

## IN-WATER RECOMPRESSION:

*On one side* are the professionals, the doctors and chamber operators who tend to look upon an in-water regimen as amateur idiocy, something only a little less insane than nonprofessionals attempting major surgery.

*On the other side* are increasing numbers of divers with technical and scientific backgrounds who are questioning whether the doctor really does know best.

By Walter Starck, Ph.D.

For years the consensus in the diving medical community has been that there is an unacceptably high risk in treating decompression sickness with in-water recompression (IWR). But IWR is becoming an issue again as divers explore more remote frontiers. For those who regularly dive at depths below 100 feet / 30 meters, make several dives a day or use mixed gas, the debate over IWR is not entirely academic. Sooner or later you or someone diving with you is likely to be faced with the choice of a long delay in getting to a chamber or immediate treatment. The consequence of making the wrong decision may range from inconvenience to life in a wheelchair or worse.

Let's consider the doctors' point of view

# PROBLEM OR

first. When it comes to their patients, doctors are conservative. Minimizing patient risk is a fundamental tenet of their training. When risk is at all avoidable, they will advise against it. Doctors who specialize in diving medicine know how dangerous DCS can be. They know that it isn't simply a matter of a bubble somewhere, but rather an aggregation of poorly understood physiological processes. Even in a hyperbaric chamber, patients can take a turn for the worse and require skilled medical intervention.

Compounding the medical situation are liability laws that have pushed an already conservative approach to treatment into an ultraconservative one. Doctors now dare not even think of anything other than proven procedures. IWR, though widely used, has never been tested under controlled conditions. There are no clinical records or statistical studies on it. Only a handful of doctors have even anecdotal experience with it. For the medical community it is simply outside the pale, a treatment that can't even be considered. In rejecting this treatment because of its potential risks many ignore the risks of delaying treatment in order to get to a recompression chamber. IWR has one outstanding merit: immediacy. Properly applied, it is really treating a different condition than the one doctors see at recompression chambers.

Instead of calling both conditions DCS, let's distinguish them as DCS-Stage 1 and DCS-Stage 2. These stages should not be confused with Types I and II DCS to distinguish between mild symptoms and the more dangerous cardiopulmonary and cerebral cases. Type I does have a strong tendency to develop into Type II with delay in treatment, as do Stages 1 and 2. During a tunneling project in Hong Kong where recompression was immediately available, only one incidence of Type II bends was reported in 793 cases of DCS.

In contrast, where recompression was delayed among fishermen in Singapore, 47 of 58 cases of DCS were Type II.

In DCS-Stage 1 a gas bubble(s) has just begun to form and put pressure on nerves and blood supply. Tissue damage is minimal to nonexistent and if recompression treatment is begun immediately, the prognosis for successful uncomplicated treatment is excellent. This we know from empirical experience where chambers are available at the dive site and from the experience of commercial divers such as the black coral divers in Hawaii and the pearl shell divers in northern Australia, whose treatments are hardly sophisticated. When pain starts, they get back in the water and go down until it stops, wait a while, then slowly ascend. If pain starts again, they go back down a bit and wait longer. Basically they are titrating the dive, keeping the bubble below the pain threshold until it has time to be reabsorbed. It's crude, doctors shudder at the idea, but it works most of the time.

If treatment is delayed it's a different story. Untreated DCS-Stage 1 generally progresses to DCS-Stage 2, in which the growing bubble(s) damage tissue by distorting and rending it as well as cutting off blood supply. Both the damaged tissue itself and the body's response to it set complex physiological processes in motion, which compound the situation. Depending upon the tissue involved, the severity of the case and the length before recompression begins, treatment may be lengthy and fraught with complications.

Exacerbating the problem is the tendency for Type II DCS symptoms to develop, so that not only has tissue been damaged, but the most delicate, unforgiving and dangerous tissues of the heart, lungs and central nervous system have become involved as well. By the time most divers get to recompression facilities, many if not most have some level of

# SOLUTION ?

DCS-Stage 2 symptoms. Since cases seen by doctors and chamber operators are at some level of DCS-Stage 2 with a frightening level of Type II involvement, it is not surprising that they cannot imagine trying to treat these patients in the water.

## WHAT TO DO

Unfortunately there are no hard and fast rules. We do know that immediate treatment greatly enhances the probability of success, which may make IWR worth considering. The time required to get to a chamber, the nature and severity of symptoms, the prospect of hypothermia, availability of oxygen for treatment, availability of a full face mask should there be any likelihood of loss of consciousness, as in Type II DCS, are all factors that impinge on such a decision. If considered, treatment should begin at the first sign of DCS. Since no hard data exist, the following procedures, based on U.S. Navy tables, are suggested as a starting point.

When only air is available, the victim, accompanied by safety divers, should descend until the symptoms disappear plus another 10 feet / 3 meters. Wait an hour then ascend at 2 minutes per foot / 30 centimeters to 20 feet / 6 meters seawater. Wait an hour then ascend at 2 mpf to 10 feet / 3 meters. Wait another half hour, then if no symptoms return, surface at 1 foot / 30 centimeters per minute. If symptoms start to return at any point, descend until they disappear plus 10 feet / 3 meters and proceed as before.

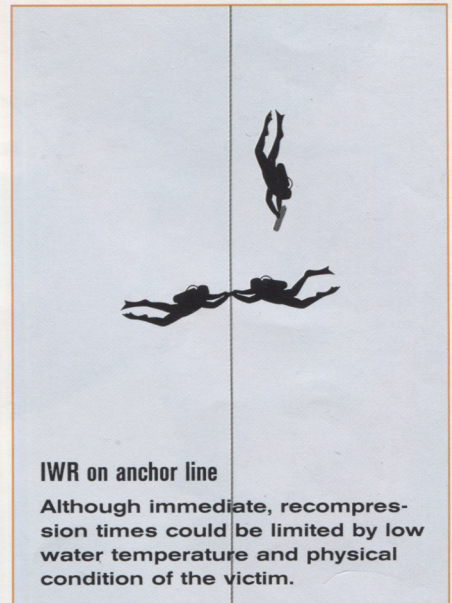
Breathing pure oxygen greatly enhances the effectiveness of recompression treatment. If available, it should be used starting at 30 feet / 9 meters for 45 minutes, then ascend at 1 foot / 30 centimeters per minute to 20 feet / 6 meters. Stop again for 45 minutes, then ascend at 1 foot / 30 centimeters per minute to 20 feet / 6 meters. Stop again for 45 minutes,

then ascend at 1 foot / 30 centimeters per minute to surface.

The above presumes Type I bends. Treating Type II bends shouldn't even be considered without a full face mask. Even then, it is very risky but still probably better than letting someone die or suffer permanent brain damage or paralysis because of a long delay in getting to a chamber. Letting Type I, Stage 1 DCS, which is easily treated in water, develop into a Type II, Stage 2 catastrophe during a lengthy delay in getting to a chamber because it is "safer" is insanity. We need to collect data from those who have used this technique and we need to conduct trials under controlled conditions. This could help in weighing the risk of treatment in the field against the risk of delayed treatment.

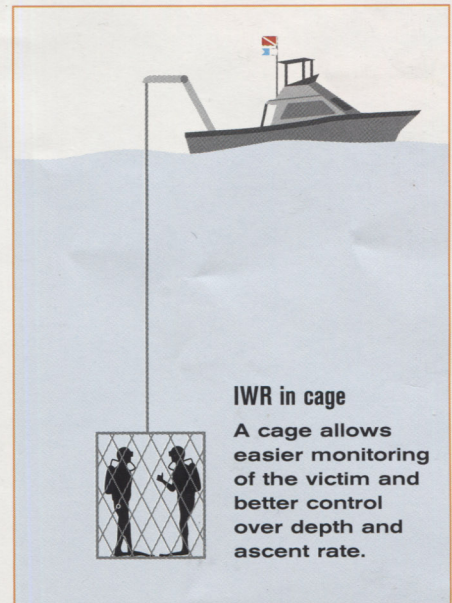
Dive boat operators and dive resorts should at minimum have open-circuit oxygen and full face masks before considering this treatment. Bigger vessels and resorts really should have recompression chambers, since they offer a huge safety advantage. In-water recompression was examined at a workshop at the University of Hawaii Medical School earlier this year. Audio tapes of the sessions are available from: Tree Farm Communications Inc., 23703 N.E. Fourth Street, Redmond, Wash. 98053-3612. Phone: (800) 468-0464; fax: (425) 868-2495; e-mail: audiotapes@msn.com; Web: www.treefarmtapes.com. There is also an excellent review of DCS and its treatment, plus a list of further references, on the Web at [www.gulftel.com/~scubadoc/decodvr.htm](http://www.gulftel.com/~scubadoc/decodvr.htm)

Walter Starck is a marine scientist in Townsville, Australia, who has operated research vessels in the Caribbean and Pacific. He developed the dome port used for underwater wide-angle photography and the Electrolung, an electronically regulated, closed-circuit mixed-gas rebreather.



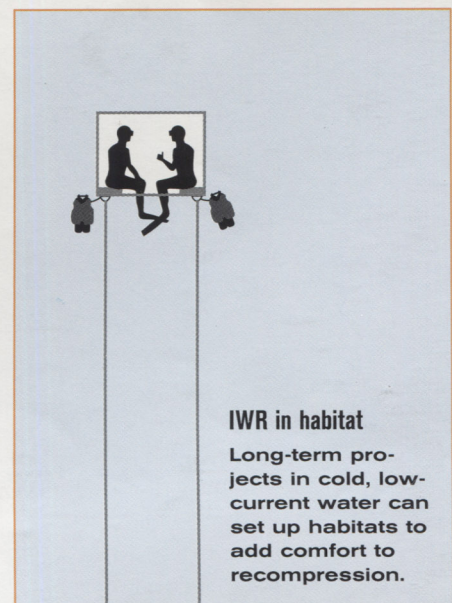
### IWR on anchor line

Although immediate, recompression times could be limited by low water temperature and physical condition of the victim.



### IWR in cage

A cage allows easier monitoring of the victim and better control over depth and ascent rate.



### IWR in habitat

Long-term projects in cold, low-current water can set up habitats to add comfort to recompression.