In the case of early decompression sickness there is such a test.

The test consists of returning the diver to the chamber and taking him to a depth of sixty feet while breathing pure oxygen. Given the mild, early nature of the symptom in question, if it is due to decompression sickness it should be relieved rather quickly. If the symptom is not gone, or significantly improved after a period of twenty minutes, then it is probably not decompression sickness. Remember that the symptom in question is rather vague, elusive, or otherwise suspected not to be decompression sickness. Usually there is the suspicion that the diver is suffering from a simple muscle or joint strain and needs no treatment. If the diver has obvious pain in a joint there is usually no question about the nature of the problem and no need to do any sort of test. In my experience, the relief often comes well before sixty feet is reached, perhaps even at just a few feet of depth. If this occurs, then the question as to the nature of the symptom has been settled and the diver is treated according to the appropriate table. If recompression for twenty minutes has no significant effect on the symptom in question, it is probably another type of problem and the diver is returned to the surface. Since he is breathing oxygen throughout the test period, his decompression status is not affected adversely.

Some commercial diving supervisors have a strong belief that any recompression should be nothing less than a complete table. This may be because, in earlier times, treatments were often concocted on the spot. The diver received sufficient recompression to relieve all or most of his discomfort, but without resorting to scientifically formulated tables. This sort of inadequate treatment should not be confused with the test of pressure. The manoeuvre is not treatment when it is instituted and should not be interpreted as treatment by anyone reviewing the records of the dive. As mentioned earlier, it is analogous to the diagnostic use of nitroglycerine in a puzzling case of chest pain. Should the test relieve the symptom in question, it may then become part of the treatment which will be carried out. Should the test be negative - thus allowing the conclusion that there is no decompression sickness present - this is not inadequate treatment or any sort of treatment at all. Rather it is a direct and logical method of solving a puzzling and potentially serious problem. It reflects alertness and awareness on the part of the person utilizing the test.

A recent case in the Gulf of Mexico illustrates the use of this test. A commercial diver sustained a mild, pain-only bend on a Tuesday which was quickly and appropriately treated by his supervisor. He was then held out of the diving rotation for twenty-four hours (a matter of company policy) and returned to diving on Thursday, completing the job. He returned to shore the following day and noted mild but definite pain in his shoulder late Friday night which was still present upon awakening Saturday morning. In this case, the question was not the nature of the discomfort but rather the timing of it. Mild pain after this long a delay is supposedly not typical of decompression sickness. Nevertheless, a test of pressure was elected and the patient experienced total, near-instantaneous relief of pain as he was passing a depth of 12-13 feet.

Based on my experience with the disorder, I think atypical presentations of decompression sickness are more common than one sees with other diseases generally. I am much more suspicious than I used to be and much more ready to either treat, or at a minimum, utilize the pressure test. In the case just described, there was a time when I probably would have pronounced the pain muscular and not recommended decompression.

The thing that has educated me the most is that, the more I use the test, the more peculiar things I see being relieved by recompression. I specifically include divers reporting mild problem with mood or orientation. It is precisely these types of soft, subjective complaints, unaccompanied by any objective neurologic abnormality, which may lead to the diver being labelled as a malingerer and make him reluctant to discuss his symptoms at all. While one cannot exclude a placebo effect, we should remember that the diver, while wanting to remain healthy, does have a reluctance to re-enter the chamber unnecessarily.

The test of pressure is direct, logical, and does no harm to the diver. I have found it extremely useful in my own practice. I can say that, in times past, I probably should have used it more often. I believe that diving physicians who use it aggressively will find, as I have, that mild decompression sickness is more common than most of us realise.

DIVING TREATMENT TABLES WHEN IS ENOUGH TOO MUCH?

Marcel Johnson

State of the arts diving techniques and equipment mean big returns in all facets of the diving community, sport, research, scientific, and commercial. These returns may vary according to the goal orientation of each segment; however, one particular factor never varies. Man under hyperbaric pressure is subject to decompression sickness.

The past decade has marked a radical development period for the diving community. Men have gone to deeper depths and remained there longer than ever before, probing further and further, seeking to define our limitations. And in the process, as in all other facets of diving, divers got bent from time to time. In dealing with these cases in the real world, treatment techniques for decompression sickness have also advanced. These advancements involve not only tables but also procedures for use of equipment and diagnostic techniques.

Let us look at a commercial dive job.

The first diver in the water is to clear loose debris from an area over a pipeline, use a water jet to remove the mud from the area and then cut a section of pipe out for repair using an oxygen arc cutting torch.

After working for forty minutes at 250 feet of sea water, breathing a mixture of 10 percent oxygen and 90 percent helium, being roughed up by crane slings, chains and jet hose, shocked and abused by the oxygen arc cutting lead and ground cable, in pitch black water, it is time to leave the wonderful world of zero visibility, jagged-sharp metal, and cold water. But this leaving takes a while because now the diver has to hang onto a down line at in-water stops while decompressing for the next 83 minutes while the cold gets colder, for now he is not working. The extra heat of work and the concentration used for the job are replaced by greater heat loss and boredom. By the time he climbs into the recompression chamber on the surface to recompress and breathe oxygen from a mask for 177 minutes at 40 fsw, even chamber time feels like a weekend vacation. It is hard to suck oxygen from the mask. Just the continuous working of a man's diaphragm and lungs against the mask diaphragm makes him sometimes want to give up breathing; however, he is now on a mattress with sheets, blankets, a pillow, magazines, coffee, juice, food, and maybe even heat. So just remember to breathe, breathe, that's it. Keep breathing ...

The washed out look and feeling of a man when he comes out of the chamber is something hard to describe. He looks as if he has been in the hospital under treatment for a long time, one step beyond tired and beat - more like used up.

Now the next man takes his turn and the first waits 18 hours. Then, get up and do it again. Amen.

How does a man feel before, during and after this sort of exposure? Depending on the individual and the job, that will vary somewhat, but following a dive like the one described here, he is going to have pain in his body, a headache sometimes, be tired, and his lungs will be tired and sore. He will have cuts, scratches, bruises, trains, and possibly even decompression sickness.

It would seem that symptoms of decompression sickness might be easy to miss or ignore when mixed in with all of the other sensations the body enjoys during hardworking dives and decompression. And it sometimes is, unless it is a very serious case with paralysis and unconsciousness. For this reason, it is a growing consensus among diving physicians that all bends cases, not matter what their degree, should be treated on a USN Table 6 or 6A, when the case is being handled in the field by diving personnel. If the dive team is inexperienced and ill-equipped, this consensus has its merits. However, this is, in most cases, not the situation.

If the diver being considered for treatment has just completed two or three hours of chamber time, breathing oxygen from a mask, essentially he has just undergone a routine treatment built into surface oxygen decompression tables. (Tables may vary according to the employer).

The diver may be physically unable to undergo further prolonged treatment on any oxygen table because of lung fatigue or oxygen toxicity problems. He may not be bent, or his problem may be resolved by use of USN Table 5. One thing is sure, he must go back under pressure to sixty feet on oxygen.

A complete and thorough neurological examination must be conducted as soon as possible, either on deck prior to recompression or at sixty fsw in the chamber. This examination will provide a road map of symptoms. The initial examination followed by frequent subsequent examinations throughout therapy, enables supervising personnel to pinpoint, trace, and alleviate suspected bends symptoms.

In cases where symptoms are subtle or doubtful, it is easy for the diver/patient to take this examination as a joke. When the Emergency Medical Technician (Diver)(EMT-D) has him wagging his tongue, rolling his eyes and fingering his nose, the diver may possibly feel he is auditioning for a slapstick comedy routine. Therefore, it is important that the examiner be well trained in what he is looking for and why. It is also helpful if the diver has had the basic concept of neurological examinations explained to him at some prior time. Check too for oxygen toxicity signs, and find out if the diver/patient can tolerate oxygen therapy.

Another tool used in diagnosis of suspected pain-only bends, and in conjunction with a neurological examination, is the test of pressure. Basically, this is when the diver enters the chamber and begins breathing oxygen at the surface, as he is recompressed at 60 fsw. He then continues to breathe O_2 for 20 minutes. If the symptoms are not relieved or improved by recompression and the neurological examination is negative, we can assume that the diver is not bent and he may be decompressed with no further treatment. This is not a treatment table. It is, however, a diagnostic tool.

During this evaluation period, critical decisions must be made regarding treatment table selection and logistics. If the diver is bent, most situations may be adequately resolved with supplies on hand using USN Treatment Tables. However, there are occasions when these are not enough and nitrox saturation techniques are necessary, as when a patient is at the end of his treatment table but needs more time at depth, or he needs to remain under pressure but can no longer tolerate breathing oxygen from his mask. The supervisor must recognise these facts and understand that he does not have to decompress. The patient may remain at his depth of relief indefinitely if emergency nitrox saturation techniques are instituted immediately, stabilizing chamber atmosphere within acceptable saturation limits.

Emergency nitrox saturation may be conducted in a standard double lock decompression chamber. The patient and tender are kept at treatment depth while all equipment, supplies and medical assistance are transferred, installed

and administered under pressure. Oxygen toxicity is a prime concern during this manoeuvre, therefore, if the situation indicates saturation, a positive decision must be made and carried out with all dispatch.

Lowering the recompression chamber partial pressure of oxygen to 0.5 atmospheres absolute by dilution with 100% nitrogen and installing a portable carbon dioxide scrubber will provide the necessary additional requirements. Because gas and equipment are not always readily available on site, it is a good idea to have planned for this eventuality ahead of time, so that one radio or phone call can mobilize all of the necessary people and supplies.

There are many factors to be weighed when dealing with a possible or known bend, no matter what the degree. It is important to have well-trained people on each dive site who are trained in diving medicine, such as an EMT-D and an experienced diving supervisor. These professionals should be able to recognise when a neurological examination and test of pressure are negative and the patient may be decompressed without treatment. They must determine how much treatment a diver/patient may require and how much he can physically tolerate.

There is no one magic answer to diving medical problems, and any oversimplified rule of thumb can lead to more problems than it resolves. Training, experience, and planning are our greatest allies during normal operations and emergency situations. By using a logical, well-planned response scenario, we can respond, without over-reacting and manage to a successful conclusion any diving medical problem that might arise on site.

THE DECISION TO "EMERGENCY SATURATE"

Marcel Johnson

Occasions sometimes arise in the treatment of decompression sickness when the normally used USN Treatment Tables are not adequate for a particular situation. A patient may require more time at his depth of relief than allowed by these tables, or he may need time at depth on O_2 and be physically unable to tolerate O_2 therapy. For whatever reason, if a patient needs to remain at his depth of relief for a prolonged period or needs deep recompression therapy, two items must be addressed immediately: Oxygen toxicity and decompression commitment.

The possible need for emergency saturation should be discussed and planned for at an earlier date by persons connected with diving operations, because when emergency nitrox saturation therapy must be conducted, time is very important. Because of the high level of oxygen the chamber occupants may have already been exposed to, the chamber environment must be brought within acceptable saturation limits and maintained there until such time as saturation decompression is indicated and completed.

The following is a step-by-step example of such a procedure, as used in actual field emergencies. It is offered only as a reference to those interested. The author assumes no responsibility for its use by others.

On the job site a double lock DDC is used. Should a decompression problem arise, it is treated in this chamber. The patient and inside tender go into the chamber and are pressurised to treatment depth and then undergo therapy as indicated. If during the course of events saturation therapy is indicated, saturation procedures are initiated while the patient and tender are at the patient's depth of relief. They will remain under pressure until proper decompression is completed.

1. Load into outer lock the following items as soon as possible and pressurise outer lock to inner lock depth.

   a. Emergency Medical Technician (Diver) (EMT-D).
   b. Medical kit
   c. CO_2 scrubber
   d. Portable heater/chiller unit
   e. Chamber lights
   f. Two crescent wrenches
   g. One pipe wrench
   h. Teflon tape
   i. Wiring harness for scrubber, heater and lights
   j. Wiring harness installation-under-pressure tool
   k. Thermometer, hygrometer

2. After blowing the outer lock down to inner lock depth with air.

   a. Inside the chamber, the EMT-D conducts a thorough neurological examination and administers medical assistance as necessary.

      Outside the chamber, the topside crew installs a 100% nitrogen supply whip to the outer lock blow down valve. Air or treatment mix is plumbed to the chamber built-in breathing system supply (BIBS), and a chamber atmosphere analysis tube and flow cap are installed.

   b. The EMT-D transfers from the chamber inner lock to the outer lock. He then passes all of the previously loaded items from outer lock to inner lock.

3. Close the inner lock hatch and commence decompression of EMT-D on the appropriate table.

   a. The inside chamber tender installs the wiring harness installation-under-pressure tool in a through hull penetrator.

   b. The outside tender installs the through hull penetrator with its pig tail resting in the installation-under-pressure tool.