# DECOMPRESSION SICKNESS AND DIVE TABLES

by Kenneth Capek RRT, CHT, MPA

When scuba divers come to your hyperbaric department for the treatment of decompression sickness (DCS), they may have their dive computer with them. The Divers Alert Network recommends divers bring their computers if they need hyperbaric treatment and today many divers own these devices.

So what are dive computers and what purpose do they serve to the hyperbaric staff? Before we can answer these questions we should review two related topics: DCS and the dive tables. When a diver descends into the water (or is placed in a hyperbaric chamber) he or she is exposed to increasing outside pressure, which in turn increases the partial pressure of gases within the body.

The two most prevalent gases are oxygen and nitrogen. Oxygen is used for cell metabolism, but nitrogen is not used. Nitrogen is, therefore, classified as an inert gas. The partial pressure of nitrogen increases in the blood and tissues as more pressure is applied to divers as they descend. The tissues absorb this extra nitrogen and keep it in solution under pressure.

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When this pressure decreases, such as when the diver ascends to the surface, the process is reversed. The nitrogen gas is released into the blood and then is carried back to the lungs to be exhaled. This process can only work safely if enough time is given for the nitrogen gas to slowly come out of solution and be eliminated. If not, the reaction in the body can be similar to when you open a bottle of soda.

The soda in the bottle is under pressure (CO2 in this case). When it is opened rapidly, the pressure is released, and the soda will bubble out. Just as in the soda bottle, the nitrogen gas within the blood and tissues can form bubbles when pressure is changed too quickly (rapid ascent). This is what happens in DCS, and it can result in pain, paralysis and even death. Therefore it is important for a diver to know how much actual time is required to safely eliminate the amount of nitrogen gas that they have absorbed during the dive. The dive tables provide this gas elimination time requirement for the diver.

### *Dive tables*

The U.S. Navy created the dive tables more than 30 years ago, and they provide information to the diver on nitrogen gas absorption based on depth and bottom time (time spent underwater not counting the ascent). This allows the diver to plan no-decompression dives, which are dives not requiring mandatory stops at various depths upon ascent, and repetitive dives

If the diver exceeds the depth and time limitations stated in the dive tables, he or she runs the risk of getting DCS. DCS can still be avoided at this point if divers perform mandatory extended stops during their ascent to allow nitrogen elimination, or off-gassing. These stops are called decompression stops and can be found on another U.S. Navy dive table called the decompression table. This table is more complex and is more often used by specially trained advanced divers.

In the case of repetitive dives, when divers continue to dive multiple times each day, their bodies are continually absorbing nitrogen on each dive. They must now eliminate nitrogen during the time spent on the surface between each dive. This time period is called the "surface interval." Another table is then utilized to determine how much time is available to a diver on subsequent dives based on this surface interval.

If nitrogen is still in the body from the last dive, the time or depth for the next dive will be reduced on these tables. In addition to the information provided in the tables, one of the most significant factors contributing to DCS is the time taken by the diver to ascend to the surface. If he ascends too rapidly, there will not be enough time for nitrogen gas bubbles to be eliminated. Therefore divers use a maximum rate of ascent of 30 feet per minute.

There are other contributing factors to DCS, but dive time, depth and ascent rate top the list. On occasion, after a process of elimination, the causes for a diver getting DCS may not be discovered.

Any time you use ambient room air to compress patients or attendants, as is the case with a multiplace chamber, you run the risk of giving your patients and attendants DCS if you do not follow the rules of the dive tables. A monoplace chamber using 100-percent oxygen does not have the same DCS risk because there is no nitrogen in the inhaled gas mixture. Now that we reviewed DCS and the purpose of the dive tables we can discuss dive computers.

### *Dive computers*

A dive computer typically looks like a very large watch and can be worn on the diver's wrist or attached to his regulator air hose. It provides valuable information and performs multiple

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functions to assist the diver in safely planning and managing their dives. The dive computer measures and displays the time and depth of the diver during the dive on a continuous basis. Because the computer operates using the dive tables, it has the ability to alert the diver if they have reached their depth and time limitations.

The advantage of computerized tables over written tables is that written tables assume one constant depth throughout the entire dive rather than adjusting for actual changes in depth and time. Therefore when the tables are computerized, they constantly calculate time and depth as it actually occurs, resulting in increased allowable time for a dive. The computer will also calculate the nitrogen elimination time for repetitive dives (another table) to determine the impact the actual surface interval time will have on future dive times.

The computer performs all of these dive table calculations in addition to the measurement and display of the diver's ascent rate. It will alert the diver if he exceeds the dive limitations of the dive tables or proper rate of ascent by means of a flashing display and audible alarm. This is a great safety function to help avoid DCS.

The computer also has a "dive log" mode, which the hyperbaric staff will be most interested in. The information displayed in this mode is a record of past dives, displayed in chronological order. In other words, it provides a detailed description of the dive: actual depth, time at depth, ascent rate and any alarms that occurred. This information may help determine why the diver got DCS and help them prevent future occurrences.

The multiple functions performed by these computers make diving safer and more enjoyable. This is why computers have become so popular and the standard for safe diving. Some scuba training organizations such as Scuba Diving International require their use for certification.

For the hyperbaric staff, this is valuable information when trying to determine the reason the diver has DCS. Dive computers facilitate the accurate retrieval of what happened on the dive much like the black box on an airplane. Collecting data on the possible reasons for DCS is an important process. This information is sent to the Divers Alert Network, which will track and analyze these occurrences. DAN uses this analysis information to educate other divers in hoping to reduce the occurrence of DCS.

You can visit DAN online for more information about DCS accidents at www.diversalertnetwork.org.

*Ken Capek, RRT, CHT, MPA is Director of Respiratory Care and Hyperbaric Oxygen Therapy at Englewood Medical Center in Englewood, NJ. He can be reached at Ken.Capek@ehmc.com*

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