The Underwater Swimmer's/Breath-hold Diver's Disease:

Taravana. or Shallow Water Blackout

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March 14, 1997, Revised 2-12-2015

Taravana is the South Sea Islander's name for a disease which can effect all breath hold divers. It is a deadly disease, and is also known as an expert's disease, for it most often effects those who have a great deal of experience. However, it can effect anyone, diver or underwater swimmer, who stays underwater too long. It usually effects those who try various techniques to extend their breath hold diving time, who dive repeatedly or who compete or try to set underwater distance records.

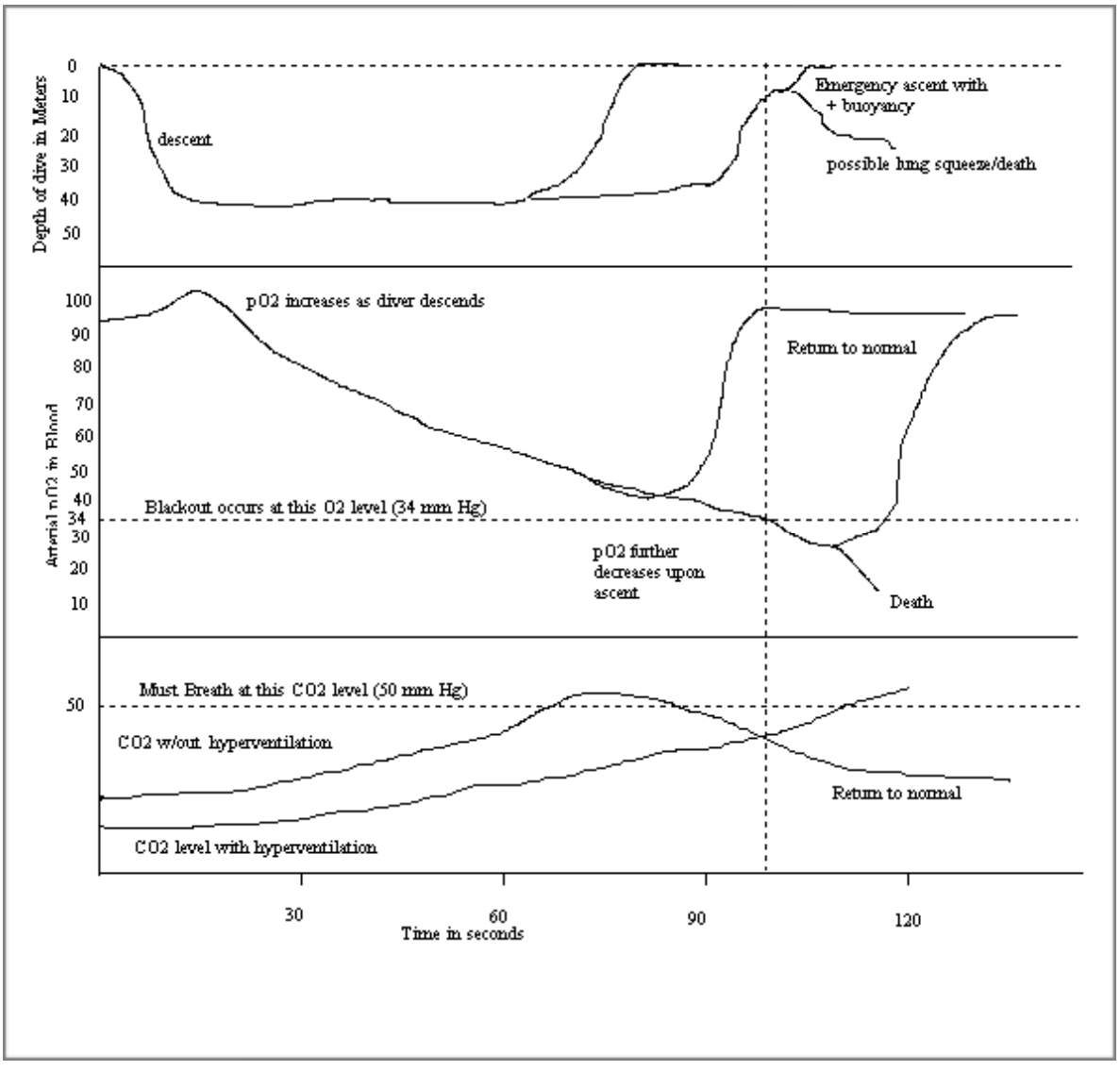
This has happened to me in a high school swim team breath-holding contest between me and my good friend, Tommy Lengyl. His Mom was our coach, and I was determined to beat his swim of four, 20-yard length of the pool. I hyperventilated until I could "see stars," than took a deep breath and dove into the pool from the shallow end. I swam underwater swimming a modified breast stroke. At the third turn, I felt some urge to breath but suppressed it. Then I came to the fourth turn, and told myself I would turn, take one stroke underwater, surface and swim to the side of the pool. I did that; the trouble is that I remember nothing from the time I pushed off that fourth turn, until I was at the edge of the pool breathing deeply. I am thoroughly convinced that had I not told myself to surface and swim to the side of the pool, I would have swam underwater until I died (that's how it happens sometimes, as documented in physiology journals I read in the 1970s at Oregon State University).

Divers who suffer taravana usually follow similar predive preparations. They hyperventilate (inhale deeply and exhale completely at a fairly fast rate) for a prolonged period, usually until they get dizzy, en the mistaken idea that they would increase the amount of oxygen in their lungs or blood. They would then either dive right in or wait a little to come back to normal and then dive in for the underwater swim. Once in the water, victims often commented that they felt great, as if they could "swim forever." Towards the end of the dive these symptoms were felt: slight urge to breath, blind spots in the vision, seeing "shooting stars" and luminous sparklings, dizziness, nausea, vertigo, and partial or complete paralysis.

Those who suffer those symptoms, including South Sea Island pearl divers, unanimously agree that once the symptoms were felt it was too late to do anything about them. With astounding suddenness the victims then blacked out. Some continued swimming after memory loss and some, until they collapsed and died. Many of those who recovered needed mouth-to-mouth artificial respiration.

After effects included being dizzy, "shaky," having a slight headache, exhaustion, sluggishness in responding to commands, periods of non-breathing, roving eyes, a bloody froth in the mouth, partial paralysis (sometimes permanent) and mental retardation. When the victims must be pulled out of the water they are flaccid (limp), non-breathing and very cyanotic (a condition in which the skin, lips and nails turn blue). Those who lived through the ordeal apparently didn't cough or inhale water. Those who didn't survive were found with a bloody froth in the mouth and lungs filled with water, apparently due to a relaxation of the throat muscles after blackout. Death is due to hypoxia, or a lack of oxygen.

But how does a person get himself into such a jam? Here the explanation gets a bit technical. When a diver hyperventilates, two things happen. First, the percentage of carbon dioxide (CO2) in the blood is lowered, but the percentage of oxygen remains approximately the same since arterial blood is normally 95% oxygenated. Secondly, hyperventilation causes a decrease in blood flow to the brain which results in cerebral anemia for a period of time before the dive begins. This is why a person gets dizzy and sees stars after prolonged hyperventilation. However, it is the increase in the percentage of CO2 in the blood which is critical, for this is what triggers the breathing reflex in the brain. A lack of oxygen doesn't trigger this response. But increased CO2 makes the diver feel that he must breath. Hyperventilation, by lowering the CO2 Level in the blood,



postpones this signal (see Graph I). It becomes dangerous when the signal is postponed to a point where the oxygen level in the blood becomes insufficient for the maintenance of consciousness.

This can happen in two ways. One is on a shallow dive, when the diver experiences the urge to breath and, with the lowered percentage of CO2 from hyperventilation, stays underwater until he blacks out (represented in Graph I). The other way happens on deeper dives, those deeper than 33 feet (10 meters). This is taravana, the feared disease of the South Seas. The diver hyperventilates, as before, then dives deep. As (s)he dives the pressure increases, and the partial pressure of oxygen also increases. The diver pushes himself to stay somewhat longer than he normally would, and is finally forced to the surface. As he does, the pressure decreases and the partial pressure of oxygen also decreases in the lungs. But the partial pressure of oxygen in the blood remains high, since it is almost a closed system. However at the lungs, oxygen, because of the higher partial pressure in the blood, passes back into the lungs and is lost for metabolic purposes. Couple this to another phenomena, than the body has a higher tolerance to higher percentages of CO2 when exercising which allows the diver to stay down even longer before the urge to breath is felt, and the result is catastrophic: acute hypoxia and unconsciousness. Brain damage is imminent if the diver isn't resuscitated immediately because the brain is already depleted of oxygen. This condition is depicted in Graph II.

How can shallow water blackout, or taravana, be prevented? The most important point is NOT TO HYPERVENTILATE. Ventilate the lungs with a couple of deep breaths, but not more than three. When breath hold diving, it takes about 15 minutes for the body

to adjust to the water. Establish a cycle to diving, where the divers dive until they feel the urge to breath, surface and stay on the surface recovering until they feel comfortable (at least two or three minutes) then dive again. With practice, the diving times will lengthen. The deeper the dives, the longer the recovery time needed by the diver; the same advice goes for submergence time--the longer the breath holding time, the greater the need for longer surface recovery. Deep, long dives (undefined--individual's vary) may take 15 minutes for recovery. During the time the divers are recovering, they can monitor their buddy.

Wearing a functional life vest is highly advised when breath hold diving. If a diver questions whether (s)he can regain the surface, (s)he can inflate the vest or take off the weight belt and hold it. In doing so, the diver will regain the surface if blackout occurs. Spare cartridges can be kept on a float or boat.

If any symptoms of taravana are felt, discontinue diving for the day. And, always dive with a buddy who's capable of rescuing you (and vice versa) and who watches you while you dive.

Finally, it is my hope that you'll abide by those warnings. I've experienced both blackout and vertigo on two occasions, and it's not pleasant. I've also lost a good friend to this disease. So please, take preventive measures and breath hold diving can be an inexpensive, safe and interesting sport.

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