

## FITNESS TO RESUME DIVING AFTER A DECOMPRESSION INJURY

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### Key Words

Diving medicals, fitness to dive, medical conditions and problems, recreational diving, standards.

There are guidelines for the routine medical assessment of divers but, for post-accident assessment, the guidelines are less prescriptive. The circumstances of each decompression-related accident are so different that an even greater emphasis must be placed on the knowledge and experience of the examining doctor. The medical assessment of those who wish to return to diving after a decompression injury rests on the same basic principle as any other medical assessment of recreational divers, future in-water safety. Provided there has been a full recovery of function, a resumption of diving should not be associated with any greater in-water risk than before, particularly as decompression accidents rarely manifest before surfacing. The spotlight turns to longer-term considerations including the likelihood of another incident and the possibility of secondary long-term health effects.

But those people used to assessing recreational divers should be aware that, in any such assessment of a working diver, early consideration should also be given to motivation. If the diver really does want to get back into the water, this is not a problem but if, after apparent recovery, he/she might be looking for some medico-legal benefit from being unable to return to diving, then it will be difficult to declare them fit.

### Immediate lay-off

Guidelines have been issued for naval and commercial diving that prescribe minimum lay-off periods after a full recovery, which usually occurs during recompression. From the time of full recovery a set number of days is recommended for each of the categories of decompression injury after which, unless the injury was only joint pain, the diver must be assessed by a doctor. In many treatments of working divers there was a chamber close to the site of diving operations and so, unlike recreational diving incidents, recovery has not been compromised by extended delay before recompression.

The recommendation of the US Navy Diving Manual is that a diver may return to diving 7 days after surfacing from a Table 6 recompression for a simple uncomplicated limb-pain only incident.<sup>1</sup> It recommends that a diver may resume normal diving 14 days after the treatment of patchy peripheral sensory-only neurological decompression illness

that completely responded by the end of the second oxygen period at 60 ft (18 m). Those who have suffered any cardio-respiratory or any neurological manifestations (other than just peripheral and transient paraesthesia) should remain out of the water for four weeks and then should then be reviewed by a diving medical officer. Should any of these serious cases have warranted treatment on USN Table 4 or USN Table 7, the lay-off should be for at least three months. An assessment by an experienced diving doctor is recommended before the diver resumes diving.

The Diving Medical Advisory Committee (DMAC), which is recognised by the HSE in the UK and world-wide by the International Marine Contractors Organisation, recommends the following minimum periods before considering a return to diving after decompression illness.<sup>2</sup>

*A Limb pain, cutaneous (skin rash with severe itching), lymphatic (swelling of tissues) or non-specific (persistent headache, excessive fatigue, loss of appetite, nausea) manifestations only*

- i With uncomplicated recovery, 24 hour lay-off.
- ii Where there has been a recurrence or relapse requiring further recompression. 7 day lay-off.

*B Neurological or pulmonary manifestations:*

- i Altered sensation involving the limbs only: 7 day layoff. Return to diving only after review by a diving medicine specialist
- ii Other neurological (including audio-vestibular) or pulmonary manifestations: 28 day lay-off and return to diving only after review by a diving medicine specialist

*C. After an incident of pulmonary barotrauma resulting in a pneumothorax or mediastinal/subcutaneous emphysema.*

The diver should be assessed by a diving medicine specialist. Return to diving may be permitted, but not normally until at least 28 days following complete recovery.

DMAC further says that in cases where there are significant residual neurological manifestations, even after repeated treatment, the diver should normally be considered unfit to dive. Return to diving should only be permitted if sanctioned by a diving medicine specialist.

For the recreational diver, no such prescription is appropriate but some time on the beach is advisable before returning to the water, and only then if a full clinical recovery has been made. During that period of diving idleness, no doubt the diver will contemplate the risk of another incident against the relative safety of retiring from this particular recreational activity. The factors to be considered are much the same as those confronting a working diver though the weighting applied to each factor may be different.

## No residua ?

Conventional wisdom suggests that after treatment for an episode of decompression illness, the diver may return to the water provided there are no objective residua, but this statement is an over-simplification. How are these residua defined? Is it just the presence of some muscular weakness or a patch of skin with sensory impairment, or are the results of special investigations needed?

The reason for concern is based upon the knowledge that in decompression illness, any neurological manifestation has probably left a permanent scar. So, except perhaps in the most rapidly treated cases, there is probably a diminished reserve capacity in the brain and cord for any future episode from which functional recovery may be required.

Possible investigations have included MRI, SPECT scans, electrophysiological and neuropsychometric investigations. The use of such investigations has been confounded by the findings of alleged "abnormalities" in perfectly healthy divers who have never had an incident. So, if there is a shadow on a scan, a delay on an evoked potential, or some diminution of short-term memory, what does that mean? It may be that the patient is better served by a review of other factors related to his/her bend.

## The nature of the dive

Was the bend "deserved"? Did the decompression incident arise from a dive which was within the accepted envelope of safe decompression tables but which, for whatever reason, had not followed accepted decompression procedures? For instance, out-of-air leading to omitted stops. Repetition of such an incident is avoidable by better dive management.

Was the bend "unexpected"? Did it follow a safe dive using accepted tables? If so, the individual may be "bends susceptible" and its repetition cannot be so easily avoided. If the incident was neurological, and particularly if it was the second such incident, consideration should be given to echocardiography to detect a PFO. However because some 25-30% of the population has a PFO, its association with the causation of neurological decompression illness is far from absolute and other factors must be reviewed.

## The number of decompression incidents

Depending on circumstances the number of episodes is not necessarily a critical factor but bends-susceptibility does appear to be a real phenomenon. It also appears to be transient, associated with some dive groups for a while, but not with other groups on similar schedules. One wonders if there might be some non-diving factor here, such as the

subjective reporting threshold for symptoms, but this cannot be proved.

There have been some working divers, with *no* PFO and *no* neurological residua, who in the past have been medically disqualified after two mild neurological incidents, each treated immediately with complete relief. For a breadwinner this is a tough decision that may not seem justified and one hopes that similar cases in the future are reviewed with a more comprehensive assessment.

## The nature of the decompression illness

Latency is a useful indicator and the more rapidly the onset arises after a dive, the more severe is likely to be the injury. The various manifestations have been categorised traditionally into mild (such as cutaneous and limb-pain) and serious (such as chokes, staggers and paresis). This can be misleading during the management of acute illness because the patient may be progressively deteriorating. When used retrospectively however this provides a simple guide to severity.

Within the neurological manifestations, Pitkin et al.<sup>3</sup> have tested an established scoring system<sup>4</sup> that provides a broad prediction for the success of treatment or severity of outcome. The variables used to assess each case are

Repetitive dive, yes/no.

Improvement, stability or deterioration of neurological symptoms before recompression.

A sensory deficit detectable to the examiner.

The extent of any motor impairment.

Urinary disturbance, yes/no.

Each answer is given a weighting (0 - 6) and the total score provides a guide to outcome. A low score was associated with a favourable outcome whereas a high score, though including all the severe outcomes, was less predictive.

## The nature of the treatment

Some other factors, such as delay between onset and recompression, may need to be considered for prediction in these neurological cases. However Ross<sup>5</sup> has shown that, when all DCS presentations are considered together, outcome is not related to the delay. The tendency is for the minor cases (which numerically are in the majority) to improve with time thus obscuring deterioration in the neurological minority. This delay is a factor in maybe 15% of all DCS cases in his series. The relationship between delay and outcome is further confounded because the seriously ill tend to get accelerated attention. In two studies, outcome was related to clinical condition at the time of recompression.<sup>5,6</sup>

Was the patient recompressed and, if so, what was the delay before recompression? More importantly, was the response to treatment rapid and complete? Or was it slow? Was there any deterioration at pressure and, during or after the treatment and relapse or recurrence. Were one or more repetitive treatments with HBO required after the first recompression? One is tempted to specify what table was used but, whatever the treatment, all one needs to know is how effective it was.

The absence of detectable residua has already been mentioned whereas the advice to those with some residua will be discussed later. On the grounds of the potential consequences of another decompression incident upon an already damaged cord, a sports diver who has had one severe neurological incident, should be recommended to give up diving.

Nevertheless, a restriction to shallow diving may be appropriate for a few. Consider the ex-commercial diver who had a bad spinal bend with some minor residua, but who has no functional deficit. Consider the sport diver who had an "undeserved" but very mild neurological decompression illness after a "safe" decompression dive and who is then found to have a PFO. A shallow diving limit may be appropriate but there are other restrictions that might be more practical. One example is simply to restrict no-stop times, either by going "one down" on the tables or by using a decompression computer that at sea-level is switched to the altitude mode. Of course this can make the diver very unpopular with others because he/she always needs to surface early. Regular diving can be considered by someone who is prepared to go to the trouble and expense of nitrox-scuba training. This is not used to increase no-stop times (on the usual grounds that there is less nitrogen uptake) but instead the normal tables or computers for air diving are used when in fact breathing nitrox. No guarantees, but this should provide a good safety margin.

### The assessment

Whatever the reason, if an examination is needed, it needs to be done by someone who is competent, a doctor who has a full understanding of the diving environment. A medical practitioner who is merely trying to follow printed guidance may reach an inappropriate conclusion and will be unable to give appropriate advice to a disabled diver or to a diver after some illness, surgery or accident. Any consideration of a restricted certificate of fitness must be based on a thorough understanding of the environment's possible demands upon the impaired diver.

In following up persons after decompression illness, long term surveillance for dysbaric osteonecrosis should be considered in order to detect any juxta-articular lesion before the articular surface is damaged.

### References

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