under instruction. If an applicant is medically approved for diving and the instructor believes the student has a condition that may not be suitable for diving it is appropriate for the instructor to inquire from the student and seek further guidance for the physician who examined the student. The Law and The Diving Professional[7] discusses this point "ultimately, the scuba instructor must make the final decision as to whom will be permitted to take a scuba course. Scuba instruction is not a right to which all persons are entitled. It is a private recreational choice on the part of both the instructor and the applicant. An instructor has absolutely no legal obligation to accept every applicant. Therefore, keeping in mind these considerations in the area of medical fitness, an instructor may exercise discretion by refusing admission to an application if, the the instructors judgement, there is cause for concern".

As stated earlier, it is important for an instructor not to assume responsibility for medical judgements or approvals. This is solely the physician's area of expertise, the instructor is required by PADI, to leave this responsibility to the physician.

Conclusions

By using the PADI Medical Statement, instructors, students and physicians are all assured they are doing their best to ensure individual health for diving. The process of student, instructor and physician interaction is designed to provide information about student medical history and risk identification to make an informed recommendation prior to scuba diving. This in turn will support a continuance of safe and enjoyable scuba diving for the majority of the interested population.

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Drew Richardson is Vice President Training and Education, PADI International. His address is 1251 East Dyer Road, #100, Santa Ana, California 92705-5605, U.S.A.

SPUMS policy is that every intending diver should have a medical from a doctor trained to do diving medicals before starting to dive.

With this issue of the Journal comes a copy of the SPUMS submission to Standards Australia Committee CS/83 detailing what is considered necessary for a diving medical for recreational divers.

Further copies are available from the Secretary of SPUMS, C/o Australian College of Occupational Medicine, P.O.Box 2090, St Kilda West, Victoria 3182, Australia.

THE RECREATIONAL DIVE PLANNER AND THE PADI EXPERIENCE

Raymond E. Rogers

Introduction

In 1988, the Professional Association of Dive Instructors (PADI) began distributing the Recreational Dive Planner (RDP) as an alternative to the US Navy tables, which had long been accepted around the world as a de facto standard for recreational use. Although the USN tables were neither designed nor tested for the way they were commonly used[1], their very familiarity made them tolerable to most experts in the field of diving safety. The most likely reason that they were well accepted by the medical and scientific communities was not from any inherent excellence, but from the fact that divers who used them had a very low rate of decompression sickness (DCS).[2,3]

As dependable as the USN tables were, they were far from perfect and were criticized in many quarters. Some considered them unnecessarily conservative and restrictive for repetitive diving.[4] The RDP is a result of this body of opinion, and so are virtually all dive computers in the world. But there was another opinion which was shared by some well-respected individuals, an opinion which holds that the old tables were too generous.[5,6] After all, hundreds of DCS cases were being treated each year,[7] and, at least until recently, the overwhelming majority of divers who experienced DCS had used USN tables.[8] Because of this, some people were understandably concerned that any procedure which allowed more bottom time was something to be feared.[9,10]

Testing of the RDP has been reported to SPUMS on a previous occasion.[11] The reports were well received, but some observers were pragmatic enough to realize that a favorable laboratory outcome does not guarantee acceptability in practice. They wanted to know what the experience would be after many divers were using the RDP. This paper discusses that experience. As with all diving statistics, answers are hard to come by, and when given, are usually suspect, but the duty to search for them still exists. A superficial examination of reports about diving and dive accidents reveals the inadequacy of most of these reports, and a careful examination reveals that they are not as good as they seem. Yet, it is possible to work only with the materials at hand. These caveats having been pronounced, it may be said that the experience with the RDP has been good.

DAN accident reports

The best source of information is the Divers Alert Network (DAN), even though a chronic shortage of funds limits DAN in its ability to be as thorough as it would like.[12] DAN has improved its data collection and analysis remarkably in the last few years, but it is the first to admit that it has a way to go. DAN deserves credit for the progress that it has made and it will continue to improve. The DAN 1989 Report on Diving Accidents and Fatalities has just been released, and is the most current, finalized information available.[13] This means that there is no official information about the last 18 months, a period when several new dive computers were introduced, and when PADI phased out the old USN tables in favor of the RDP. There is, however, some preliminary and unofficial information.

Even when reports exist, it does not mean that desired answers are available. It is necessary to discriminate between what is written and what may have really happened. Examination of accident reports demonstrates how many cases are caused by diver error. Only a small number occur with divers who did things correctly and still had DCS, or as it has been called "an undeserved hit."

A detailed study of the first 33 RDP incidents reported to DAN in 1989 revealed the nature of this problem, and the analysis was published in mid 1990.[14] The rest of the 1989 reports were similarly studied when they became available. The results of this analysis were combined with that of the first, and are summarized here. Some of the incidents were more apparent than real. Several of the cases clearly were from use of the old USN tables, but they were marked as "RDP" and thus were listed on the database printout. A few divers were using computers with the RDP as a backup, and both methods were recorded. Of those that did appear related to the RDP, five categories seemed to characterize the incidents; and some reports fit in more than one of these categories. A few examples are listed to illustrate each category. In all examples the depth/time is given followed by the surface interval, usually in minutes, in brackets.

Rule violations

21 cases of DCS were obvious rule violations. Two examples are:

Profile: 105/24
Over limit of 110/16 by 8 minutes; no emergency stop.

Profile: 90/22 (90) 90/32 (90) 80/35.
No safety stops were ever made; 2nd dive was over limit; did not quit for 6 hours as required; rapid ascent (low on air); over limit again on 3rd dive; rapid ascent (low on air again); felt numbness/tingling before the last dive but continued to dive; drug use.

Dubious reporting

20 cases of DCS were dives which are suspicious because of dubious reporting. Four examples are:

Profile: 90/20 (3.5 hour) 50/25 (1 hour) 30/40
Profile: 80/20 (80) 80/20
Profile: 40/40 (20) 40/40
Profile: 30/35 (90) 35/40 (90) 35/60 (90) 40/25 (60) 40/20 (75) 65/30. A marginal note said "Don't remember exactly".

Equipment malfunction

Five cases reported equipment malfunctions such as stuck inflator hoses, computer shorted out and the diver changed to RDP in mid-dive. Some of these reports were obviously incomplete such as timing device failures, with no report of how the dive time was determined!

Benign exposures

21 Cases of DCS occurred with benign exposures

TABLE 1

REPORTED SURFACE INTERVALS SHOWING TENDENCY TO ROUND-OFF

"EXACT"			ROUNDED		
Obviously	Possibly	Probably	Obviously	Possibly	Probably
22	20	35	1:30	30	90
33	40	65	2:00	30	90
34	50	95	2:00	45	90
48	50	95	3:00	45	90
48	140			45	90
52	140		1 hour	45	90
92	140		3.5 hours	45	105
102	140			60	120
142	150		2 .5 hours	60	165
152	160		3 hours	60	165
	200			60	180
	220		30 - 45	75	180
					210
					210
					300

permitted by any system. Four examples are:

Profile: 40/43 (52) 30/46
Profile: 92/10
Profile: 70/30
Profile: 35/20

Permitted by RDP but not by USN tables

Three cases of DCS occurred with exposures permitted by the RDP but not by USN tables.

Profile: 50/33 (50) 50/33 (50) 60/29
Profile: 51/37 (60) 30/40 (45) 50/47
Profile: 50/47 (150) 60/49 (140) 50/51

Diver error is not specific to the RDP. It applies across the board to all divers and to all decompression procedures. Because it is global in nature does not mean that it less important. The opposite is true. Individuals with physiological aberrations may be beyond the reach of those concerned with safety, but correction of diving deficiencies is an area that is amenable to improvement.

As a further observation on "Dubious reporting", Table 1 shows surface intervals in two groups: those that seem exact, and those that seem rounded off to the nearest quarter-hour. It is apparent that many divers reconstruct profiles *ex post facto*. Note that even those that appear exact usually end in "0" or "5".

Table 1 is a discouraging list for anyone who desires a valid appraisal of the RDP. Fortunately, a few facts are available to help evaluate the RDP. Through 1989, we know the total number of DCS cases reported to DAN, the number of these cases associated with the RDP,[13] and the number of RDPs distributed (Table 2).

TABLE 2

FOUR YEAR SUMMARY OF DAN AND RDP DATA

YEAR	DAN cases	RDP cases	Number of RDPs
1986	562	-	-
1987	602	-	-
1988	553	11	188,958
1989	678	59	417,972

The number of RDP cases for 1988 may be deceptively low. The RDP was available only part of that year and took time to become widely used. Information for 1990 is incomplete, but unofficially, the incidence rate seems to be about the same as in 1989.

It is possible to reach a number of conclusions from this information.

For the only full year (1989), 9% of the DCS reports were related to the RDP, and 91% of the DCS reports were unrelated to the RDP. The number of DCS reports increased from 553 in 1988 to 678 in 1989, or by 125. 53% of the reports in this increase were unrelated to the RDP.

If the RDP did not exist, RDP divers would have used another procedure. On the improbable assumption that none of the RDP divers would have DCS, the DAN totals of Table 2 would be as in Table 3, or a 4-year average of 580.

TABLE 3

FOUR YEAR SUMMARY OF DAN DATA (IF ALL RDP DATA IS DELETED)

YEAR	DAN cases
1986	562
1987	602
1988	542
1989	619

Making the more likely assumption that, if the RDP divers had used another procedure, some of them would have had DCS anyway, the totals would be consistent with the historical annual increases in the number of DCS cases.

Estimates of percentage of RDP users

Anyone investigating diver safety faces the necessity of working with "soft" data, and a difficulty with evaluation of dive accidents is that it involves multiplying one estimated number by another estimated number. One is an estimate of the dives performed by an "active diver" and the other is an estimate of the active divers. Both these numbers are controversial, especially the number of active divers.[15] Additional disagreement relates to the "drop-out" rate,[16] since this determines the number of active divers. The SPUMS Journal ran a series of articles on the topic several years ago. The issue was not resolved and may never be, and this is not an attempt to reopen the controversy. It is merely a suggestion to establish a plausible basis of comparison that can provide a reasonable perspective.

Estimates of the number of active divers have ranged from 700,000[15] to 2,700,000,[17] with an active diver being defined as one making at least three dives per year.[18] This yields, at a minimum, a range of 2,100,000 to 8,100,000 dives per year. The reality is that anyone who dives at all probably dives more than three times a year, making the latter number much larger.[2] The implication is that one figure may differ from another by a factor of four (or more) and still be within bounds of published estimates. There is no way of learning the number of dives performed around the world, and it is therefore more rewarding to discuss percentages. If estimates are within an order of magnitude of being correct, that may be as much as can be expected. The following approximations are presented with the stipulation that they should not be interpreted too rigidly.

A survey has shown that divers drop out at a rate of 15% within the first year after certification, 8% in the second year, 10% in the third year and 20% in the fourth year. Within two years following certification, 77% remain active.[19]

Almost 585,000 entry-level divers have been certified with the RDP. If the erosion rate is as described, a cumulative 496,000 of these divers would still be active. (Since the RDP is relatively new, these figures are fairly reliable; there is less anecdotal evidence associated with them than with statistics that go back 35 years.) Other active divers have acquired about 160,000 RDPs outside a certification program, and presumably, most of these are used today. Previously certified divers who begin to use the RDP reduce the number of non-RDP users and simultaneously increase the number of RDP users. Applying the above erosion data to this group yields a number of 131,000 RDPs in active use.

Combining new and previous divers, (arbitrarily decreased by 20%), leaves an estimated total of (496,000+131,000)x0.8=502,000 divers who are presumed to use the RDP actively.

If the number of active divers is the largest estimated,[17] then RDP users are (502,000/2,700,000)x100=18% of the total. If the number of active divers is the lowest estimated,[17] then RDP users are (502,000/700,000)x 100 = 72% of the total. A superficial inspection of divers at most dive sites will suggest that the first figure is too low, and the second is self-evidently too high.

If a number is chosen halfway between the extremes, there would be 1,700,000 active divers. RDP users would represent (502,000 / 1,700,000) x 100 = 30% of active divers, a figure that is perhaps debatable but not unrealistic. Even if this calculated percentage is too large by half, RDP users would nevertheless represent 20% of active divers, and if too large by as much as a factor of two, RDP users would represent 15% of active divers. DAN accident information relates approximately 9% of DCS reports to the RDP.[13]

Conclusion

No evaluation or analysis can be any better than the data on which it is based. Most dive accident reports are flawed. They are almost entirely subjective, usually being based on information provided by the affected diver, who is possibly too ashamed and embarrassed to reveal the truth. The problem is made worse in that record-keeping is often so poor that a diver may not know the truth at all, and has to resort to haphazard guesses. Nevetheless, much time is spent analyzing this defective information, but until better methods of data collection are developed, data interpretation will remain weak. If this problem could be significantly reduced, causes of accidents could be better identified, and diving safety would be enhanced.

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The address of Dr Raymond E Rogers, DDS, is Box 759, Blairsville, Georgia 30512, U.S.A.

TRIAL OF IN-WATER OXYGEN RECOMPRESSION THERAPY IN ANTARCTICA

Peter Sullivan and Attila Vrana

Abstract

In recent years the Australian National Antarctic Research Expeditions have carried out several extensive diving programs in Antarctica. As access to a recompression chamber in this situation is usually impossible, a case of decompression sickness would present a major therapeutic problem. It has been suggested that, despite the extremely cold conditions, the technique of emergency recompression in water, using oxygen, may be applicable even in Antarctic waters. This paper presents the results of thermal monitoring carried out during two simulations of the technique under actual Antarctic conditions. The first trial had to be aborted after 90 minutes when one subject sustained a significant drop in his core temperature. In the second trial a heavier subject was able to maintain an acceptable rectal temperature for the entire 2 hours 36 minutes duration. From this it is concluded that, using current diving equipment, the technique cannot be adequately relied upon for the treatment of decompression sickness. For the technique to be safely used, even better thermal insulation than that currently in use would have to be employed.

Introduction

The concept of using oxygen underwater for the emergency treatment of decompression sickness in remote areas was first suggested by Edmonds in the early 1970's, although not published until 1976.[1] It was devised as the result of a number of cases of decompression sickness occurring in extremely isolated areas of the south-western Pacific, where evacuation to a recompression chamber would have involved a delay of many hours or even days. Originally, it was hoped that this technique would prove adequate for the treatment of minor cases, and prevent deterioration in serious cases until suitable transport could be arranged. Not only was it successful in these aims but, in a number of cases of neurological decompression sickness, the procedure resulted in dramatic improvement and even cure. Indeed, the technique has proven so effective that it has been approved, although only for emergency use in areas remote from a chamber, by the Royal Australian Navy[2] and in the 1979 Australian Diving Standards (AS 2299).[3] In recent years, the United States Navy approved a modified version of oxygen in-water recompression therapy, but only as an option of last resort.[4] At the Twentieth Undersea Medical Society Workshop on the Treatment of Decompression Sickness members concluded that while they could not recommend the widespread use of underwater oxygen treatment, they did note: "In remote conditions, with expert and experienced personnel, and when procedures have been fully planned and the