

# REMOTE DIVE SITE DECOMPRESSION ILLNESS – HOW TO SAVE A DIVERS LIFE



By Bret Gilliam

As secret agent James Bond once sagely observed to Q, who supplied his special equipment and was complaining that he was bringing it back damaged, “It’s hell out there in the field.”

Divers aren’t dealing with jet-packs, ejection seats in Aston-Martin sports cars, or the best way to use the strangling wire released from the stem of a Rolex. But it can get a bit dicey in the field for us as well. I’m talking about the hard and grim reality of dealing with medical injuries in the middle of nowhere when facilities are not available and evacuation is not an option. If you are on a live-aboard, expedition vessel, or remote island when emergencies arise, you will have to be prepared to deal with them on-site and with the equipment on hand.

There are scores of scenarios that may present, from tropical viruses and severe stinging organisms, to lethal bites from sea snakes. But the most prevalent danger over the years has been decompression illness (DCI). If you pick up just about any diving text, medical reference, or even read DAN's protocol for what to do when DCI manifests in a diver, the first directive will be to administer 100% oxygen by demand mask and transport the patient to a recompression chamber. Great advice. Good luck if you happen to be anchored in Chatham Bay at Cocos Island... 380 miles offshore. In Costa Rica there are no helicopters or seaplanes that can travel the distance, let alone do it round-trip, without refueling. And there is no fuel on Cocos Island. No Starbucks either, for that matter. The same is true in the Komodo Islands, Raja Ampat, or the Banda Sea in Indonesia. Think you can get to a chamber in the Solomon Islands? Oh yeah, it's right next to the IMAX theater on Guadalcanal.

Reality is a bitch. If you or a member of your team gets bent in a remote area you will have to deal with the treatment yourself. This not only takes special training, it requires onboard-specific special equipment and trained support staff. A couple of D-cylinders in your nice little oxygen case aren't going to get the job done.

Let's take a quick review of DCI and what must take place to get a satisfactory outcome. First and foremost, you need oxygen. And lots of it. Secondly, you need pressure. That what's going to crush the inert gas bubbles and let them be absorbed back into blood and tissue without occlusions and permanent physiological deficits. Time is the critical issue: the window for the most effective treatment is about one hour from the first presentation of symptoms. Tick, tock...

It must be ingrained in divers to recognize and report DCI symptoms as early as possible. Unless you are dealing with extreme exposures and incomplete decompression, symptoms will usually not present while the diver is still underwater. But upon surfacing the clock is running. This article does not have the space for a treatise on symptomatology but DCI will present as pain in the limbs or joints, or as more subtle neurological deficits initially; but central nervous system (CNS) issues will progress and can include paralysis.

Many texts distinguish DCI symptomatology into Type I (pain only) or Type II (serious symptoms, CNS involvement). To the layman or diver in the field, this distinction is not of great importance and requires special training in

many instances to classify presentations. Most importantly, we want our readers to be able to recognize any symptoms or signs of DCI quickly and take immediate action.

At the first sign or symptom, the patient should immediately be placed on 100% oxygen... via demand mask. Don't waste your time even putting a free flow mask in your gear package. You need to get the patient oxygenated. Free flow masks are wasteful of the gas, inefficient in their delivery, and you only have so much inventory of oxygen available. The therapeutic effects of 100% oxygen to a DCI victim cannot be overstated. In a significant number of cases, immediate oxygen breathing will arrest symptom progression and achieve relief without the need for recompression. But the key word here is "immediate". Every minute lost allows for more inert gas bubbles to form and aggregate. By flooding the victim with 100% oxygen and eliminating any further intake of nitrogen from atmospheric air, you are creating a gradient for bubble size reduction and elimination. Cross your fingers and hope the victim begins recovery. You should be trained in field neurological exams and go through the checklist as soon as the diver suggests they may have DCI. Do a re-exam after the first hour of O<sub>2</sub> breathing. If the patient's symptoms have stabilized or improved, continue O<sub>2</sub> administration with hourly reassessments. If you're lucky, they may have dodged a bullet.

But you have to have an available inventory of oxygen onboard. I recommend a minimum of three H cylinders and a transfer method to the smaller cylinders commonly used with DAN O<sub>2</sub> kits and to O<sub>2</sub>-cleaned scuba tanks because you're going to need a lot of gas. If you're getting results with demand mask oxygen, continue the patient's breathing for two hours, then a 10-15 minute air break, then back on for two more hours. Follow this regimen for 12 hours and then make a complete assessment. If the patient is symptom-free, it's probably okay to take them off O<sub>2</sub> and confine them to a bunk for another 12 hours or so. Check urine output as well for volume and color. Cease all diving activity for 72 hours, or completely, unless they have a specific skill necessary to the project.

Now comes the tricky part: if the victim does not get better within the first hour on oxygen they probably need to be recompressed. The only way to do this is to get them in the water. This requires an in-water oxygen delivery system. Ideally, there should be an oxygen clean full-face mask available but an oxygen clean scuba regulator will do. (Full-face masks are preferred

since the patient is less likely to lose their airway in the event that an oxygen induced convulsion event occurs.) Obviously, it is not desirable to attempt to place an unconscious unresponsive patient underwater. But as long as they can breathe on their own, I'd even risk this since the alternative is so dire.

In-water recompression has been around for five decades but it requires very specific training and equipment. You cannot attempt such a treatment without training. There are a variety of treatment tables that work extremely well. Some have evolved over years of experimentation and commence at shallower depths than conventional tables used in dry chambers. Other experienced contingency experts like to proceed with Table 5 that begins with a direct descent to 60 feet. But all this is predicated on oxygen supply, an oxygen clean delivery system, a conscious patient that is aware of what is happening, and several divers to rotate as underwater tenders with the patient. Most treatments will run two hours or more.

Ideally, a surface supply hose system to the patient is safest and most efficient. Air breaks also have to be factored in since a patient cannot breathe oxygen exclusively at depth. So the supply system underwater must allow for gas switches either from the surface supply hose or by changing scuba cylinders underwater.

You're going to be underwater for a while. Proper thermal insulation for the patient is necessary as well as a fresh water hydration delivery bag or bottle. Most DCI cases manifest toward the end of the diving day and so it's likely that a good portion of the treatment will be conducted in the dark... after sundown. Lights need to be available and the tender may also have to deal with patient anxiety. You also need to be prepared for marine life encounters. It's unlikely that a shark will decide to chow down but the presence of predators is also a reality and the team should be prepared to ward off aggressive threats.

It all sounds more than a bit daunting. And it should. But the alternative is almost certain serious physiological damage including paralysis and death. You have to plan well in advance to have the necessary support equipment onboard and this is not easy in most third world countries. First and foremost, you have to have enough oxygen and the average live-aboard barely carries enough O<sub>2</sub> for more than about a four-hour surface breathing period. If the operator cannot provide the other breathing delivery equipment, you may have to bring it with you. For the vessel operators that I

provide operations consulting to, I recommend that they be fully prepared with all gear and staff trained to do the treatments if necessary. But these operators are few and far between. Do your advance due diligence, get proper training in field treatment contingencies, and expect to be called on to perform.

Remember: Evacuation is not an option. Without sufficient oxygen the patient has no chance. And if they don't respond to surface oxygen breathing, there is no choice but to proceed with in-water protocols since you have to get the hyperbaric effect of pressure for inert gas bubble compression.

That's the straight talk. Now you decide to what level you want to be prepared. There are no short cuts. TDI Headquarters can refer you to proper training professionals. This is not a dumbed-down meaningless dive specialty card. This is dead serious. I intend no pun with that last sentence...

Bret Gilliam is the founder of TDI, SDI and ERDI. He is credentialed as a Recompression Chamber Supervisor and an Instructor Trainer for Diving Medical Technicians and Physicians. He has been widely published on diving emergency medical procedures including in-water recompression. Professionally diving since 1971, he authored the diving medicine section of the reference text "Pre-Hospital Trauma Life Support" and has treated or consulted on over 200 diver treatments in his career.