbaric and Underwater Medicine in Milan. From so many meetings in so short a space of time and on such a relatively rare condition, there can be only one conclusion. There is no consensus.

Yet the obstacles to consensus are slowly being cleared away. There is recognition of the need to use agreed descriptive nomenclature, to collect detailed case histories (not anecdotes) from different treatment centres for analysis and, wherever feasible, to conduct trials of therapy on a scientific basis. In the meanwhile, we are forced to rely upon personal observations and experience, based on case histories. These are traditional tools in medicine which are still useful and, at the very least, can lead to the development of new hypotheses.

In the continuous search for some unifying solution, reports are presented in which treatments are compared with other treatments when, from the diverse nature and time scales of the original decompressions, one should not expect such cases to have evolved comparable pathology. The pattern of illness appears to vary with the nature of the preceding pressure exposure. For example, there are the gross differences in clinical presentation and time-course between the "bends" (old terminology) of aviators, tunnel workers and divers. Within diving itself there are differences, not surprisingly, in the presentations of decompression illness between oxy-helium saturation, oxy-helium excursions, and surface-orientated diving. Similarly, within the broad range of compressed air recreational diving there seem to be clinical differences, for instance, between those who stick to the no-stop protocols of 2 tanks-a-day for 6 days of sub-tropical resort diving and those who dive on deep wrecks in cold waters. To take this example further one could run into trouble with confounding individual variables such as acclimatisation, complement levels and hangovers that might or might not be associated with some types of diving and/or decompression illness. So there is reason to suggest that the presentation, nature and severity of decompression illness arising from advanced recreational diving might not be the same as that arising from other types of recreational diving.

Also consider how the clinical features of any decompression illness change during the first few hours after onset. Bubbling is a dynamic condition as are the sequelae. The underlying pathological status when the initial manifestations first arise is quite different from that in the same individual some 12 hours later. Most algorithms for recompression fail to acknowledge this time factor. The "Time From Surfacing to Onset" and the "Time From Onset to Recompression" are part of the management assessment and these factors should feature in the decision-trees.

Diagnosis

It is not sufficiently acknowledged that an accurate pathological diagnosis is often impossible. Also the bubble has, so to speak, much to do before its host will be diagnosed. The bubble must cause sufficient symptoms so that the diver recognises that he or she has a problem. The threshold for reporting this to somebody else is likely to vary from the hardened professional, who has been through