

I have written quite a lot on shallow water blackout, both on vintage diving websites and with NAUI years ago. As a former PJ, and also a NAUI Instructor (#2710, inactive), shallow water blackout (SWB) is a considerable concern in both civilian and military training. With breath-holding underwater, normally the CO₂ in the blood stream will build up to a "must breath" level of about 50 mm of mercury (Hg). This normally will happen in about a minute. However, if a diver hyperventilates a lot, the diver will blow off enough CO₂ to be able to extend that time until the oxygen level goes down below the blackout level (about 34 mm Hg).

This can further be complicated by depth. At depth, the oxygen level is increased by the partial pressure of oxygen in the bloodstream. But as the diver ascends, that partial pressure lessens, and there can actually be a transfer of oxygen from the blood back into the lungs. Blackout occurs at about 10 feet underwater when breath-hold diving to depth.

SWB can be prevented by not hyperventilating more than about two or three breaths before diving. I have long advocated using a "rhythm diving" method too, where you dive underwater until first feeling the "must breath" signal, then surface. Breath normally for about two minutes, then dive again. Over time (15-20 minutes) you'll be extending your time underwater by relaxation and your body's adaptation to the breath-holding.

To show what this hazard is, here is my story of SWB. I was on the YMCA Swim Team in Salem, Oregon as a kid. My friend, Tom Lengyel had just swam four lengths of a 20 yard pool, and I wanted badly to beat his record. So I hyperventilated over a minute, enough to get a bit dizzy, then dove in and swam underwater breast stroke. The first two lengths were easy. On the third length, I was beginning to feel the urge to breath, but suppressed it. Coming into the turn at the end of the fourth length, I said to myself, "I'll make the turn, take one stroke underwater, then surface and swim to the side of the pool." And, that's exactly what I did. The trouble is that I did not remember anything after the pushoff of the turn. The next thing I knew, I was at the pool's edge and dizzy, regaining consciousness. I told our swim coach, who was Margaret Lengyel, mother of Tom, and also an Olympic Silver Medalist in breast stroke in the 1930s from Hungary (unconfirmed, but that's what we heard), and she immediately stopped all underwater competitions.

This may not fit with the military training for PJs or SEALs, but it is about the only way to prevent SWB. By pushing people into SWB, the risk is that it won't be recognized by the instructors or buddy, and that the person will die. Had I not pre-programmed my mind to surface, I would not have, and would have continued swimming underwater until I was dead! This has been documented in professional physiology journals since the 1960s. So simply waiting for symptoms to "show" during military training may actually be too late to revive the diver.

<http://www.ncbi.nlm.nih.gov/pubmed/25996093>