Too many out of air ascents fail to reach the surface.

There is a simple-to-learn routine (Table 2) which will see the diver to the surface, the continuous breathing cycle ascent protocol. This should become the standard teaching.

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The views expressed in this paper are Dr Knight's and not the policy of SPUMS.

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THE SPUMS WORKSHOP ON EMERGENCY ASCENT TRAINING

Des Gorman and Drew Richardson
Workshop Co-Chairmen

Introduction

The utility of emergency ascent training (EAT) has always been, and still is, controversial. Much debate on the efficacy and safety of EAT has preceded the SPUMS Workshop, but very little of it has been based on reliable, or even any, data. Such data-free subjective debates are unfortunately common in diving and diving medicine. Despite the reasonable consensus reached on EAT at the 1977 Workshop on this theme conducted by the (then) Undersea Medical Society,[1] the issue has been projected back into prominence by the development of a Code of Practice for diving in Queensland. Several SPUMS members and the Society itself have been consulted for an opinion. In the past, such a policy would have been produced by a volunteer or directed member of the Society's Executive Committee. Clearly, such policies may not reflect the overall opinion of the Society.

The SPUMS Workshop on EAT was designed to achieve the following two goals:

a to develop (if possible) a SPUMS policy on EAT; and,

b to illustrate that a Workshop is an appropriate method of forming Society policy.

In the final analysis, the Workshop achieved both goals admirably. Only on a single issue, buddy breathing ascents, was a consensus not possible. The widespread agreement was largely due to the "hard" data produced during the various presentations, which are published in this issue, and the active participation of those attending the conference. The Society's Guest, Professor David Elliott and his countryman, Phil Bryson, were particularly involved.

In addition to the invited presentations of Chris Acott, Drew Richardson, John Knight (given by Guy Williams) and Terry Cummins, written submissions were also received from James Francis (the Senior Medical Officer in Diving Medicine for the Royal Navy), John Williamson, Gerry Stokes (Irish Underwater Council) and Larry Williamson (Submersible Systems Inc.). All these

contibutions are printed in this issue. Special recognition is due to SAAB and Submersible Systems for their sponsorship of the Workshop.

The workshop

A series of fundamental questions was addressed and both the key-note addresses and the subsequent discussion are summarised below.

Is there a need for emergency ascent training?

This question was largely answered by Chris Acott in his presentation, from the Diving Incident Monitoring Study (DIMS), of those incidents of being out-of-air/low on air (pages 222-225).[2] Approximately 20% of more than 500 incidents reported to DIMS have involved such a situation, many leading to an emergency ascent. Those involving buddy breathing often caused later problems (salt water aspiration). The utility of alternative air supplies (e.g. SPARE AIR) was discussed. Chris Acott reported that a fully pressurised SPARE AIR cylinder provided about 20 breaths at 20 msw, but that mechanical problems with the regulator system had been experienced. Guy Williams confirmed this experience. It was agreed that while the availability of alternative air supplies may reduce the frequency of needing to perform an emergency ascent, it would not reduce the need for training in emergency ascent techniques. Considerable support existed for the reintroduction of sonic reserves. Complete redundancy of equipment (e.g. cave diver's rig) was not considered necessary in conventional recreational diving.

The following conclusions were drawn from Chris' presentation and the ensuing discussion:

a despite the current emphasis in training on attention to air supply status, recreational divers still occasionally exhaust their air supplies;
b inflation of a buoyancy vest can rapidly convert a low on air to an out-of-air situation;
c dependent ascents (buddy breathing and octopus assisted) are often impossible because of the separation of diving buddies; and,
d buddy breathing under stress often causes salt water aspiration in both participants.

How do the recreational instructor groups train entry level SCUBA divers in emergency ascents?

Drew Richardson presented an overview of NAUI, PADI and SSI training techniques (pages 214-222).[3] Drew divided techniques into dependent (assisted) and independent groups. During the discussion, Phil Bryson and Bob Borer described how these techniques differed from those employed by the British Sub-Aqua Club (BS-AC). The lack of a centrally accepted and applied training standard made consideration of CMAS policies impossible.

It was evident that the great majority of trainees are neither taught nor practise a true free ascent. A "free ascent" is defined here as an ascent that requires no equipment, in which the subject exhales into the water, and where the ascent is controlled by respiratory volume alone. The emergency swimming emergency ascents in training are performed with a regulator kept in the mouth. This latter practice was strongly advocated in the subsequent presentation by Guy Williams on behalf of John Knight (pages230-236).[4]

What is the efficacy and risks of emergency ascent training?

None of the Workshop presentations included data on the efficacy of EAT, with the exception of Chris Acott's DIMS data which suggested a significant morbidity for buddy breathing ascents (pages 222-225).[2] However, John Williamson argued strongly that data from resuscitation training show that even a single trial of, or exposure, to a technique significantly improves performance of that technique in an emergency. It is likely that Chris Acott's continuing DIMS study will provide considerable insight into the efficacy of EAT.

Guy Williams read a paper from John Knight outlining the health risks of EAT to both the trainees and their instructors (pages 230-236).[4]

John Knight considered the major risks to the trainees to be:

a pulmonary barotrauma;[5]
b salt water aspiration;[2] and,
c hypoxia.[6]

Using submarine escape training tower (SETT) data, John Knight estimated that the risk for each emergency-ascent-exercise was about 1:2,000 for pulmonary barotrauma (including air embolism) and about 1:40,000 for sudden death. These data contrast sharply with those presented subsequently (pages 225-230).[7]

The critical data that enabled an overall consensus to be reached were presented by Terry Cummins on behalf of himself and Drew Richardson (pages 225-230).[7] Based on PADI training records and PADI accident reports (likely to be inclusive due to the link between reports and liability insurance), the following data were presented:

a PADI have records of more than 3,754,704 trainee EAT vertical ascents to the surface in open water;
b the associated injury rate is about 1:100,000 ascents for trainees; and,
c the associated fatality rate is about 1:2,000,000 ascents for trainees.

The size of the denominator encourages confidence in these figures. Consequently, it is evident that EAT is a negligible risk to trainees and, as conducted by PADI, is at

least 50 times safer than SET.[4] Many of the conventional "medical" objections to EAT have been based on SETT figures, for very fast ascents, which were, until the Cummins and Richardson paper, the only available statistics. Many participants were influenced to modify their stance by this PADI data.

The production of the PADI data at a SPUMS meeting is a significant demonstration of the maturing relationship between SPUMS and the recreational diving industry. In previous years, such data would not have been shared with SPUMS for fear of its "mis-use".

John Knight also used the experimental data of Harpur and Suke[6] from Tobermory, Canada, to argue that hypoxia was a major cause of a loss of consciousness during an emergency ascent and to advocate the emergency ascent technique proposed by Harpur at the 1977 UMS Workshop on EAT.[1,4,6]

It was agreed by the SPUMS Workshop, notwithstanding that the Harpur and Suke[6] trial involved divers ascending from a ventilatory starting point of functional residual capacity (FRC), that hypoxia was a major problem in emergency ascents and would be exaggerated by work performed in trying to contact a separated buddy. It was also and consequently agreed that:

a the fundamental nature of the technique advocated by Harpur[1] and those taught by NAUI (emergency swimming ascent), PADI (controlled emergency swimming ascent) and SSI (emergency swimming ascent) is common;

b EAT simulation by horizontal swimming does not provide realistic practice for either breath or buoyancy control;

c. the technique of not ascending completely to the surface (recommended by Professor Elliott) should be safer (by avoiding the greatest dysbaric stress) but would not be as effective a training activity;

d other than trainees repeatedly practising to remove their weight belt effectively, without actually ascending, there was little to be gained by actually conducting a buoyant ascent over and above the controlled swimming ascents;

e the use of a vertical ascent line improved the safety of all techniques; and,

f time and already depleted gas supplies should not be exhausted trying to re-establish contact with a significantly separated buddy, and an early decision to ascend to the surface should be encouraged.

A consensus could not be reached on buddy breathing. Many of those at the Workshop argued that the practice was dangerous and some anecdotes suggested that it may be lethal. Greg Leslie, with an apt fornication-based analogy, suggested that buddy breathing should be restricted to established "buddy-pairs". It was however agreed that, if Chris Acott's DIMS Study (pages 222-225)[2] continues to demonstrate a significant morbidity for buddy breathing, that it should be actively discouraged.

The risks of EAT to the Instructor, multiple ascents and a consequent risk of decompression illness (DCI), were then debated. Although such instructors were grossly over-represented in a series of divers treated for DCI at Townsville,[8] other centres have not reported such a bias.[9] It was nevertheless agreed that the number of ascents performed by an instructor during a dive with trainees should be minimised (but not to any arbitrary level such as 5 ascents/dive as imposed in some training facilities in the United Kingdom).

The SPUMS policy developed at this Workshop is printed on page 239.

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SPUMS POLICY ON EMERGENCY ASCENT TRAINING

The SPUMS policy on EAT developed at the 1993 Workshop is summarised below.

1 The frequency of recreational divers becoming low on air or running out of air completely is unacceptably high. Instructor agencies must increase the training emphasis on attention to air supplies and to avoiding unnecessary inflation of buoyancy vests, especially when air supplies are low. The latter will also require an improvement in buoyancy control. The availability of alternative air supplies does not obviate the need for avoiding low on air and out-of-air situations. A sonic reserve alarm may be helpful.

2 An alternative (i.e. independent; e.g. SPARE AIR or redundant scuba cylinder) supply of air is recommended for deep diving (beyond 30 m), cave diving, penetration wreck diving, staged decompression diving and other diving where entanglement is likely. The alternative supply must be appropriate to the circumstance.

3 Emergency ascent training should be taught to and practised by entry level scuba trainees.

a ***Academic information only.*** Positive buoyant ascent (when the diver drops his or her weights and utilises lift from all forms of buoyancy, BCD and exposure suit).[1]

b ***Academic information and confined water (eg pool or lagoon) skills training.*** Weight-belt removal and buddy breathing, when two or more divers share a common air supply by passing the regulator second stage from one diver to another.[1]

c ***Academic information, confined and open water skills training.*** Emergency (controlled) swimming ascent (when the diver swims to the surface with the regulator in the mouth, exhaling continuously), octopus assisted ascents (using an alternative air source, usually an additional second stage known as an octopus regulator) and normal ascents (a direct swimming ascent, with the mouth-piece in place).[1]

4 Emergency ascent training to the surface should be confined to a maximum depth of 9 m.

5 Emergency ascent training should be conducted vertically and involve a vertical safety-line.

6 The number of students per instructor, the number of assistant instructors and the conduct of EAT should be organised to minimise the number of ascents that instructors and their assistants have to perform.

7 The safety and efficacy of buddy breathing is suspect and is under active review.

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