

## REVERSE DIVE PROFILES

Guy Williams

### Key Words

Decompression illness, diving tables, risk, safety.

### Introduction

On October 29th and 30th 1999 the Smithsonian Institution held a Reverse Dive Profile Workshop in Washington, DC. The 49 person workshop was called to decide if there was evidence to show that reverse dive profiles were more dangerous than those where the first dive was the deepest and any repetitive dives were shallower. The participants mostly (41) came from the USA, two from Canada and Germany, and one each from Finland, Norway, Switzerland and the UK. Four of the participants have been Guest Speakers at SPUMS Annual Scientific Meetings, Glen Egstrom was our first Guest Speaker in 1978 and again in 1991, Alf Brubakk in 1999, Bill Hamilton in 1996 and Richard Moon in 1997 and 1999. This paper is an attempt to summarise the 295 page book of the Proceedings, edited by MA Lang and CE Lehner, which was published by the Smithsonian Institution in 2000.

Three reviews of the Workshop Proceedings appeared in one issue of the Journal in 2000 [32 (3): 115-117, 144-145 and 145-147].

### What is a Reverse Dive Profile?

The Workshop adopted the definition that a reverse dive profile was either two dives performed within 12 hours in which the second dive is deeper than the first; or the performance of a single dive in which the latter portion of the dive is deeper than the earlier portion.

For many reasons reverse dive profiles are being performed in recreational, scientific, commercial, and military diving

### What is wrong with a reverse dive profile?

Although there appears to be anecdotal and practical support for avoiding reverse dive profiles the exact origination of condemning this profile is unclear. It appeared in recreational dive training in early 70s and became accepted as a standard recommendation by the training agencies by the mid 80s.

The reverse dive profile "problem" is limited to recreational diving as neither the US Navy nor the commercial diving sector have prohibited reverse dive

profiles. This may be due to their infrequent usage of repetitive diving or to their more disciplined diving routines.

The prohibition of reverse dive profiles by recreational training organisations cannot be traced to any definite diving experience that indicates an increased risk of DCS.

However, when divers use US Navy tables, reverse profiles always produce less bottom time on the second dive to the no-decompression limits so there are practical reasons to avoid deeper repetitive dives. After all recreational divers want to spend as much time as possible underwater. Intuitively one can understand the theoretical attraction of adding less nitrogen to the body by doing shallower dives after a deep one and benefits that this might bring to avoiding decompression sickness (DCS). Add the legal advantage that teaching deep dive first would bring to the instructor if a diver sued after suffering DCS after a reverse dive and it is small wonder that reverse dive profiles were advised against.

### Are reverse profile dives safe?

No convincing evidence was presented that reverse dive profiles within the no-decompression limits lead to a measurable increase in the risk of DCS.

No theoretical or experimental evidence can be found that indicates a repetitive dive must be shallower than the dive that precedes it.

Many divers using PADI recreational dive planner (RDP) or dive computer to do deeper repetitive dives are beyond the tested envelope which is mostly military and experimental dives. The commercial diving industry does not often open its records to outsiders.

Deep repetitive dives that are followed by a direct ascent to the surface have been shown to produce a high incidence of DCS. Repetitive deep decompression dives that do not push the limits do not seem to have the same problems.

However no evidence was produced that showed that reverse profile dives were safe. Only evidence which suggested that they were not dangerous. The General Session discussion which finishes the book makes it quite clear that no one was willing to say that it was safe to use reverse profile dives except in the no-decompression limits. Tom Neuman made it quite clear that, from his experience treating bent divers, doing a deep dive as the last dive was a dangerous practice because many recreational diver paid no attention to keeping some air for emergencies and most of his cases had run out of air and had to make an out-of-air ascent. From a shallow dive this was not likely to be

followed by DCS but DCS was very likely after a rapid ascent from a deep dive.

### Safe diving

For divers who use a dive computer and are taking advantage of its multi-level capacity, any rule to avoid reverse profiles would seem irrelevant.

For those still using a dive table, the avoidance of reverse profiles is an important practical rule that results in more bottom time.

### Conclusions

The final statement of the meeting was "We find no reason for the diving communities to prohibit reverse dive profiles for no-decompression dives less than 40 msw (130 ft) and depth differentials less than 12 msw (40 ft)".

In the 21 pages of the General Session discussion it appears that the consensus, give and take a few, was that conservatism, staying well within the times at depth, ascending slowly and decompressing longer than required by the tables, appears to be the best way to avoid decompression sickness. This discussion, the Introductory Session and the Medical Session were the easiest for medicos to understand. Two major sessions, Physics/Physiology and Physiology/ Modelling were dominated by mathematics. The Operational Experience Session was very interesting.

Nowadays most divers use dive computers. Computers rarely are victims of DCS, but divers can be! In fact, in some series of Decompression Illness reports, 50% and more of the affected divers were using computers.

*Dr Guy Williams is Immediate Past President of SPUMS. He has a general and diving medicine practice. His address is 1239 Nepean Highway, Rosebud, Victoria 3939, Australia. Phone +61-3-5981-1555. Fax +61-3-5981-2213. E-mail <guyw@surf.net.au> .*

### A SUMMARY OF THE UNDERSEA AND HYPERBARIC MEDICAL SOCIETY NEAR DROWNING WORKSHOP

Chris Acott

### Key Words

Drowning, incidents, near drowning, physiology, treatment.

### Introduction

The Undersea and Hyperbaric Medical Society (UHMS) Workshop on near-drowning was held in 1997.

One of the most interesting presentations was by Carl Edmonds on drowning and near-drowning.<sup>1</sup> Table 1, chosen from that paper, shows what I consider to be the interesting parts of his data. This reported 100 Australian divers, who fitted the requirements for being classified as dying from drowning.

TABLE 1

### COMPARISON BETWEEN 100 DROWNED DIVERS AND 48 WHO SURVIVED NEAR-DROWNING

Taken from tables in C Edmonds, *Drowning with scuba*.<sup>1</sup>

	Drowned	Survived
<b>Training</b>		
No training	38%	4%
Under training	8%	15%
<b>Experience</b>		
None	37%	31%
Novice	30%	35%
Some	27%	29%
<b>Equipment</b>		
Faults	31%	18%
Misuse	43%	38%
<b>Buoyancy</b>		
Overweighted	25%	27%
BCD not inflated	52%	31%
BCD failed to inflate	5%	8%
BCD inflated before incident	12%	-
Victim inflated BCD	15%	35%
Buddy operated BCD	16%	25%
Overall inflated BCDs	31%	60%
<b>Air</b>		
Out of air	49%	27%
Low on air	11%	8%
1/4- 1/2 cylinder	11%	20%
>1/2 cylinder	29%	45%
<b>Water environment</b>		
Poor visibility	26%	18%
Current	55%	31%
Rough	44%	41%
<b>Weight belt</b>		
Not ditched	66%	48%
Ditched by victim	10%	19%
Ditched by rescuer	20%	25%