Causes of drowning in divers

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Key words
Drowning, incidents, recreational diving, training, buddies

Abstract
Drowning is the endpoint of many diving fatalities for a variety of reasons. Most divers are not well enough trained and should be encouraged to undertake more training beyond basic recreational open water diving. Unexpected equipment failures may sometimes occur. How to cope with these problems is not always adequately taught during initial training. A quarter of equipment failure incidents result in morbidity, yet a surprising number of divers have poorly maintained or serviced equipment. Running out of air is one of the most common serious diving incidents, which suggests that there is something wrong with how divers are trained. Air integrated gauges/computers, most of which have audible warnings, are useful tools for gas supply management and should be utilised more than at present. Wrist mounted displays are more readily seen than dangling consoles. The Cave Diving Association of Australia training and certification system is an example of successful self-regulation in recreational diving. Medical conditions may predispose divers to a diving incident. Increasingly, risk recognition and management is being emphasised in the medical assessment of diving candidates.

Introduction

Prevention is the best method of stopping divers drowning. Only fish are fit to dive, so humans are at risk every time they enter the water. Drowning is the endpoint of many diving fatalities for a variety of reasons. The following is an experienced scuba diver/general practitioner's personal view of this subject. I will comment on aspects of prevention, diving equipment, diving practice and medical problems that I consider relevant.

Prevention

How might we reduce the number of divers drowning? My belief is that most divers are not well enough trained in general, and the preponderance of untrained or inexperienced divers in the fatality statistics bear this out.[1,2] We should be encouraging divers to undertake more training and particularly for some of the more specialised aspects of diving such as wreck diving or cave diving. We should encourage people who want to do anything more than basic recreational open water diving to obtain the appropriate training. It really is worthwhile doing extra training, and there are many training modules available these days.

Equipment failure and maintenance

Unexpected equipment failures like blown O-rings, ruptured hoses and problems with buoyancy compensators (BCDs) may sometimes occur. How to cope with these problems is not always adequately taught during initial training.

All diving equipment sold currently includes a contents gauge. A failed gauge is perhaps the only excuse for running out of air. Unfortunately, most divers do not have their gauge examined when their diving regulator is serviced. If you have not had your gauge checked recently, then do so soon.

In a report on equipment failure problems, 27 of 105 events resulted in morbidity.[3] The same report describes strategies to minimise adverse outcomes in diving.[1] Table 1 shows how the divers were injured and the causes of their problems.

It is amazing the number of divers who have poorly maintained, poorly or never serviced diving equipment. In most parts of the world scuba cylinders have to be tested by law or they will not be filled. Perhaps there should also be a voluntary code of practice whereby regulators need a date code indicating servicing date. It could be argued that regulators, the contents gauge and the BCD should all have a mandatory service every year.

Loss of gas supply

Divers obviously need better education about how to cope with an out-of-air situation, as running out of air is one of the most common causes of diving incidents. Another option for divers who run out of air is to have more air. Obviously we cannot carry an infinite amount of air, but if one has a spare supply, it is a good idea. The concept of redundant systems is in fact nothing new in Victoria (Australia) where the dive industry has just such a voluntary code of practice in place. If you are going out on any of the charter boats and wish to dive below 30 m you must have a bail-out bottle; you either have to have your own or they will rent you one.

It is remarkable that divers run out of air as a single event. The fact is that many divers seem to conduct their dive in such a poor manner that they do not have an adequate gas supply to return to the surface. Discussions with the operators of dive charter vessels indicate that running out of air happens regularly. This suggests to me that there is something wrong with how we are training divers. I emphasise that running out of air really just should not happen.

I believe air integrated gauges/computers, most of which have audible warnings, are really useful tools for gas supply management. They alert the diver if the dive is going to be limited by the decompression tables or the air supply, provided you look at them regularly. I would encourage divers to consider them when they next purchase new equipment. The ideal place to have a gauge when diving is on the wrist because it is easy to look at. Most divers look at their wrist more often than they examine a dangling trail gauge during a dive. A wrist-mounted computer display, especially if it includes air supply, is a better and safer option than having to retrieve a contents gauge and look at it.

SHOULD DIVER-EMPTIED TANKS BE FILLED?

Perhaps the lateral thinker's approach to divers running out of air would be for the dive industry to decline to fill completely empty scuba tanks without doing an internal visual inspection and charging a fee for this service. An alternative and innovative approach was adopted by the dive operator at the 2000 SPUMS ASM, who warned divers that an empty tank signified the diver wished to purchase

TABLE 1
MORBIDITY ASSOCIATED WITH EQUIPMENT FAILURE (from Acott[1])

Morbidity	Total	C	CG	D	I	F
Decompression illness	16	6	6	2	2	-
Pulmonary barotrauma	6	-	2	-	2	2
Salt water aspiration	1	-	1	-	-	-
Near drowning	1	-	-	-	-	1
Ear barotrauma	1	-	-	1	-	
Not specified	2	-	-	-	2	-
Totals	**27**	**6**	**9**	**2**	**7**	**3**

Causes
C = Computer failure
CG = Contents gauge failure
D = Depth gauge failure
I = Inflator failure (spontaneous inflation 5, failure 2)
F = First stage failure

the cylinder, the cost of which would appear on their hotel account!

MULTIPLE CYLINDERS AND FULL FACE MASKS

As far as I know divers are not trained to use multiple cylinders in open-water training. There is no doubt that extra cylinders and extra valves and regulators increase the complexity of the diver's equipment. Multiple cylinders weigh more, and because of their bulk there is more risk of entrapment. There is more to maintain and more to go wrong. Of course, this makes diving even more expensive. Should all divers be trained to use these back-up systems as part of their basic training? I would say probably not. Should divers who are doing deep air dives or technical dives be encouraged to use a full-face mask? If they do have a fit or lose consciousness underwater, they might have a chance of surviving if they had somebody nearby.

Diving practices

ENTRAPMENT

Many people have run out of air when entrapped. For example, they have died in caves in South Australia; that is, until the Cave Diving Association of Australia (CDAA) introduced a training and certification system. The CDAA system is one of the success stories of self-regulation in recreational diving in reducing cave diving fatalities. Divers have died lost in wrecks, they have become entangled or lost and ultimately exhausted their air supply and drowned. A diver may also become virtually entrapped, in that the diver may have done a decompression dive and discovered that they cannot surface due to a decompression ceiling, although they are low on air. Unusual environmental conditions such as the powerful down-currents experienced in Palau may present similar virtual entrapment problems.

BUDDY DIVING

I am not a great proponent of buddy diving. I believe that unless your buddy is tethered to you on a line, he (or she) is not close enough to be of much use to you. If they are out of sight or at a distance then they are not going to be able to provide you with much support in the event of an incident.

Medical problems

There are a variety of medical reasons why one might drown. Epilepsy, diabetes, myocardial infarction, oxygen toxicity, carbon monoxide and other gas toxicities and hypoxia (eg. shallow water blackout) are a few. There are many more medical reasons why one might lose consciousness underwater and drown, or if lucky near drown and be rescued.

SPUMS supports making certain that divers are fully fit to dive, hopefully to detect and advise on medical conditions that may predispose prospective divers to having a diving incident. Risk recognition and management are emphasised in the current SPUMS diving medical assessment form.

Conclusions

I believe that divers need to be better trained. Divers using modern equipment properly maintained should not run out of air. If divers are running out air, and they are, there is something wrong with how they are trained. Diving training agencies need to emphasise to trainees that divers have to think about what they should be doing to maintain and enhance their own safety.

Drowning is the endpoint of many diving fatalities for a variety of different reasons. Most divers who drown or near drown do so either by running out of air or losing access to their air supply. Divers mostly run out of air through basic errors and simply not looking at their gauges. Other factors include diver error leading to panic and panic leading to diver error. Entrapment (eg. lost in a cave or wreck) may result in an out-of-air situation. Equipment failure and unconsciousness from medical causes may also result in drowning.

I have made various suggestions with regard to equipment such as redundant systems, and mandatory servicing. I think some of them would be best brought about through voluntary action by the dive industry.

References

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