

# The Four R's of Managing a DCI Injury

*Recognize Symptoms.  
Respond with Oxygen.  
Relay with EMS/DAN.  
Recompress Early.*

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Oxygen is critical to supporting life. We know this as a basic tenet of biology - from our first encounters in elementary school, when we read of Joseph Priestley's "discovery" of the gas, to high school chemistry and the studies of chemical bonding, oxidation and human physiology. Oxygen is a fact of life, no matter how closely - or casually - we view it.

To a diver with decompression illness (DCI), oxygen has an even greater significance - it can mean the difference between having residual symptoms of the injury and being symptom-free after a diving accident. And it's important to act quickly: Early recognition and treatment of a diving injury has significant benefits. Besides increasing the effectiveness of recompression therapy, it improves your chances of complete resolution of symptoms.

In the unlikely event that you or your dive buddy are affected by a decompression illness accident, following these four steps will increase the chances of symptom-free recovery and get you back into the water a lot sooner.

## ***The Steps to Managing Decompression Illness (DCI)***

There are four easy steps to managing DCI: Recognize the symptoms early; deploy oxygen first aid rapidly; activate emergency response services and DAN; and get recompression therapy early.

It's important to follow all these steps - their combination leads to successful recovery from a diving injury. If any step is missing, it could compromise the medical outcome, whether it's you or your buddy who's injured.

## **1. Recognize the Symptoms**

The first step to managing any diving accident is recognizing symptoms of DCI. Decompression illness is a broad term used to categorize the symptoms of both decompression sickness (DCS) and arterial gas embolism (AGE). Symptoms of either ailment can range from subtle indications like pain and numbness to more severe indications, such as unconsciousness and paralysis.

Other symptoms include dizziness, weakness, extreme fatigue, headache, nausea and itching. DCI symptoms usually manifest themselves during the first 20 minutes after surfacing from a dive, though divers experiencing more subtle cases of DCS may not recognize their symptoms until later.

However, for many divers, it's not recognizing symptoms that's the problem - it's telling someone. To admit that you might be injured is difficult. DAN statistics show that approximately 20 percent of injured divers continue to dive after noticing their symptoms.

Denial should also be considered one of the most common signs and symptoms of a decompression illness - your mind can use defense mechanisms to protect you when illness sets in. Many times, unless your injury is obvious and noted by others, it's easy to ignore your symptoms or attribute aches and pains to other, less serious problems like sports injuries.

So what can you do? You can become more aware of the various ways DCI shows itself. Remember that mild, pain-only symptoms of decompression sickness can progress into more serious stages. If you question whether you have symptoms following a dive, tell someone and get assistance - there's no harm done if your symptoms turn out to be unrelated to your dives. Remember the axiom: It's better to be safe than sorry.

## **2. Respond With Oxygen: The Golden Gas**

The second step to managing DCI is to get oxygen. Whether it's for you, your buddy or another diver, the field delivery of emergency oxygen is an essential step in the healing process. Once you've established the airway, breathing and circulation (ABCs), your first priority is providing as close to 100 percent inspired oxygen as possible to the injured diver.

Why oxygen? By excluding nitrogen from your lungs, you will more quickly eliminate the excess nitrogen accumulated from your dive. This may also reduce nitrogen bubble size, increase oxygenated blood flow to the body's tissues and reduce blood sludging (a thickening of blood resulting from excess nitrogen). Oxygen also can help reduce tissue swelling, and for those divers in respiratory distress, it may ease breathing.

The most recognized benefit of emergency oxygen use, however, may also contribute to a delay in calling for assistance. How? Sometimes when oxygen is delivered to injured divers, symptoms are completely relieved. DAN's 1996 Report on Diving Accidents and Fatalities notes: "12 percent of all reported DCI cases [in 1994] were symptom-free prior to receiving recompression therapy when receiving supplemental surface oxygen, whereas only 3 percent of the DCI cases not receiving oxygen were symptom-free before recompression."

Because oxygen sometimes completely relieves symptoms, injured divers may feel that they no longer need to be evaluated and treated. However, they still require medical evaluation. Anytime you treat a diving injury, you should relay with Emergency Medical Services and then contact DAN. You need to pass the injured diver into the health care system as soon as possible to minimize the effects of the injury.

Although it's encouraging to note an increase in the percentage of injured divers who received emergency oxygen prior to recompression treatment, according to the 1996 Report, seven out of 10 injured divers still do not receive emergency oxygen prior to recompression treatment. There's much room for improvement.

## **3. Relay with EMS/DAN: The Handoff**

Once you've recognized the symptoms of a diving accident and provided first aid for the injured diver through emergency oxygen, the next step involves getting the injured diver into the health care system. In keeping with the recommendations of the Journal of the American Medical Association (JAMA) and the American Heart Association (AHA), when you respond to an unresponsive diver, you should activate the Emergency Medical Services (EMS) after your initial assessment but before providing emergency first aid.

It's critical to establish an Emergency Action Plan for all diving activities. Know the location of the nearest telephone - and carry coins to make the call. In many communities, EMS is activated by simply calling the local emergency telephone number 911. In areas which do not have an EMS system established, you should investigate and set up procedures for handling diving emergencies. This information needs to be available to all divers in the group.

Cellular phones help provide an added insurance to communications, especially from remote locales. At sea in the United States, you can call the U.S. Coast Guard on VHF radio channel 16 for assistance. Although the USCG generally responds only to life-threatening emergencies at sea, it may be added insurance in some emergencies.

If you're not sure who to call, or if the injured diver is conscious and alert, call DAN at (919) 684-8111. Remember, you can call collect in an emergency. When you've reached DAN, state that you have a diving emergency, and you will be briefed on what to do next. DAN has a team of physicians, nurses and emergency medical personnel on call 24 hours a day to help injured divers in an emergency. DAN can also help coordinate recompression therapy. If EMS personnel or assisting physicians have questions on dive accident management and treatment, DAN is ready to help answer those questions as well.

The information that you need to provide to the EMS responder includes:

- 1) the location of the emergency (as precisely as possible);
- 2) the phone number from where the call is being made;
- 3) circumstances of the diving emergency;
- 4) how many divers are injured;
- 5) current condition of the injured diver(s);
- 6) what first aid is being given; and
- 7) any other information as requested.

You, the caller, should hang up the phone last to make sure the EMS and/or DAN personnel have no further questions.

This third step in the treatment of DCI is paramount to successful treatment. This is where DAN acts as a resource to both the diving and medical communities. It's critical that injured divers enter the health care system so they can be evaluated by medical professionals for stabilization and coordination of recompression treatment - the sooner the better.

#### **4. Recompress Early: The Last Hurdle**

The final step in the treatment of a decompression illness is hyperbaric therapy - as soon as possible. The longer the delay in calling for help to actual recompression, the less effective the treatment. Timely recompression can minimize the likelihood of residual symptoms and help avoid permanent injury.

Once a physician diagnoses an injured diver with DCI, DAN can recommend treatment at the nearest hyperbaric chamber. By recompressing the diver in the chamber, the size and volume of nitrogen bubbles are reduced. This, followed by a slow "ascent" in the chamber, allows a steady release of excess nitrogen, restoring the flow of blood to the tissues and relieving symptoms.

Because breathing 100 percent oxygen at treatment depths of 60 feet/18 meters (2.8 ATA) is recommended, additional washout of nitrogen occurs with the increase in the pressure gradient. This use of 100 percent oxygen in the chamber helps the injured diver avoid any more absorption of nitrogen during recompression.

Early recompression is a critical step in helping divers with DCI. This treatment, combined with early recognition, emergency oxygen and good communications with EMS and DAN, means divers have more reasons than ever to brush up on their communication and dive skills, and support DAN, the link to dive safety the world over.

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### **Gearing Up for Oxygen**

Although it has long been documented that the use of emergency oxygen is the most beneficial first aid measure an injured diver can receive, it wasn't until DAN introduced the "Oxygen First Aid in Diving Accidents" course and associated emergency oxygen equipment in 1991 that there was a standard established for what training and equipment is necessary to provide first aid to divers with decompression illness.

What types of oxygen equipment are available? Which type will provide you with the greatest amount of inspired oxygen? There are two common kinds of emergency oxygen delivery equipment: demand and constant-flow. While both systems are capable of delivering high percentages of oxygen, only the demand valve used with a tight-fitting mask can deliver 100 percent inspired oxygen.

The demand regulator system has many other benefits for divers. It's similar to a scuba system, so training is simplified. It's also the only system that delivers 100 percent oxygen, which gives the greatest nitrogen washout benefit. The demand system conserves oxygen better than the constant-flow system, and because the demand regulator is activated by the diver's inhalation and stops delivering oxygen when the injured diver exhales, it meets 100 percent of an injured diver's inspiratory (breathing) needs.

Although the constant-flow system is not as efficient as the demand system, because its ability to deliver high percentages of inspired oxygen varies, it is still a viable system if used properly. When the constant-flow system is used in conjunction with a non-rebreather mask, it delivers upwards of 90 percent inspired oxygen. For the non-breathing diver, by using a Pocket Mask™ with supplemental oxygen, the rescuer increases the oxygen percentage to the injured diver from 16 percent to 50 percent or more when performing artificial respirations.

### ***When in doubt, call DAN***

DAN's data on how long it takes injured divers to call for help indicate that the average time to call for help is 18 hours. Many injured divers call DAN not because they have symptoms, but because their symptoms won't go away. When the symptoms of DCI are immediate, obvious and life-threatening, divers call for help right away. However, since most diving injuries are not immediately life-threatening, the delay to call can be long - 6 percent of all DCI reported to DAN in 1994 requested help more than four days after the onset of symptoms were noted.

### ***Oxygen First Aid: The Dive Accident Solution***

In the DAN "Oxygen First Aid in Dive Accidents" course, you learn the signs and symptoms of decompression illness, trends in diving accidents, the benefits of oxygen and the hazards associated with its use. You also get the opportunity to practice using the DAN Oxygen Unit, which incorporates both the demand and constant-flow systems, while learning how to activate the EMS and DAN.

The DAN Oxygen course is an introduction for divers to learn more about the "Four R's" of managing a diving accident. Although the factors surrounding each decompression illness are unique, these four clear and consistent steps will ensure a successful outcome for the injured diver.

**Recognize the symptoms of DCI.** Assessment includes the subtle, constant process of observing and interacting with those with whom you dive. Remember, the denial of symptoms may be the first sign that an injury has occurred.

**Respond with oxygen.** Once you've established the airway, breathing and circulation (ABCs), provide oxygen. This increases the effectiveness of recompression therapy and may relieve symptoms. One hundred percent oxygen should be delivered by a demand valve and tight-fitting mask.

**Relay with EMS/DAN.** By activating EMS or calling DAN, you set in motion the mechanism to get the diver to advanced medical treatment. Have an Emergency Action Plan and know the location of the nearest phone.

**Recompress early.** Lastly, treat decompression illness in a recompression chamber. The sooner an injured diver receives definitive treatment, the better the chances of a symptom-free recovery.

The Four R's of Managing Decompression Illness are like a ladder. Just take it one step at a time and you'll find yourself with a successful recovery and complete relief of DCI symptoms. For more information on the DAN Oxygen Program, call (919) 684-2948, extension 555.

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