South Pacific Underwater Medicine Society Journal

ISSN 0813 - 1988
ABN 29 299 823 713

Volume 32 No. 3
September 2002

Quarterly Journal of the South Pacific Underwater Medicine Society (Incorporated in Victoria) A0020660B

SPUMS

CONTENTS

Print Post Approved
PP 331758/0015

OBJECTS OF THE SOCIETY

To promote and facilitate the study of all aspects of underwater and hyperbaric medicine.
To provide information on underwater and hyperbaric medicine.
To publish a journal.
To convene members of the Society annually at a scientific conference.

OFFICE HOLDERS

ADMINISTRATION

MEMBERSHIP

Membership is open to all medical practitioners.
Associate membership is open to all those who are not medical practitioners but are interested in the aims of the Society, and/or those engaged in research in underwater medicine and related subjects.
Membership application forms can be downloaded from the Society's Web Site at *http://www.SPUMS.org.au*

Further information on the Society may be obtained by writing to:
SPUMS Membership,
C/o Australian and New Zealand College of Anaesthetists,
630 St Kilda Road,
Melbourne, Victoria 3004, Australia
or e-mail
<stevegoble@bigpond.com>

The Society's financial year is January to December, the same as the Journal year.
The 2003 subscriptions will be Full Members $A132.00 and Associate Members $A 66.00, including GST in Australia. All those outside Australia will be charged the same amounts, as the GST component partly covers the cost of having the Journal delivered to them by Air Mail.

The Editor's offering

How safe is scuba diving? As Ladd et al point out in our first article, recreational scuba has been variously described as a dangerous high-risk sport to a very safe activity. Whilst the number of fatalities in a given diving community are identifiable with reasonable accuracy, epidemiological studies in sport diving have been hampered by a lack of data on the denominator, that is, the number of divers or the number of dives they undertake. The British Columbia (BC) team argue that it is diving activity that is the most useful parameter to use. They have set out to measure this by counting scuba tank fills throughout BC. It is a remarkable achievement in public relations that two thirds of the fill stations in this huge geographic area co-operated in the project. Whilst their data still only provide us with indicative rates, scuba fatalities in BC appear to be of the same order as drowning rates in Western communities for the population as a whole. This suggests that scuba is no more dangerous than any other water-related activity.

They also report a rate for clinical presentation of decompression illness (DCI) for these cold northern waters (and this is definitely dry suit country) that is the same as that for a tropical live-aboard vessel doing multi-day multiple dive patterns. These two field studies now provide us with some measure of the clinical presentation rate for DCI in sport diving – in the order of 1 in 10,000 dives. Given the predicted rates of DCI from testing tables and the work of Weathersby, Dick Vann and others on maximum likelihood analysis of decompression procedures, this is a surprisingly low incidence. This again argues for the relative safety of recreational scuba diving (some would say, despite divers' efforts to the contrary). It would be interesting to utilise the health survey method advocated by David Doolette in similar groups of sport divers.[1]

Another aspect of diving safety is reported by Taylor et al. The use of diving-related drugs such as nasal decongestants and anti-motion sickness agents, as well as chronic medication for concomitant medical conditions, is surveyed in two populations of divers in Australia and the USA. Quite high rates of medication use are reported, which parallel a recently published survey of medical conditions in recreational Australian divers by the same group (this paper will be reproduced in the next journal issue).[2] Self-medication is obviously common amongst divers but may not always be in their best diving safety interests. Not enough is known yet of how many of the commonly used agents might interact with the underwater environment.

Papers from the 2001 ASM continue to trickle in to the editorial office. Our Treasurer, Barbara Trytko, gave two interesting talks at Madang on hyperbaric medicine issues. Following Dr McKay's analysis of the Campbell ventilator in the last issue,[3] she provides a pragmatic insight into some of the general principles and difficulties inherent in ventilating sick patients in a hyperbaric environment. The study on blood sugar levels in diabetics will be the topic of her SPUMS Diploma thesis and is therefore reported in abstract form only. The reasons for hypoglycaemia during HBOT are still a matter for conjecture and ongoing research.

This year's ASM guest speaker was Dr Trish Batchelor, whose special interests are travel and altitude medicine. Trish is currently working in Kathmandu, Nepal. Six hours of fact-crammed lectures presented with enthusiasm and a firm intellectual hold on the subject matter confirmed for me the status of travel medicine as a sub-specialty in its own right like diving and hyperbaric medicine. The series of articles by Dr Batchelor that will appear over the next year in the Journal will be an important resource for any medical practitioner who advises travellers, has to manage post-travel illness or is planning to work or vacation abroad themselves. She opens with altitude medicine, the immune-compromised traveller, which includes pregnant women, and an exhaustive list of worldwide resources that members may access.

Hot water immersion has been used for the first aid care of fish spine envenomation for decades to relieve the severe pain of these injuries. The prevailing tenet is that this denatures the heat-labile toxins injected into and beneath the dermis. David Muirhead, a GP in Adelaide, questions this view based on a personal experience. He reviews the literature, which provides no evidence for this assumption, and argues that modern pain theory provides a better explanation for the evanescent relief often obtained.

Some changes to format can be seen in this issue, and further changes will occur in 2003. We are keen to hear from any member of the Society how they would like to see the Journal develop. Diving and hyperbaric medicine are inextricably linked, as has been evident for some years in this publication. Whilst the primary focus will remain diving medicine and physiology, we do wish to see a strong component on hyperbaric medicine, reflecting the rapid growth of this specialty around the Pacific and SE Asia region in recent years.

Mike Davis

References

1 Doolette D. Field identification of decompression sickness. *SPUMS J* 2000; 30: 203-205
2 Taylor DMcD, O'Toole KS, Ryan CM. Experienced, recreational scuba divers in Australia continue to dive despite medical contra-indications. *WEM* 2002; 13: 187-193
3 Mckay R, Bennett M. Evaluation of the Campbell EV 500 ventilator under hyperbaric conditions. *SPUMS J* 2002; 32: 62-70

The new SPUMS Journal editorial team

In my first summer diving in 1963, I was fortunate to spend two months in Cyprus on a Cambridge University Underwater Exploration Group expedition. I was helping on one of the first ever open-water diving experiments on nitrogen narcosis – I was hooked! For the next seven years as a medical student and junior resident I grabbed every opportunity I could to be involved in research diving – geology, archaeology, marine biology, animal behaviour, physics, human performance and physiology. One such university expedition, of which I was the leader, won the first BSAC Duke of Edinburgh Prize for Diving Science in 1965. Before leaving the UK in 1974, I was closely involved in developing the Underwater Association Code of Practice for Scientific Diving, which subsequently became the gold standard for research diving.

I was determined to enter the diving world as a full-time medical career, but the Royal Navy wouldn't have me because of my paretic polio leg. So I embarked on a career in anaesthesia and intensive care medicine instead. During my training at the Westminster Hospital, London, home of Sir Ivan Magill, I took regular time off to pursue my own diving research as "Saturday morning projects". One of these was on the effects of cold water diving, during which the regular use of rectal temperature probes earned me a dubious reputation amongst my fellow divers!

Now hooked on anaesthesia and intensive care as an exciting and satisfying professional career, diving remained a pastime and occasional research interest only, whilst I worked in Sweden and the USA. In 1976 my wife, Rosie, our two small children (with a third on the way) and I immigrated to New Zealand, and we settled in Christchurch the following year.

Little did I know that a recompression chamber was about to be donated to the hospital board by the local diving community! When this became operational in 1979, I became the SMO of an enthusiastic band of volunteers, (doctors, nurses, technicians and local divers) who, on a financial shoe-string, provided for the next 15 years an emergency hyperbaric service for over half the country. This was, of course, over and above my busy life as Senior Lecturer in Anaesthesia at the medical school. Ours was a 20-year battle to obtain the recognition and funding needed to establish a proper hyperbaric medicine service. Some of this saga has appeared within the pages of the SPUMS Journal over the years. Finally, in November 2000, the Christchurch Hospital Hyperbaric Medicine Unit was established and I became its medical director. I remain an active diver and still satisfy my competitive urge playing

underwater hockey – a breath-hold water sport that is far and away the best means I know of maintaining water fitness and skills for scuba diving.

I have over three dozen papers published in peer reviewed journals in the anaesthesia, intensive care, diving and hyperbaric medicine fields, as well as contributions to books and many articles in the SPUMS Journal before it became an indexed publication. I never again wish to go through the arduous grind of writing up an MD thesis whilst working full time and trying to enjoy life with my growing family and hard-working GP wife – and neither would they! However, these experiences have given me a healthy respect for the hard work involved for anyone who dares to question "the world as it is" to expand the boundaries of our knowledge.

The thought of stepping into John Knight's shoes as Editor is both daunting and at the same time exciting. As with the Society as a whole, the SPUMS Journal stands at a crossroads in its development. However, it will only progress beyond the healthy state in which John has left it with the strong support of the SPUMS membership to publish in their own society's journal, thus building its international reputation. Our circulation is nearly half that of the leading journal in the field, Undersea and Hyperbaric Medicine, and is now indexed in EMBASE, the Elsevier database. So there is no excuse for researchers not to consider it as a suitable vehicle for publication of their work, especially in the field of diving physiology and medicine. With your help, I look forward with enthusiasm to leading the journal forward – hooked once again!

Francis Michael (Mike) Davis
MA,MB,BChir(Cantab),DipDHM,FRCA,FANZCA,MD(Otago)

I graduated from the University of Warwick (UK) in 1995 with a BA Hons in Modern European History and the dream of getting a job in the glamorous world of publishing. My big break came the following year, when HarperCollins Publishers offered me a position in their Children's Books Department at their London office. My move to the Royal College of Physicians of London three years later seemed obscure to my trade publishing colleagues at the time, but was the best decision I ever made. I took over the day-to-day running of the College Journal, under the watchful eyes of the Editor and the Editor Emeritus, both prominent diabetic physicians. I soon realised how much I'd missed my sciences (which I'd left behind when I went to university) and how much more civilised doctors are to work with as authors than their 'artistic' trade publishing peers!

I came to Christchurch in April 2001, when my Kiwi partner, Roger, decided that he couldn't bear another English summer and it was time to come home. I fell back on my secretarial qualifications for a while, before being offered a position at Landcare Research, New Zealand's Crown Research Institute for environmental science. Although I was thrilled to be back in the world of science, my editorial skills were languishing and when Mike contacted me to work on the SPUMS Journal, I leapt at the opportunity. Since then, I have begun work for the New Zealand Medical Journal and am once again firmly and happily ensconced in the world of medical publishing.

As for diving, I took my open water ticket in Byron Bay last year – an enormous personal achievement of will over fear (Steven Spielberg has a lot to answer for!). I'm waiting expectantly for the great New Zealand summer that my partner has promised me, so that I can get my BC wet in Kiwi waters. In the meantime, I'm looking forward to helping Mike continue the good work of John Knight at the helm of the SPUMS Journal.

Sarah Webb
BA Hons

Original articles

The Abacus Project: establishing the risk of recreational scuba death and decompression illness

Gary Ladd, Victor Stepan and Linda Stevens

Key Words
Scuba, recreational diving, deaths, decompression illness, epidemiology

Abstract
In order to establish the relative risk of death and non-fatal decompression illness (DCI) in recreational scuba diving in British Columbia (BC), Canada, a field survey was conducted. For 14 months, every dive shop and charter operator in the province of BC was asked to count the number of scuba tanks that were filled for use in recreational scuba diving. For the same 14-month period, hyperbaric chambers reported the number of BC divers treated for non-fatal DCI and the provincial coroners records were reviewed for scuba fatalities. Over the 14 months that scuba tank fill information was collected, an average of 65% (range: 60–71%) of the fill stations reported. Death and DCI incidence rates were calculated based on the 146,291 fills reported by the participating stations. During this same period there were 3 fatalities and 14 cases of non-fatal DCI. The incidence of recreational scuba death was 0.002% (2.05/100,000 dives). The incidence of non-fatal DCI was 0.010% (9.57/100,000 dives). Results are discussed in light of this being the first time a reasonably reliable measure of diving activity has been achieved in a large geographic area over an extended time period.

Introduction

As a recreational sporting activity, the relative risk of death and non-fatal decompression illness (DCI) in recreational scuba diving is unknown. Sport diving has been variously described as a dangerous, high-risk sport and a very safe activity that has a low mortality risk.[1-4] Calculating the relative risk of sport diving requires accurate information about diving activity, diving fatalities and non-fatal DCI.

Information on the incidence of death and DCI in specific geographic areas or jurisdictions has been available for several years. The Divers Alert Network (DAN) has been compiling and publishing annual reports on recreational diving fatalities and DCI in the United States since 1987.[5] In Australia, Project Stickybeak has documented recreational snorkel and scuba diving fatalities .[6,7] In British Columbia (BC), Canada, the Underwater Council of British Columbia (UCBC) uses information from the provincial coroners service to document recreational dive fatalities.[8, 9]

The major impediment in analysing the risk of recreational scuba diving has been the lack of an accurate denominator. Risk estimates have been made using either a diver participation approach (ie. risk/diver) or a diving activity approach (ie. risk/dive). With the diver participation approach the number of divers is used as the denominator while the diving activity approach uses the number of dives as the denominator.

Following up on an inquest into a recreational diving triple fatality, the Abacus Project was created to carry out one of several recommendations by the Provincial Coroners Service to improve dive safety in the province.[10] It was established to investigate the relative risk of death and DCI in recreational scuba diving in the province of BC. The Abacus Project utilized a diving activity approach based on recording recreational scuba diving tanks filled in BC.

Methods

Information was collected on the total number of recreational scuba tanks filled in the province of BC over a 14-month period. This was used as a measure of the number of dives that were done. Each recreational scuba tank fill (fill) was counted as one dive. Information was also collected on the total number of recreational fatalities and cases of DCI for the same period. This information was used to calculate incidence rates.

SURVEY METHOD DEVELOPMENT

The design and preparation of the project took approximately two years and extensive consultation with industry stakeholders (eg. dive medicine specialists, training agencies, charter and dive store operators, Canadian Coast Guard Service, recreational divers, scientific divers). The project required a simple and reliable method of counting fills that every fill station in the province could use. A fill station was defined as any facility that filled scuba tanks with air or other compressed gases used for breathing in recreational scuba diving. This included charter operators, dive shops and other marine services providers (eg. marinas).

Second, the method required a means of reporting the fill information in a timely manner to a central data collection agency in a way that protected the business interests of the

fill stations that reported their information. The Divers Alert Network (DAN) acted as the central collection agency.

Endorsement of the project was sought and received from every certification agency that was operating in the province. ACUC International, IANTD Canada, PADI Canada, SSI Canada and TDI Canada each provided a letter of support, which was sent to their respective dive shops. Endorsement was also requested and received from the Vancouver General Hospital (VGH) Division of Hyperbaric Medicine. VGH operates a hyperbaric chamber and is the sole provincially designated facility for the treatment of recreational dive related DCI.

SCUBA TANK FILL INFORMATION

A database was developed of every fill station in the province. This included a contact person, telephone and fax numbers, mailing and e-mail addresses (when applicable). The number of fills made over the 14-month period from 1 October 1999 – 30 November 2000 inclusive was tabulated using survey information collected monthly from participating fill stations. Over this period, some fill stations went out of business while new ones opened. Some fill stations closed for various times during the winter. These changes were tracked and the database updated each month.

Two months before the start of the project, a letter was sent to every fill station. This letter announced the Abacus Project and requested each fill station's support and participation. The fill stations were informed that the goal was to count every fill made in the province for a period of 14 months.

A month prior to the beginning of the project, each fill station was supplied with a hand tally counter, a reminder card to display at the fill station, and staff training instructions. Fill station operators were instructed to train their staff and hang the enclosed counter on or near the yoke of the tank filler. Personnel were to push the button on the counter once for every fill made for recreational use (eg. air, nitrox, paid, air card credit, rental tank, free fill, personal use, pool training, open water instruction, instructor, student). At the end of each month, each fill station sent the total number of fills shown on the counter to DAN via telephone or e-mail.

It was crucial to the participation of several stakeholders that individual fill station fill reports be kept confidential. In order to protect the anonymity of the fill stations, a blind trust system was used for reporting and collecting the fill information. Each fill station was issued an identity code. DAN required the stations identify themselves by their code when reporting monthly fill information. The Abacus staff knew the identity of the individual fill stations and the corresponding codes but did not have access to the fill information for any of the individual stations. Monthly reports sent to the Abacus staff by DAN were limited to identifying whether stations had or had not reported. At the end of the data collection period, the central reporting agency provided the Abacus Project coordinator with only the total number of fills that had been reported by all stations for each of the 14 months.

Near the end of each month, fill stations were reminded to submit the count for the month. Each month the Abacus staff were advised which fill stations reported to the central reporting agency and which did not. This information was used to follow up by telephone with fill stations that did not report. Three attempts were made to request monthly fill information from stations that did not report. If a station still did not report and it was affiliated with a training agency, the name of the shop and its contact information was forwarded to a dive training agency representative who would telephone the non-reporting fill station. For fill stations that were not affiliated with a training agency and for those that were affiliated but still were not reporting after being contacted by the training agency representative, a dive shop operator who was a member of the UCBC Safety Committee telephoned the fill station to request their participation. If the fill station still did not report, no further attempts were made to request participation.

RECREATIONAL SCUBA DCI INFORMATION

All hyperbaric chambers in BC, the province of Alberta, Canada and western Washington State, USA, that were known to treat scuba divers were contacted. The Alberta and Washington chambers were surveyed because, historically, a significant number of people are known to travel from these areas to dive in BC waters. Each chamber was asked to do a file review for the 14-month period starting 1 October 1999 and to report the number of recreational scuba divers that had been treated for non-fatal DCI following one or more dives in BC waters.

RECREATIONAL SCUBA FATALITY INFORMATION

Recreational scuba fatality information was obtained from the BC Ministry of Attorney General, BC Coroners Service, which maintains centralized files for the whole province. The Coroners Service reviewed the Judgments of Inquiry for the 14-month survey period and provided copies of all reports that involved a scuba diving fatality to Project Abacus staff. A Judgment of Inquiry reports the facts determined as a result of the inquiry into a death.

Results

RECREATIONAL SCUBA TANK FILLS

A total of 146,291 recreational scuba tank fills were reported during the 14-month survey period and the number of stations that were operating fluctuated. The average number of stations in operation each month was 78 (range 76–84). Monthly reports were received from 65% of the province's fill stations (range 60–71%).

TABLE 1
MONTHLY REPORTING BY FILL STATIONS

Fill stations	Month													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Total number	84	83	80	78	79	80	78	77	78	77	76	76	76	76
Number that reported	59	55	52	51	49	48	50	50	55	51	47	48	50	48
Percentage that reported	70	66	65	65	62	60	64	65	71	66	62	63	66	63

These results are summarized in Table 1 (above).

RECREATIONAL SCUBA DCI

During the survey period there were 14 recreational scuba divers treated for non-fatal DCI following one or more dives in BC waters. Eleven divers were treated in BC. One diver was treated in Alberta. Two divers were treated in Washington State. A total of five chambers were surveyed. The incidence of DCI was 0.010% (9.57/100,000 dives).

RECREATIONAL SCUBA FATALITIES

There were three recreational scuba fatalities during the survey. The BC Coroners Service's Judgments of Inquiry listed all three fatalities as accidental deaths. The incidence of death was 0.002% (2.05/100,000 dives)

RISK OF DEATH AND DCI

Using fatalities, DCI cases and the total number of fills the combined incidence of death and DCI in recreational scuba diving was 0.012% (11.62/100,000 dives).

Discussion

Estimating the risk of recreational scuba diving is not possible without a trustworthy estimate of diving activity. The lack of an accurate denominator has obstructed the epidemiological analysis of recreational scuba diving.

Using the diver participation approach has proven to be problematic. It requires accurate information on how many people are diving. It is unknown how many people dive and usually only very crude estimates are available for a country or particular geographic area. For instance, one estimate of the number of people who participate in scuba diving as a sport in the United States ranged from 1.5 million to 3.5 million.[11] In a critical review of the methods used for estimating the risk of recreational scuba diving, Monaghan observed that industry estimates of the number of people who dive do not adequately take into account diver drop out or multiple certifications by one person, thereby inflating the estimated number of participants and minimizing the estimate of risk.[12] He suggested that a tenfold greater rate of diver deaths reported in Australia compared to that of the United States of America was most likely due to differences in how the number of divers (i.e., the denominator) was calculated.[13]

Using the diver participation approach is further compromised by the lack of a useful definition of what constitutes an "active diver". For instance, the National Sporting Goods Association annual survey of sports participation defined a participant in scuba diving as an individual seven years of age or older who dives more than once a year.[14]

One study has used a reliable source of information for the denominator in the calculation of diver risk. In a review of five years of diving accidents treated by the accident and emergency department of a major hospital located near the largest inland diving centre in the United Kingdom, Hart et al used diver visits to the dive centre as an estimate of the number of participants.[15] From 1992 to 1996 there were seven deaths, for an incidence rate of 2.9 deaths per 100,000 diver visits.

In a risk analysis of recreational scuba diving instructors at work, Richardson reported morbidity and mortality rates using a diver participation approach (i.e., risk/instructor).[16] From 1989 to 1993 there were 28 cases of DCI and four deaths. The incidence of DCI ranged from four cases in 55,435 instructors (0.00007%) in 1992 to nine cases in 44,252 instructors (0.0002%) in 1991. The incidence of death ranged from none in 55,435 instructors (0%) in 1992 to one death in 27,543 instructors (0.00004%) in 1989.

Diving activity is considered the more appropriate denominator for calculating the relative risk of recreational scuba diving.[11,17] Using the diving activity approach, the focus is on the relative risk for each exposure to the activity. Information about the frequency of recreational scuba fatalities and DCI is compared to the number of dives performed. This approach requires accurate information on the number of dives being done. Worldwide, only a few studies of risk in recreational scuba diving have used the diving activity approach. The Abacus Project is the first multiple site field study to use a reliable diving activity method to investigate the risk of recreational scuba diving in a large geographic area over an extended period of time.

Gilliam reported on 77,680 dives done from a dive cruise ship over a 12-month period during 1989–90.[18] Seven cases of DCI were treated in the ship's recompression chamber, giving an incidence of 0.009% (9.01 cases per 100,000 dives). Wilmshurst et al attempted to gather recreational dive activity information in Great Britain.[17] They tried several methods, including sending an activity survey to 10% of British Sub Aqua Club (BSAC) members and asking "representative dive shops" to count dive cylinder fills. While DCI risk estimates are given for 1986 and 1990 BSAC members, the method used for calculating these estimates of risk is not described and no diving activity information is reported.

As part of the Richardson study of dive instructors at work, the risk of death and DCI during ascent training was calculated using a diving activity-based formula (ie. risk/ascent).[16] Eighteen cases of DCI and zero deaths were reported in 4,906,821 emergency ascents by instructors for an incidence of 0.0036 DCI cases per 100,000 instructor ascents. In a parallel study of the risk of emergency ascent training for open water trainees from 1989 to 1992, there were 33 injuries, including one case of DCI, and two deaths in 3,754,704 emergency ascents by trainees.[19] This corresponds to an injury rate of 8.7 injuries per 1,000,000 trainee ascents and 0.5 deaths per 1,000,000 trainee ascents.

With regard to the current study, it is unknown how many fills were done but not reported, as the study's design precludes the use of missing data techniques to predict this.[20] While monthly reports were sent by an average of 65% of the fill stations, it cannot be inferred that 35% of the fills were missed. The percentage of stations that did not report is not a predictor of the percentage of fills that were missed each month. For example, in month nine of the data collection period, 55 of 78 fill stations (71%) reported a monthly total of 10,737 fills while in month 10, 51 of 77 fill stations (66%) reported 14,617 fills. The number of fills not reported could range from none to an amount equal to or greater than the number reported.

Since the estimates of death and non-fatal DCI were calculated using the number of reported fills as the denominator, it is likely the estimates are conservative. If it is assumed that recreational fills were made but not reported, the revised risk estimates would be lower than those reported. However, the difference in risk estimates would not necessarily be significant.

Field research must often balance scientific rigor and practical limitations. The study did not have built in secondary checks of the authenticity of the tank fill or DCI information that was reported. This is an extremely common limitation in epidemiological and diving medicine field research. Using sampling procedures for verification of the accuracy of fill counts and medical file reviews for verification of diagnosis of DCI would improve the trustworthiness of the results.

Feedback from dive storeowners and charter operators who took part in the study provided anecdotal support for the accuracy of the tank fill counts each month. Reports filtered back to the investigators that many fill stations had not previously tracked fill information and were finding it valuable for business purposes. Other fill stations already had computer-based systems in place for tracking fill numbers and purpose (e.g., class, recreational, commercial). Informal reports from divers of no fill counters being seen at fill stations corresponded to those operations that were not sending in fill information.

The Abacus Project required fill stations to send in counts for 14 consecutive months. In comparison to other survey methods that require a single response, the project was demanding of the research cohorts. In spite of this, monthly reports were received from 65% of the fill stations. This is a significantly higher participation rate than that typical of survey investigations requiring a single response. With a maximum of 71% and a minimum of 60% of stations providing monthly reports, the participation rate was stable over the course of the data collection period. In future studies of this type, refinement of the follow-up procedures used with non-responding fill stations could further increase the percentage of stations reporting each month.

The high response rate may also reflect several other structural factors. The organisation that sponsored the Abacus Project, the UCBC, is generally considered a relatively neutral party. Its mandate is recreational diving safety and marine environment conservation. This neutral stance was enhanced by the endorsement of the project by all training agencies that conduct business in the province, by the blind trust strategy used for collecting the fill count information and by DAN acting as the central collection agent for the fill information.

The non-fatal DCI incidence rate of 9.57 cases per 100,000 dives for the Abacus Project is comparable to the 9.01 cases per 100,000 dives aboard the dive cruise ship reported by Gilliam.[18] However, the incidence of scuba deaths is different. Gilliam did not report any deaths during the one year study period, while the Abacus Project found a rate of 2.05 deaths per 100,000 dives.

Comparison of the number of dive fatalities during the Abacus Project to available information from the BC Coroners Service suggests that the survey period was representative. From 1985 to 1999 there were an average 2.53 fatalities per year.[9] The one year average for the Abacus Project was 2.57 fatalities. It was not possible to do a similar comparison for DCI since the annual incidence rate of DCI in BC is unknown.

In prior years there had been instances of student death and DCI in provincial waters. Therefore, fills for scuba students were counted. Two of the three fatalities that occurred during the 14 months of data collection took place

during instructional dives. One was a student in a basic open water course. The other was a student in an advanced open water course. The third fatality was an inexperienced open water certified diver accompanied by an instructor.

This project has established a baseline estimate of the risk of death and non-fatal DCI for recreational scuba diving in the province of BC. The results can be used as a reference point for future studies. Continuous tracking of recreational scuba diving activity, fatalities and DCI treatments in BC using the methods employed in the present investigation could help answer questions about diving trends and safety.

Research is needed on the risk of recreational diving death and DCI in other geographic areas. It is unknown whether the BC estimates of risk are applicable to other geographic areas. Differences in dive conditions (eg. water temperature, visibility, typical sea conditions) may influence the relative risks. Similarly, certain areas may attract divers who are generally at greater or less risk because of significant differences in physical and psychological conditioning, dive training and experience. Replication of this study in different geographic areas of the world where recreational scuba diving is popular is required.

Acknowledgements

We thank the many people who contributed to the Abacus Project, especially John Smith, New Mind Technologies; Dr Michael Lepawsky, Division of Hyperbaric Medicine, Vancouver General Hospital; Donna Uguccioni, Divers Alert Network, Tej Sidhu, BC Coroners Service and Bill Klikach, Dive & Sea Sports. This research was sponsored by the Underwater Council of BC and donation of services by Divers Alert Network and Vancouver Aquarium Marine Sciences Centre. The project was funded by private donors, Hendry Swinton Insurance Ltd, Pacific Northwest SCUBA Challenge, PADI Canada and SSI Canada.

References

1 Nevo B, Breitstein S. *Psychological and behavioral aspects of diving.* Flagstaff, AZ: Best Publishing, 1999
2 Spira A. Diving and marine medicine review Part II: Diving diseases. *J Travel Med* 1999; 6: 180-198
3 Brylske A. How safe is diving? *Dive Training*. 1999; October: 43-48
4 Smith N. SCUBA diving: How high the risk? *J Insur Med* 1995; 27: 15-24
5 DAN. *2000 report on diving accidents and fatalities.* Durham, NC: Divers Alert Network, 2001
6 Edmonds C. Snorkel diving: a review. *SPUMS J* 1999; 29: 196-202
7 Walker D. Australian diving-related deaths in 1996. *SPUMS J* 1999; 29: 182-96
8 Stevens L. Diving deaths can teach the living. *The Crowner* 2000; 2: 22-23
9 UCBC. *Recreational diving fatalities 1985-1999.* Vancouver, BC: Underwater Council of British Columbia, 2001
10 BCCS. *Judgments of inquiry: 1996 Coroners verdict at inquest.* Burnaby, BC: BC Coroners Service, 1997
11 DAN. *1992 report on diving accidents and fatalities.* Durham: Divers Alert Network, 1994
12 Monaghan R. The risks of sport diving. *SPUMS J* 1988; 18: 53-60
13 Monaghan R. Australian diving death rates: Comparison with USA and Japan. *SPUMS J* 1989; 19: 24-25
14 NSGA. *Sports participation in 2000: Series II.* Mt. Prospect, IL: National Sporting Goods Association, 2002
15 Hart AJ, WhiteSA, Conboy PJ, Bodiwala G, Quinton D. Open water scuba diving accidents at Leicester: Five years' experience. *J Accid Emerg Med* 1999; 16: 198-200
16 Richardson D. An assessment of risk for recreational dive instructors at work. *Undersea J* 1995; 2nd quarter: 14-5 and 34-38
17 Wilmshurst P, Allen C, Parish T. Incidence of decompression illness in amateur scuba divers. *Health Trends* 1994; 26: 116-118
18 Gilliam B. Evaluation of decompression sickness incidence in multi-day repetitive diving for 77,680 sport dives. *SPUMS J* 1992; 22: 24-30
19 Richardson D, Cummins T. A training agency perspective of emergency ascent training. *SPUMS J* 1993; 23: 225-230
20 King DW, King LA, Bachrach PS, McArdle JJ. Contemporary approaches to missing data: The glass is really half full. *PTSD Res Q* 2001; 12: 1-7

This project was presented at the Undersea and Hyperbaric Medical Society 2002 ASM, San Diego, Ca, USA.

Dr Gary Ladd is a registered psychologist with a special interest in dive psychology.

Dr Victor Stepan is a retired physician with an interest in hyper/hypobarics.

Ms Linda Stevens is a registered nurse in intensive care and hyperbaric nursing.

They are all recreational scuba divers and members of the UCBC, BC, Canada.

Correspondence:
Dr Ladd, 330-1200 Burrard Street,
Vancouver BC, Canada, V5W 3P1.
Telephone 01 604 682 5467
E-mail: <Gary@PsychoDiver.com>

Medications taken daily and prior to diving by experienced scuba divers

Simone Taylor, David Taylor, Kevin O'Toole and Christopher Ryan

Keywords
Scuba, recreational diving, motion sickness, nasal decongestants, epidemiology, medications

Abstract

Introduction: Medication pharmacodynamics may be altered in the hyperbaric environment, yet little research has examined medications taken by divers. We aimed to determine the nature and extent of chronic and acute medication use amongst experienced scuba divers.
Method: Cross-sectional postal survey of Australian and United States (US) scuba diving club members.
Results: 709 divers responded (Australian 346, US 363). The majority were professionals (54.9%), aged 31–50 years (59.9%), and experienced divers (median years of diving: 8). A variety of prescription and over-the-counter medications were taken daily. Many were for cardiac disease or hypertension (8.9% of divers) and asthma (2.8%). Some respondents regularly took antiepileptic agents (0.3%), oral hypoglycaemics (0.4%) or insulin (0.3%). Divers frequently took medications within two hours of diving. These usually targeted sea sickness and barotrauma. Pseudoephedrine ($p < 0.001$) and nasal decongestants ($p < 0.001$) were taken significantly more frequently by US divers. Fewer divers took antihistamines, and those taken largely reflected availability.
Discussion: Many experienced divers take a variety of medications for chronic conditions. This may reflect adversely upon their fitness to dive. Research should examine the effects of commonly-used medications in the hyperbaric environment. Our findings identify those medications that should be targeted.

Introduction

The hyperbaric environment may cause a number of physiological effects on scuba divers, including bradycardia and central nervous system effects such as nitrogen narcosis.[1–5] It has been suggested that medications modulate these physiological effects, potentially increasing the risks associated with the hyperbaric environment.[1,3–7] Unfortunately, the diving literature contains a paucity of information about the interactions between medications and diving. Accordingly, most authorities recommend that no medications be taken prior to scuba diving. These recommendations and warnings are largely based on general pharmacological properties and theoretical effects under pressure, rather than on the results of clinical studies.

Despite recommendations to the contrary, there is considerable anecdotal evidence that a notable proportion of divers take a range of medications on a daily and pre-dive basis. The aim of this study was to determine the nature and extent of medication use amongst experienced recreational scuba divers. Of interest were the medications taken daily for chronic medical conditions, as well as those taken prior to diving to assist with the diving experience. The purpose of this study was to guide future research into the effects of medications on scuba diving.

Methods

This study was a cross-sectional postal survey of Australian and United States (US) scuba diving club members. Clubs and their representatives (presidents or secretaries) were identified from lists published on the Internet. These club representatives were contacted by telephone or e-mail to obtain consent for their club to participate. Twenty nine Australian and 28 US clubs participated. These clubs were spread widely across both countries and included both inland and coastal areas.

In June 2000, each club's representative was mailed a variable number of study questionnaires. Each club was provided with 5–10 additional questionnaires over and above the number of members expected to be at the meeting. These questionnaires were distributed at the next club meeting, completed immediately and returned by the representative in a stamped, addressed envelope. In order to calculate a response rate, each representative was requested to report the total number of members attending the meeting. Two months after the initial mailing, clubs that had not returned questionnaires were mailed a reminder letter. This was repeated in one further month's time, when necessary. Participation was voluntary and responses confidential.

The questionnaire was developed by two investigators and evaluated for face and context validity by the other investigators. The first section collected demographic data on the divers including diving experience. The second section consisted of a number of questions regarding diver personalities, chronic medical conditions, diving injuries, as well as medications taken. Divers were asked to self report the medications they took daily and how frequently they took certain medications within two hours of diving.

Most responses were analysed descriptively. Median values are reported with ranges. For comparisons of proportions,

Chi square analysis was performed using the STATA statistical package (Intercooled, Version 7.0, Texas, USA). The study was authorised by the Institutional Review Board (Ethics Committee) of the University of Pittsburgh, USA.

Results

Questionnaires were returned by 709 divers: 346 from Australia and 363 from the US. The demographics of the divers are outlined in Table 1. Overall, 488 divers (68.8%) were male and most (59.9%) were aged between 31 and 50 years. The US divers were significantly older (χ^2 = 76.2, df = 5, $p < 0.001$), with 258 divers (71.1%) being aged over 40 years, compared to 144 (41.6%) in the Australian group. Most divers were professionals with a university education. Alcohol intake was greater amongst the Australians (χ^2 = 53.4, df = 4, $p < 0.001$), but overall most were moderate drinkers. Only 76 divers (10.7%) were smokers. Overall, this was an experienced group of scuba divers with the median number of years of diving for both groups being 8 years (range 0–50 for Australian and 0–45 for US divers). The median number of dives was 198 (range 0–2000) and 120 (range 0–999) for the Australian and US divers respectively.

TABLE 1
DIVER DEMOGRAPHICS (% IN PARENTHESES)

Characteristic	Australian divers n = 346		United States divers n = 363		Total n = 709	
Gender						
Male	253	(73.1)	235	(64.7)	488	(68.8)
Female	92	(26.6)	124	(34.2)	216	(30.5)
No answer	1	(0.3)	4	(1.1)	5	(0.7)
Age (years)*						
18–20	10	(2.9)	6	(1.7)	16	(2.3)
21–30	72	(20.8)	20	(5.5)	92	(13.0)
31–40	120	(34.7)	73	(20.1)	193	(27.2)
41–50	85	(24.6)	147	(40.5)	232	(32.7)
51–60	53	(15.3)	90	(24.8)	143	(20.2)
> 60	6	(1.7)	21	(5.8)	27	(3.8)
No answer	0	(0)	6	(1.7)	6	(0.8)
Highest level of education completed						
State school	8	(2.3)	4	(1.1)	12	(1.7)
High school	133	(38.4)	92	(25.3)	225	(31.7)
College/university	156	(45.1)	172	(47.4)	328	(46.3)
Post graduate university	48	(13.9)	91	(25.1)	139	(19.6)
No answer	1	(0.3)	4	(1.1)	5	(0.7)
Type of occupation						
Unemployed	24	(6.9)	16	(4.4)	40	(5.6)
Blue collar/trade	105	(30.3)	60	(16.5)	165	(23.3)
White collar/clerical	54	(15.6)	48	(13.2)	102	(14.4)
Professional	153	(44.2)	236	(65.0)	389	(54.9)
No answer	10	(2.9)	3	(0.8)	13	(1.8)
Number of alcoholic drinks/week*						
< 1	78	(22.5)	153	(42.1)	231	(32.6)
1–5	122	(35.3)	125	(34.4)	247	(34.8)
6–10	62	(17.9)	56	(15.4)	118	(16.6)
11–15	40	(11.6)	13	(3.6)	53	(7.5)
> 15	42	(12.1)	13	(3.6)	55	(7.8)
No answer	2	(0.6)	3	(0.8)	5	(0.7)
Cigarette smoker	39	(11.3)	37	(10.2)	76	(10.7)

* Significant difference between the Australian and US divers ($p < 0.001$)

MEDICATIONS TAKEN PRIOR TO DIVING

Table 2 describes decongestant use within two hours of diving. Pseudoephedrine was the most frequently used decongestant; it was taken prior to most or all dives by 71 divers (10%). There was a significant difference between the countries in terms of pseudoephedrine use prior to diving; US divers used pseudoephedrine significantly more frequently than Australian divers ($\chi^2 = 42.7$, df = 2, $p < 0.001$). Nasal decongestants were also used more frequently by US divers than Australian divers ($\chi^2 = 15.3$, df = 2, $p < 0.001$). Bronchodilators such as salbutamol (albuterol) were used before most or all dives by 21 divers (3.0%), and occasionally by 16 divers (2.3 %).

Table 3 describes the use of agents marketed as non-sedating antihistamines. These antihistamines were used less frequently than decongestants prior to diving. Table 4 describes the most commonly used anti-emetic products. Agents for the prevention of sea-sickness include antihistamines such as dimenhydrinate and diphenhydramine as well as anticholinergic agents such as hyoscine. These anti-emetics, with the potential to alter mental alertness, were used by 81 divers (11.5%) prior to most or all dives and used occasionally by a quarter of divers overall. Hyoscine hydrobromide (Kwells™) was frequently used by Australian divers, whereas US divers more frequently used diphenhydramine (Benadryl™) and dimenhydrinate (Dramamine™). Eighty seven divers

TABLE 2
REPORTED DECONGESTANT USE WITHIN TWO HOURS OF DIVING (% IN PARENTHESES)

Medication	Australian divers n = 346		United States divers n = 363		Total n = 709	
Pseudoephedrine (Sudafed™) use prior to diving*						
Never	196	(56.6)	161	(44.4)	357	(50.4)
Occasionally	129	(37.3)	126	(34.7)	255	(36.0)
Before most or all dives	9	(2.6)	62	(17.1)	71	(10.0)
No answer	12	(3.5)	14	(3.9)	26	(3.7)
Nasal decongestant spray use prior to diving*						
Never	279	(80.6)	251	(69.1)	530	(74.8)
Occasionally	50	(14.5)	62	(17.1)	112	(15.8)
Before most or all dives	3	(0.9)	20	(5.5)	23	(3.2)
No answer	14	(4.0)	30	(8.3)	44	(6.2)

*Significant difference between Australian and US divers, $p < 0.001$

TABLE 3
COMMON NON SEDATING ANTIHISTAMINE USE PRIOR TO DIVING (% IN PARENTHESES)

Non sedating antihistamine	Australian divers n = 346		United States divers n = 363		Total n = 709	
Certirizine (Zyrtec™)						
Never	327	(94.5)	313	(86.2)	640	(90.3)
Occasionally	2	(0.6)	5	(1.4)	7	(1.0)
Before most or all dives	0	(0)	4	(1.1)	4	(0.6)
No answer	17	(4.9)	41	(11.3)	58	(8.2)
Loratidine (Claratin™, Clarityne™)						
Never	312	(90.2)	285	(78.5)	597	(84.2)
Occasionally	16	(4.6)	28	(7.7)	44	(6.2)
Before most or all dives	0	(0)	12	(3.3)	12	(1.7)
No answer	18	(5.2)	38	(10.5)	56	(7.9)
Fexofenadine (Telfast™, Allegra™)						
Never	329	(95.1)	306	(84.3)	635	(89.6)
Occasionally	0	(0)	10	(2.8)	10	(1.4)
Before most or all dives	0	(0)	8	(2.2)	8	(1.1)
No answer	17	(4.9)	39	(10.7)	56	(7.9)

TABLE 4
COMMONLY USED ANTI EMETICS AND ALCOHOL USE PRIOR TO DIVING (% IN PARENTHESES)

Medication	Australian divers n = 346		United States divers n = 363		Total (%) n = 709	
Dimenhydrinate (Dramamine™)						
Never	320	(92.5)	223	(61.4)	543	(76.6)
Occasionally	5	(1.4)	81	(22.3)	86	(12.1)
Before most or all dives	3	(0.9)	28	(7.7)	31	(4.4)
No answer	18	(5.2)	31	(8.5)	49	(6.9)
Dimenhydrinate, Hyoscine hydrobromide, Caffeine (Travacalm™)						
Never	295	(85.3)	301	(82.9)	596	(84.1)
Occasionally	18	(5.2)	13	(3.6)	31	(4.4)
Before most or all dives	16	(4.6)	5	(1.4)	21	(3.0)
No answer	17	(4.9)	44	(12.1)	61	(8.6)
Diphenhydramine, Pseudoephedrine, Guaiphenesin (Benadryl™)						
Never	323	(93.4)	280	(77.1)	603	(85.0)
Occasionally	6	(1.7)	48	(13.2)	54	(7.6)
Before most or all dives	0	(0)	1	(0.3)	1	(0.1)
No answer	17	(4.9)	34	(9.4)	51	(7.2)
Hyoscine hydrobromide (Kwells™)						
Never	257	(74.3)	320	(88.2)	577	(81.4)
Occasionally	45	(13.0)	0	(0)	45	(6.3)
Before most or all dives	28	(8.1)	0	(0)	28	(3.9)
No answer	16	(4.6)	43	(11.8)	59	(8.3)
Alcohol						
Never	281	(81.2)	282	(77.7)	563	(79.4)
Occasionally	44	(12.7)	41	(11.3)	85	(12.0)
Before most or all dives	1	(0.3)	1	(0.3)	2	(0.3)
No answer	20	(5.8)	39	(10.7)	59	(8.3)

(12.3%) reported consuming alcohol prior to diving. It was not determined whether alcohol was consumed in combination with an anti-emetic whose sedative activity could be potentiated by alcohol.

MEDICATIONS TAKEN DAILY

Table 5 describes the numbers of medications taken on a daily basis by the divers. Approximately one quarter of respondents took one or more medications daily. The US divers took significantly more medications every day than the Australian divers ($\chi^2 = 32.6$, df = 6, $p < 0.001$). Table 6 describes the medications taken.

Divers took a range of cardiovascular medications including angiotensin converting enzyme inhibitors, angiotensin II receptor antagonists, beta blockers, calcium channel blockers and diuretics. One respondent took a combination of clopidogrel, simvastatin and atenolol. The diver taking digoxin also took aspirin and a thiazide diuretic. Therefore

TABLE 5
NUMBER OF MEDICATIONS TAKEN DAILY FOR ANY MEDICAL CONDITION (% IN PARENTHESES)

Number	Australian divers n = 346		US divers n = 363		Total n = 709	
None	292	(84.4)	244	(67.2)	536	(75.6)
1	34	(9.8)	60	(16.5)	94	(13.3)
2	15	(4.3)	35	(9.6)	50	(7.1)
3	4	(1.2)	12	(3.3)	16	(2.3)
4	1	(0.3)	7	(1.9)	8	(1.1)
5	0	(0)	3	(0.8)	3	(0.4)
6	0	(0)	2	(0.6)	2	(0.3)

TABLE 6
MEDICATIONS TAKEN EVERY DAY FOR ANY MEDICAL CONDITION (% IN PARENTHESES)

Medication	Australian divers n = 346		United States divers n = 363		Total n = 709	
Cardiovascular medications						
b-blockers	3	(0.9)	10	(2.8)	13	(1.8)
Calcium channel blockers	3	(0.9)	4	(1.1)	7	(1.0)
ACE inhibitors/ATII antagonists	5	(1.4)	18	(5.0)	23	(3.2)
Other antihypertensives	0	(0)	3	(0.8)	3	(0.4)
Digoxin	1	(0.3)	0	(0)	1	(0.1)
Diuretics	3	(0.9)	4	(1.1)	7	(1.0)
Lipid lowering agents	7	(2.0)	14	(3.9)	21	(3.0)
Aspirin	5	(1.4)	12	(3.3)	17	(2.4)
Clopidogrel	1	(0.3)	0	(0)	1	(0.1)
Anti asthmatic/allergy medications						
Inhaled corticosteroids	3	(0.9)	6	(1.7)	9	(1.3)
Intranasal corticosteroids	2	(0.6)	4	(1.1)	6	(0.8)
Oral corticosteroids	0	(0)	1	(0.3)	1	(0.1)
Inhaled bronchodilators	3	(0.9)	5*	(1.4)	8	(1.1)
Cromoglycate	0	(0)	2	(0.6)	2	(0.3)
Monteleukast	0	(0)	1	(0.3)	1	(0.1)
Antihistamines	2	(0.6)	26	(7.2)	28	(3.9)
Decongestants	0	(0)	4	(1.1)	4	(0.6)
Hormonal/endocrine medications						
Contraception (oral or depot)	11	(3.2)	6	(1.7)	17	(2.4)
Hormone replacement therapy	4	(1.2)	14	(3.9)	18	(2.5)
Thyroid supplementation	2	(0.6)	16	(4.4)	18	(2.5)
Oral hypoglycaemic agents	1	(0.3)	2**	(0.6)	3	(0.4)
Insulin	0	(0)	2	(0.6)	2	(0.3)
Osteoporosis agents	2	(0.6)	2	(0.6)	4	(0.6)
Analgesics/Rheumatology medications						
NSAIDs	4	(1.2)	3	(0.8)	7	(1.0)
COX-2 inhibitors	0	(0)	4	(1.1)	4	(0.6)
Methotrexate	2	(0.6)	1	(0.3)	3	(0.4)
Allopurinol	0	(0)	3	(0.8)	3	(0.4)
Others	2	(0.6)	2	(0.6)	4	(0.6)
Neuropsychiatric medications						
Anti-epileptic agents	1	(0.3)	1***	(0.3)	2	(0.3)
Anti-depressant agents	3	(0.9)	10	(2.8)	13	(1.8)
Anti-psychotic/mood alterants	2	(0.6)	3	(0.8)	5	(0.7)
Anxioloytic agents	0	(0)	5	(1.4)	5	(0.7)
Interferon b-1A	0	(0)	1	(0.3)	1	(0.1)
Anti-ulcer medications	6	(1.7)	12	(3.3)	18	(2.5)
Miscellaneous agents	2	(0.6)	10	(2.8)	12	(1.7)
Unidentifiable responses	0	(0)	7	(1.9)	7	(1.0)

* One diver took salbutamol, budesonide, salmeterol, cromoglycate and oral hydrocortisone daily
** One diver took glyburide and metformin
*** This diver took topiramate and carbamazepine

the digoxin was possibly for atrial fibrillation rather than congestive heart failure.

A range of reliever and preventer anti-asthmatic medications were taken on a daily basis. One respondent took a combination of salbutamol, salmeterol, budesonide, cromoglycate and oral hydrocortisone.

Thirty five divers (16% of female divers) took either the oral contraceptive pill or hormone replacement therapy. Unexpectedly, 16 US divers (4.4 %) reported taking thyroid supplementation. Five divers took medication for diabetes; insulin alone (two divers), metformin alone (two divers) and a combination of metformin and a sulfonylurea (one diver). Two divers took anti-epileptic medications; one took a combination of carbamazepine and topiramate, suggesting a history of epilepsy not readily controlled by first line agents. One diver took interferon b-1A used for relapsing-remitting multiple sclerosis. Anti-psychotic and mood altering medications included clozapine and various amphetamine derivatives.

Discussion

This study demonstrates that experienced divers take a range of medications within two hours of diving. The most commonly-used agents are decongestants, anti-emetics and bronchodilators. These medications are probably used to prevent aural barotrauma, sea-sickness and exercise-induced bronchoconstriction respectively.

Only a few studies have evaluated the effects of decongestants and anti-emetics in the hyperbaric environment.[3,4,8–11] A randomised placebo-controlled, double blind crossover trial evaluated the psychometric effects of pseudoephedrine and dimenhydrinate at 101 kPa and 303 kPa in a dry hyperbaric chamber.[3,4] Dimenhydrinate reduced mental flexibility (trail making test, $p < 0.05$) and depth reduced verbal memory ($p = 0.001$). Therefore the combination of dimenhydrinate and depth may contribute to the dangers of diving. In the pseudoephedrine arm, no significant alterations in psychometric performance were demonstrated. However, there was a trend towards increased anxiety scores and a significant increase in heart rate.

Sipinen and colleagues evaluated the neuropsychological and cardiovascular effects of clemastine fumarate, a sedating antihistamine, in a double blind, placebo-controlled, cross over study.[10] Once again this study was conducted in a hyperbaric chamber to a simulated depth of 51 metres. Clemastine did not increase the sedative effects of nitrogen narcosis nor increase the risk of cardiac arrhythmias.

Hence it is clear that while many divers are taking drugs prior to diving, the effects of these drugs in the hyperbaric environment have been poorly investigated. Further research is indicated to determine if divers are, in fact, at increased risk as a result of altered drug pharmacodynamics while diving. Those drugs that may affect diver safety should be identified and the nature and extent of the effect should be quantified. This information would allow divers to weigh the risks and the benefits of pre-dive medication use. Of particular interest are the effects of the potentially sedating anti-emetics used commonly in Australia, such as the Travacalm® combination product and diphenhydramine.

The finding that medications are taken daily by one quarter of divers provides insight into the medical conditions with which these divers dive. While the hyperbaric environment may modulate the effects of these medications, of greater importance is the impact of the underlying medical conditions on a diver's fitness to dive. Some divers appear to be diving despite absolute or relative contraindications to scuba diving eg. ischaemic heart disease, diabetes, asthma and epilepsy. This study is supported by an analysis of chronic medical conditions suffered by the Australian cohort. These data have been reported elsewhere.[5]

Differences were noted between the Australian and US divers. The US divers took more chronic medications, but this group was significantly older. Therefore, the differences in the number of medications used may reflect differences in the ages of the two groups. The differences in the specific agents used prior to diving may reflect differences in product availability in the two countries, as well as marketing practices. The frequency of use of decongestants prior to diving varied between the two groups. This may be due to differences in access to the medications. In Australia, pseudoephedrine can be sold only in pharmacies, whereas in places such as Florida, these agents may be sold in a variety of shops, including dive shops. This means that there is the potential to purchase decongestants (and anti-emetics) within metres of the dive boat.

This survey has some limitations. First, selection bias is likely, as we have surveyed only experienced dive club members. These results may not be reflective of all experienced divers and are likely not representative of the novice diver, who tends to be younger. Also, only a very small proportion of active Australian and US divers were surveyed. This is further likely to introduce selection bias. Few dive club representatives reported the number of divers at the meeting at which the survey was administered. Therefore it was not possible to determine a response rate.

Furthermore, there may be some potential recall and misclassification bias of medication names. If divers were concerned about their dive club officials learning that they had certain diseases or took certain medications, there is the potential for prevarication bias.

Studies are required to evaluate the effects of chronically-used medications on the risks associated with the hyperbaric environment. It would likely be more valuable, however, to evaluate the impact of the various medical conditions on diving of which the chronic medications are a marker, eg. asthma, ischaemic heart disease and epilepsy.

Conclusions

Many experienced scuba divers take a variety of medications for chronic conditions. These medications are likely to be markers of the chronic medical conditions with which the divers dive. These conditions may impact adversely on divers' fitness to dive. In addition, many experienced divers take medications to assist with diving. Further research is required to evaluate the impact of these medications on divers' fitness to dive.

Acknowledgments

We thank the Pittsburgh Emergency Medicine Foundation, Pittsburgh, PA, USA, which partially funded this study.

References

1 Edmonds C, Lowry C, Pennefather J, Walker R. *Diving and Subaquatic Medicine*. 4th ed. London: Arnold Publishers; 2002
2 Abraini JH. Inert gas and raised pressure: evidence that motor decrements are due to pressure per se and cognitive decrements due to narcotic action. *Eur J Physiol* 1997; 433: 788-791
3 Taylor DMcD, O'Toole KS, Auble TE, Ryan CM, Sherman DR. The psychometric and cardiac effects of dimenhydrinate in the hyperbaric environment. *Pharmacotherapy* 2000; 20: 1051-1054
4 Taylor DMcD, O'Toole KS, Auble TE, Ryan CM, Sherman DR. The psychometric and cardiac effects of pseudoephedrine in the hyperbaric environment. *Pharmacotherapy* 2000; 20: 1045-1050
5 Taylor DMcD, O'Toole KS, Ryan CM. Experienced, recreational scuba divers in Australia continue to dive despite medical contra-indications. *WEM* 2002; 13: 187-193
6 Walsh JM. *Interaction of Drugs in the hyperbaric environment*. The 21st Undersea Medical Society Workshop. Bethesda: Undersea Medical Society Inc; 1979
7 Harrison LJ. Drugs and diving. *J Florida MA* 1992; 79: 165-167
8 Brown M, Jones J, Krohmer J. Pseudoephedrine for the prevention of barotitis media: a controlled clinical trial in underwater divers. *Ann Emerg Med* 1992; 21: 849-852
9 Luke CG. Spray-tish for scuba-divers. *Med J Aust* 1975; 2: 407
10 Sipinen SA, Kulvik M, Leinio M, Vijanen A, Lindholm H. Neuropsychotic and cardiovascular effects of clemastine fumarate under pressure. *Undersea Hyperbaric Med* 1995; 22: 401-406
11 Williams T, Wilkinson A, Davis FM, Frampton C. Transdermal hyoscine and diver performance. *Undersea Biomed Res* 1988: 15: 89-98.

Dr Simone E Taylor, PharmD BCPS Grad Cert CRM, is an Emergency Medicine Clinical Pharmacist at the Austin & Repatriation Medical Centre, Locked Bag 25, Heidelberg, Victoria, Australia
E-mail <Simone.Taylor@armc.org.au>
Associate ProfessorDavid McD Taylor is Director of Emergency Medicine Research, Royal Melbourne Hospital, Victoria, Australia.
Dr Kevin S O'Toole is Director of Hyperbaric Medicine University of Pittsburgh, Pittsburgh, PA, USA.
Professor Christopher M Ryan PhD, is a Research Coordinator at the Western Psychiatric Institute & Clinic, University of Pittsburgh, Pittsburgh, PA, USA.

SPUMS Annual Scientific Meeting 2001

Ventilatory support in a hyperbaric environment

Barbara Trytko

Key Words
Hyperbaric oxygen, medical conditions and problems, treatment, ventilators

Abstract
As ventilatory support becomes more complex and varied, a good understanding of the changes that can occur in the hyperbaric environment to both the patient and the devices used is vital. Only with this knowledge may patients be managed safely. Unfortunately, few studies have been done so far on the physiological effects of IPPV and other respiratory support in the hyperbaric environment. What is known of these changes is summarised in this paper.

Introduction

A number of patients accepted for treatment with hyperbaric oxygen therapy (HBOT) may require some form of respiratory support. Patients with severe neurological decompression illness, arterial gas emboli, carbon monoxide poisoning and necrotising infections may all require mechanical ventilation. To manage these patients appropriately requires a good understanding of the physiological changes that occur to the respiratory system, and the effects of intermittent positive pressure ventilation (IPPV), positive end expiratory pressure (PEEP), and

continuous positive airway pressure (CPAP) under hyperbaric conditions.

Respiratory changes during hyperbaric therapy

Changes to the respiratory system during HBOT can cause problems. A number of physiologic responses may alter gas exchange and the patient's ventilatory capacity in the chamber may be inadequate. A critically ill patient may have pre-existing pulmonary pathology due to the primary disease process or even ventilator-associated barotrauma. Treatment with high-inspired oxygen can increase sensitivity to the toxic effects of oxygen on the lung under pressure. Barotrauma must be excluded, or managed, prior to compression to avoid disastrous consequences.

Aside from these possible adverse effects to the lung and risks of barotrauma, there are other effects of HBOT:

- suppression of afferent carotid and aortic chemoreceptor activity may result in initial respiratory depression in patients who are not mechanically ventilated;
- later, during treatment, hyperventilation may occur due to raised mixed venous carbon dioxide (CO_2) secondary to decreased binding of CO_2 to reduced haemoglobin;[1]
- increase in oxygen tension resulting in depression of hypoxic ventilatory drive;
- washout of nitrogen leading to absorption atelectasis.

There remains controversy over the amount of alveolar-arterial (A-a) ratio change that occurs. There is evidence that the A-a ratio remains constant, independent of inspired oxygen concentration even at increased barometric pressure.[2] However, other uncontrolled human evidence suggests that patients with lung disease seem to have arterial oxygen tensions (P_aO_2) greater then predicted, whilst patients with normal lungs have P_aO_2's that are lower than predicted when exposed to hyperbaric oxygen.[3,4]

Animal studies have demonstrated increases in pulmonary vascular resistance as well as blunting of hypoxic vasoconstriction.[5] Both may have implications in patients with significant lung pathology. Often areas of ventilation/perfusion mismatch are already present and may worsen during HBOT, resulting in marked increases in the A-a gradient. Some data suggest that, in patients requiring inspired oxygen concentrations of more than 50% for adequate oxygenation in normobaric conditions, the tissue oxygen levels achieved in the hyperbaric environment are inadequate for therapeutic effects.[5]

In patients who are not mechanically ventilated but have limited respiratory reserve, the changes above may contribute to respiratory insufficiency at increased pressure.

Physiologic effects of IPPV

The effects of IPPV have been extensively studied under normobaric conditions.[6] Unfortunately this does not appear to be the case in the hyperbaric environment. Respiratory changes induced by IPPV include increased physiological dead space, decreased functional residual capacity and increased intrathoracic pressure.[6] Cardiovascular changes include decreased cardiac output (decreased preload), increased right ventricular pressures and increased systemic and pulmonary vascular resistance. Endocrine changes include an increase in ADH release.

It is reasonable to extrapolate that the effects of IPPV and HBOT may be additive. In particular, HBOT may cause increased vascular resistance and decreased cardiac output.

Positive end expiratory pressure (PEEP)

Positive end expiratory pressure is the application of greater than ambient pressure, measured in cm of H_2O, applied during the expiratory phase of positive pressure ventilation. PEEP is often required as a method of recruiting and stabilising alveoli in the critically ill and is an important part of ventilatory strategy in the intensive care unit (ICU) setting. In the hyperbaric environment, there is evidence that significant variations in the level of PEEP may occur.

Depending on the amount of pressure and the PEEP valve used, an increase in preset PEEP by up to 4 cm of water at depth has been demonstrated.[7] Two major problems may occur as a result – cardiovascular compromise (by reducing preload), and barotrauma. Recommendations include monitoring of proximal airway pressure, use of adjustable PEEP valves and checking PEEP and readjusting after any change in pressure.[7] There may also be a problem to maintain PEEP with less sophisticated ventilators.

Despite these potential problems, there are a number of physiological reasons why PEEP should be maintained during HBOT. Most particularly, PEEP recruits and stabilises alveoli, preventing areas of collapse, which are potential areas of gas trapping. PEEP also splints open airways to allow more even gas flow and again lessens the likelihood of barotrauma. It has been demonstrated that even short periods without optimal ventilation may result in deterioration that takes up to 24 hours to resolve.[8]

Continuous positive airway pressure (CPAP)

Constant positive airway pressure, which is used with spontaneously breathing patients, is easy to apply in the hyperbaric environment. The physiologic effects are similar to those seen with PEEP. A number of circuits have been tested. A simple system with a high compliance and high volume reservoir coupled with a water valve is easy to achieve.[9] The only precaution necessary is to ensure that air from the compressors is not contaminated with oil, which may cause an adult respiratory distress syndrome (ARDS).

Ventilators

A number of studies have examined the function of various ventilators under hyperbaric conditions. Blanch et al tested

19 ventilators under hyperbaric conditions to assess their function.[10] Adequate mechanical ventilation in the chamber requires a ventilator capable of functioning predictably and safely under hyperbaric conditions.[9]

Changes that occur with increasing pressure affect ventilator function. An increase in chamber pressure may result in reduction in inspiratory flow unless the supply pressure is increased. If this happens, inadequate flow to the ventilator will not maintain adequate ventilation. An increase in pressure also increases the density and viscosity of gases, which decreases the compressibility of gases and decreases the flow rate for a given pressure.

In addition to these changes, one has to consider fire prevention and maintenance of normal oxygen percentage in the chamber atmosphere. Table 1 lists the ideal requirements of a ventilator for use in a hyperbaric chamber.[9]

VOLUME CYCLED VENTILATORS

Regulation from inspiratory to expiratory phase is by tidal volume (V_t). Once the set V_t is reached, the ventilator cycles from inspiratory to expiratory mode. During HBOT the increase in viscosity and resistance results in a decrease in flow, therefore longer time is needed for the desired V_t to be reached. As a result, respiratory rate decreases.

PRESSURE CYCLED VENTILATORS

Inspiratory to expiratory timing is determined by the set pressure being reached. During HBOT at the same passage pressures, the flow is decreased due to increased resistance resulting in a longer time to reach the set pressure. This increases the inspiratory time and again decreases the respiratory rate.

TIME CYCLED VENTILATORS

Time cycling is now the most common form of inspiratory to expiratory cycling used. Unfortunately, it is also the most affected by hyperbaric conditions. After compression, the circuit senses decreased compressibility of the gases and tends to fill and empty in a shorter time, resulting in increased frequency and decreased inspiratory and expiratory time. Decreased inspiratory time and reduced flow cause a decrease in tidal volume. In addition, a decreased expiratory time may result in auto PEEP from 'breath stacking' with a significant risk of barotrauma.

Ventilators in chambers

As a general rule, ventilators used in the chamber are not as sophisticated as those used in the ICU. Ventilation modes such as pressure support, pressure-controlled volume assist, and bilevel positive airway pressure are not readily available outside the ICU. Unfortunately, chambers are usually relatively small in size and space is at a premium. The experience in our unit with the Campbell EV 500 ventilator has recently been reported.[11]

TABLE 1
DESIRABLE FEATURES OF THE HYPERBARIC VENTILATOR

- Small and compact
- No electrical requirement
- No flammable lubricants
- Powered by compressed air or chamber environment gas
- Minimum work of breathing with low gas consumption
- Low oxygen bleed into the chamber to prevent contamination of the atmosphere
- Multiple ventilatory modes
- Stable tidal volume and rate changes with pressure
- Constant PEEP
- Continuous monitoring of tidal volume, frequency, minute volume, peak and mean airway pressure, PEEP, I-E ratio

Modified from Kluger[9]

Intensive care patients who are breathing spontaneously with ventilator support may have high airway pressures and/or high levels of PEEP, and are often difficult to manage. In addition, any move from the intensive care environment and its sophisticated ventilatory strategies may result in significant changes to respiratory parameters. Unfortunately, the deterioration in respiratory function due to any disturbance may last up to 24 hours after transfer back to the intensive care unit.[9,12]

As a result of the difficulties associated with the transfer of patients from the ICU to other environments at the Prince of Wales Hospital, we have devised a transport apparatus that brings the ICU ventilator, on the patient's bed, with the patient to the chamber. This minimizes the time in which a patient's ventilation is altered. In view of these problems and the changes that may occur, an important adjunct to treatment of the ventilated patient is regular arterial blood gas sampling. The safety of the patient depends on close monitoring, especially during the compression and decompression phases of the treatment when there are large changes in pressure.

References

1 Arieli R, Kerem D, Melamed Y. Hyperoxic exposure affects the ventilatory response to hypoxia in awake rats. *J appl Physiol* 1988; 64: 181-186
2 Gilbert R, Keighley JF. The arterial/alveolar oxygen tension ratio. An index of gas exchange applicable to varying inspired oxygen concentration. *Am Rev Respir Dis* 1974; 109: 142-145
3 Weaver LK, Howe S. Arterial oxygen tension of patients

with abnormal lungs treated with hyperbaric oxygen is greater than predicted. *Chest* 1994; 106: 1134-1139
4 Moon RE, Camporesi M, Shelton DL. Prediction of arterial PO2 during hyperbaric treatment. In : Bove A, Bachrach AJ, Greenbaum LJ Jr Eds. *Proceedings of the 9th International Symposium on Underwater and Hyperbaric Physiology*. Bethesda, Md: Undersea and Hyperbaric Medical Society, 1987: 1127-1131
5 Weaver LK and Larson-Lohr V. Hypoxemia during hyperbaric oxygen therapy. *Chest* 1994; 105: 1270-1271
6 Fairley HB. Physiology of Mechanical Ventilation. In: *Scientific Foundations of Anaesthesia*, 5th Edition, 1995: 291-303
7 Youn BA, Houseknecht R, DeAntonio A. Review of positive end-expiratory pressure and it's application in the hyperbaric environment. *J Hyperbaric Med* 1991; 6: 87-99
8 Waydhas C, Schneck G, Duswald KH. Deterioration of respiratory function after intra-hospital transport of critically ill surgical patients. *Intensive Care Med* 1995; 21: 748-789
9 Kluger M. Implications of hyperbaric medicine for anaesthesia and intensive care part 2. *SPUMS J* 1997; 27: 62-73
10 Blanch PB, Desautels DA, Gallagher TJ. Deviations in function of mechanical ventilators during hyperbaric compression. *Respir Care* 1991; 36: 803-814
11 McKay R, Bennett M. Evaluation of the Campbell EV 500 ventilator under hyperbaric conditions. *SPUMS J* 2002; 32: 62-70
12 Ratzenhofer-Komenda B, Offner A, Gabor S, et al. Alterations of arterial blood gases after hyperbaric oxygen therapy in critically ill patients. *[Abstract] Eur J Underwater Hyperbaric Med* 2001; 2: 69

Dr Barbara Trytko, FANZCA, FFICANZCA, is an Intensive Care Physician and a Consultant in the Department of Diving and Hyperbaric Medicine, Prince of Wales Hospital, High Street, Randwick, NSW 2031, Australia.

Does hyperbaric oxygen affect blood sugar levels in diabetics? (Abstract only)

Barbara Trytko

Introduction: Diabetic patients constitute a major proportion of the patients treated in our hyperbaric unit. The effect of hyperbaric oxygen therapy (HBOT) on diabetic control is still unclear. A number of papers suggest an increase in insulin production or modification of metabolism favourable to the diabetic resulting in lower blood sugar. However, the numbers are small and all studies have involved insulin dependent (IDDM) diabetics exclusively.[1–3] The effect in non-insulin dependent (NIDDM) diabetics is unknown. We have conducted an observational study over 12 months of blood sugar levels (BSL) before and after treatment in all diabetics presenting for HBOT.
Methods: Following ethical approval, 27 patients were consented, resulting in 237 episodes included for analysis. BSL was measured pre- and post-treatment for between three and 15 consecutive treatments. Glycosylated haemoglobin was measured from patients having more than 10 treatments. In addition, a daily diet plan, medication chart, and activity log were completed for each patient.
Results: The mean change in BSL over a single HBOT was a drop of 2.0 $mmol.l^{-1}$ (SD +/- 2.5 mmol). Patients with IDDM accounted for 133 (56%) of treatment episodes. Of these, a reduction in BSL was recorded in 112 (84%) episodes. Seventy one (63%) of these reductions were > 2 $mmol.l^{-1}$. Twenty one (19%) were > 4 $mmol.l^{-1}$ with the majority requiring treatment. Eighty (77%) of the treatments in the NIDDM group were associated with a drop in BSL but none required intervention.
Conclusion: Our results show that on average diabetics having HBOT will drop their BSL by 2 $mmol.l^{-1}$ during each treatment. There is however, considerable variability in this response. Non-insulin dependent diabetics appear to be more predictable in their response than insulin dependent diabetics and are unlikely to drop their BSL sufficiently to require treatment. We recommend that all diabetics eat a meal within two hours of their HBOT if possible and have a BSL prior to treatment. Significant hypoglycaemia is likely to be avoided if patients with IDDM and a BSL < 8.0 $mmol.l^{-1}$, and with NIDDM and a BSL < 6.0 $mmol.l^{-1}$, are given oral glucose before treatment. Larger numbers of patients should be studied to confirm this recommendation.

References

1 Ekanayake L, Doolette D. Effects of hyperbaric oxygen treatment on blood sugar levels and insulin levels in diabetics. *SPUMS J* 2001; 31: 16-20
2 Longoni C, Camporesi EM, Buizza M, et al. Reduction in insulin requirements during hyperbaric therapy. *Undersea Biomed Res* 1998; 15(Suppl): 16-17
3 Rose RE, Rice JH, Kraft KL, et al. An ongoing study of plasma glucose measurement in diabetic patients during hyperbaric oxygen therapy. *Undersea Hyperbar Med* 2001; 28(Suppl): 32

For author details see article above

SPUMS Annual Scientific Meeting 2002

Altitude illness

Trish Batchelor

Key words
Travel medicine, altitude, hypoxia, medical conditions and problems

Abstract
Travel to previously geographically remote areas of the world has increased dramatically in recent years. In particular, high altitude travel is becoming increasingly popular. High altitude travel presents a number of specific risks, including acute mountain sickness and its life-threatening forms – high altitude pulmonary oedema and high altitude cerebral oedema. These entities can largely be prevented with medications and behavioural modifications. However, travellers are often unaware of the risk posed by journeys into high altitude areas.

Introduction

Of the potential environmental hazards the traveller may face (Table 1), high altitude is one of the most common. Millions of people now travel to, or live in, high altitude areas of the world. Access to many of these areas is no longer purely the domain of the young, fit and adventurous. There are many parts of the world where it is possible to fly from sea level to over 3000 m in less than a few hours, providing a rapid altitude gain and a high likelihood of developing acute mountain sickness (AMS). High altitude is defined as an altitude above 2500 m, very high altitude is 3500–5800 m and extreme altitude is above 5800 m. Above 5800 m one cannot acclimatize and there is a gradual and chronic deterioration.[1]

Oxygen changes at altitude

The term high altitude illness is used to describe the cerebral and pulmonary syndromes that can develop in unacclimatised persons shortly after ascent to high altitude.[2] The most important effect of high altitude on physiological processes is the decrease in oxygen pressure and content in the circulating blood. The percentage of oxygen in the air remains at 21% whether at sea level or altitude. However, at 18,000 feet the atmospheric pressure is approximately 50% of that at sea level and subsequently the partial pressure of oxygen is also 50% of that at sea level – a state of hypobaric hypoxia. At the summit of Mount Everest the partial pressure is reduced to 30% of the value at sea level. To a degree, individuals can compensate for this decrease in partial pressure by increasing their pulmonary ventilation, yet this compensation is only partial.[3] Other environmental changes include a drop in ambient temperature of 2^0C for every 300 m altitude gain and an increase in UV radiation of 10% for very 1000 m in altitude gain. These factors increase the risks of hypothermia, frostbite, snow blindness and UV skin damage.

Physiological responses to high altitude

There are some known physiological responses to ascent to high altitude. In the respiratory system there is a reflex increase in ventilation, and pulmonary vasoconstriction. Initially, cardiac output, heart rate and blood pressure rise secondary to sympathetic activation, which response lasts for a few days. As a result of dehydration there is an initial increase in the haemoglobin concentration. After some weeks, there is an increase in red blood cell production secondary to an increase in erythropoietin production. All

TABLE 1
HEALTH RISKS ASSOCIATED WITH ADVENTURE ACTIVITIES
(modified from Zell[4])

High altitude trekking	Mountain climbing	Scuba diving	Freshwater kayaking/ rafting
AMS, HAPE and HACE	AMS, HAPE and HACE	DCI	Drowning
Snow blindness	Hypothermia	Barotrauma	Leptospirosis
UV damage	Snow blindness	Marine envenomation	Hypothermia
Hypothermia	Frostbite	UV damage	Enteric infections
Frostbite	Major musculo-skeletal injury	Sea sickness	
Enteric disease		Infected coral cuts	
Animal bites			

individuals will develop some degree of cerebral oedema. However there is marked individual variation in this. For reasons not yet understood, some individuals will have an excessive response to altitude and will consequently develop one of the forms of altitude sickness.

High altitude syndromes are considered to sit on a spectrum from the milder acute mountain sickness (AMS) through to the life-threatening forms of high altitude pulmonary oedema (HAPE) and high altitude cerebral oedema (HACE). Other syndromes include high altitude deterioration, and for residents of high altitude areas, chronic mountain sickness.

Acute mountain sickness

Acute mountain sickness (AMS) is a syndrome of non-specific symptoms and is therefore subjective.[2] The Lake Louise Consensus Group defined AMS as the presence of headache plus one or more of insomnia, dizziness, lassitude, fatigue, anorexia, nausea or vomiting in an individual who has recently arrived at an altitude of greater than 2500 m.[5] Symptoms of AMS typically develop within 4–12 hours of arrival at altitude and occur in 40% of individuals ascending from sea level to over 3000 m and in 75% of those ascending to altitudes greater than 4500 m. The exact process of AMS remains unknown, however it is known that hypoxia elicits neurohumoral and haemodynamic responses that result in overperfusion of neurovascular beds, elevated hydrostatic capillary pressure, capillary leakage and consequent oedema in both the brain and the lungs.

There is currently no accurate method of predicting individual susceptibility to AMS. The only clear risk factor, apart from rapid ascent, is a past history of AMS, HAPE or HACE. Prevention of AMS will logically prevent progression to the more severe forms of altitude sickness. The most effective method of prevention is graded ascent. Essentially, this involves following a conservative approach to altitude gain. Recommendations include walking in rather than flying to altitudes of > 3000 m, when above 3000m limiting daily altitude gain to 300–500 m and having a rest day after every 1000 m of altitude gain. Another useful activity is to walk or climb higher than the sleeping altitude at some time during the day.

DRUG PROPHYLAXIS FOR AMS

Drug prophylaxis can be useful if a rapid ascent is unavoidable (eg. flying to over 3000 m) or if there is a past history of AMS. Acetazolamide (Diamox) is the drug of choice under these circumstances. This carbonic anhydrase inhibitor acts to decrease the degree of alkalosis with a resulting increase in arterial pCO_2 and increase in ventilation. The ideal dose of Diamox is controversial, traditionally 250 mg BD has been recommended, however many experts now recommend a dose of 125 mg BD. This lower dose appears to be effective for most individuals and has a far lower incidence of side effects.[6,7] Another advantage of Diamox is that it reduces the sleep hypoxia and periodic breathing that is a common complaint at altitude. Diamox should be avoided in those with an allergy to sulphur-based drugs.

Alternative medications include Dexamethasone 4 mg daily, however this is rarely recommended. Promising results have been shown in two studies using the herb Ginkgo Biloba to prevent AMS in both gradual and sudden ascents to altitude.[8,9] These studies have also shown that Ginkgo Biloba provides the benefit of increased peripheral circulation, thus reducing the incidence of uncomfortably cold extremities and frostbite.

High altitude pulmonary oedema

The progression from AMS to HAPE or HACE is accompanied by the development of physical signs and symptoms. HAPE is usually preceded by AMS and in context should be suspected when an individual suffers decreased performance and dry cough. As it progresses, tachycardia, tachypnoea and respiratory distress ensue. HAPE is a non-cardiogenic pulmonary oedema associated with pulmonary hypertension and elevated capillary pressure.[2]

Those individuals who develop HAPE have a relatively poor ventilatory response to hypoxia, exaggerated hypoxic pulmonary vasoconstriction and subsequent excessive pulmonary hypertension.[2] Whilst it may seem feasible that such individuals could be predicted by laboratory testing, there is substantial overlap between susceptible and non-susceptible groups. Predictions of susceptibility in the field based on laboratory testing do not yet seem possible.

A past history of AMS is the main risk factor. Those with a history of HAPE have a 60% chance of recurrence with abrupt ascent to high altitude.[10] The priority in treating HAPE is increasing oxygenation hence the primary treatment is oxygen, followed by descent to a lower altitude. Descent may be actual or simulated in a portable hyperbaric chamber (eg. the Gamow bag). Nifedipine SR 20 mg six-hourly is used if oxygen or descent are not available.

High altitude cerebral oedema

HACE is a clinical diagnosis defined as the onset of ataxia and/or altered consciousness in someone with AMS or HAPE. It is characterised by a global encephalopathy rather than focal neurological signs. The treatments of choice are descent to a lower altitude and oxygen. Dexamethasone may also be used at a dose of 8 mg stat, then 4 mg QID.

Retrieval

Data published in 1989 on helicopter rescues in Nepal showed a rate of 75 rescues for every 100,000 trekking

permits issued. The most common reasons for rescue were AMS (36%); trauma (26%); illness (26%) and non-traumatic orthopaedic problems (10%).[11] Accurate data on exact numbers of helicopter rescues in Nepal are impossible to obtain, however it was estimated that around 370 rescues per 100,000 trekkers occurred.

Data collected at the CIWEC Travel Medicine Centre, Kathmandu, from October 1999 to October 2000 examined 140 evacuations. Of these, 46% were for AMS, 13% for infections (not diarrhoea), 10% for diarrhoea, 10% for musculoskeletal problems and 5% for chest pain. Interestingly, whilst only 20% of trekkers visit the Everest region, 80% of altitude-related evacuations were from there. This reflects the higher altitude reached by trekkers in this region. It is interesting to see the rather dramatic increase in the rate of helicopter rescues being carried out in Nepal. This is probably due to improved communications (satellite phones are now available in many locations on the major trekking trails), and to the increase in the number of private helicopter companies providing these rescue services. There were no deaths in this study cohort (Pandey P, CIWEC Clinic, Kathmandu, personal communication).

Whilst trekking is generally a reasonably safe activity, high altitude mountain climbing is a highly dangerous endeavour. An analysis of deaths in summiteers of the world's two highest mountains showed the influence of the use of supplementary oxygen.[12] On Mount Everest, one in 29 summiteers using oxygen died on descent whereas for those not using oxygen the death rate was one in 12. On K2, the death rate was one in seven of those using oxygen and one in five of those who summitted without oxygen. It is thought that the even more extreme hypoxia resulting from climbing to these altitudes without supplementary oxygen contributes to this excessively high death rate, the majority of which are caused by falls and altitude sickness.

Contraindications to high altitude travel

Some individuals should not travel to high altitude. These include those with pulmonary hypertension, pulmonary atresia, moderate to severe COPD, unstable cardiac disease, and sickle cell disease. Individuals with asthma, diabetes, epilepsy, controlled hypertension and other forms of controlled heart disease may travel to altitude as long as they have been adequately prepared by a travel medicine practitioner with experience in high altitude medicine.

The elderly and young children appear to be at no increased risk of AMS. The International Society of Mountain Medicine has published guidelines for preventing and recognising altitude sickness in children.[13] Pregnant women are generally advised to stay below 4000 m and should take great care if visiting less developed countries to avoid enteric pathogens and mosquito-borne diseases.

References

1 Ward M, Milledge JS. Griffith Pugh, Pioneer Everest physiologist. *High Alt Med Biol* 2002; 3: 77-88
2 Hackett PH & Roach RC. High-altitude illness. *N Engl J Med* 2001; 345: 107-114
3 Hultgren H. *High Altitude Medicine*. California. Hultgren Publications, 1997
4 Zell SC. Environmental and recreational health hazards associated with adventure travel. *J Travel Med* 1997; 4: 94-99
5 Roach RC, Bartsch P, Oelz O, Hackett P. Lake Louise AMS scoring consensus committee. The Lake Louise acute mountain sickness scoring system. In: Sutton JR, Houston CS, Cootes G, eds. *Hypoxia and molecular medicine*. Burlington, Vt. Charles S Houston 1993; 272-274
6 Dumont L, Mordisoroff C, Tramer CR. Efficacy and harm of pharmacological prevention of acute mountain sickness: a quantitative systematic review. *BMJ* 2000; 321: 267-272
7 Bartsch P, Schneider M. Pharmacological prevention of acute mountain sickness. *BMJ* 2001; 322: 48 (letter)
8 Maakestad K, Leadbetter G, Olson S, Hackett PH. Ginkgo Biloba reduces incidence and severity of acute mountain sickness. [abstract] *WEM* 2001; 12: 51.
9 Roncin J, Schwartz F, D'Arbigny P. Egb761 in control of acute mountain sickness and vascular reactivity to cold exposure. *Aviat Space Environ Med* 196; 67: 445-452
10 Bartsch P, Maggiorni M, Ritter M et al. Prevention of high altitude pulmonary oedema by nifedipine. *N Engl J Med* 1991; 325: 1284-1289
11 Shlim DR, Houston R. Helicopter rescues and deaths among trekkers in Nepal. *JAMA* 1989; 261: 1017-1019
12 Huey RB, Eguskitza X. Supplemental oxygen and mountaineer death rates on Everest and K2. *JAMA* 2000; 284: 181-182
13 Children at high altitude. An international consensus statement by an ad hoc committee of the International Society for Mountain Medicine. *High Altitude Med Biol* 2001; 2: 389-40

Dr Trish Batchelor, MB,BS, FRACGP, MPH (Trop Med), is the Medical Adviser to The Travel Doctor TMVC, New Zealand. Trish was the principal guest speaker at the SPUMS ASM, Port Vila, Vanuatu, May, 2002.
Currently she is working as a medical officer at the CIWEC Travel Medicine Centre, PO Box 12895,
Durbar Marg, Kathmandu, Nepal
E-mail: <trishb@mos.com.np>

The immunosuppressed traveller to less developed countries: considerations for preparation

Trish Batchelor

Key words
Travel medicine, immunosuppression, infectious diseases, vaccination

Abstract
The immunosuppressed traveller presents several unique concerns when preparing to travel to less developed countries. Some vaccinations may be contraindicated, whilst others may provide less than adequate protection. Immunosuppressed individuals may be more susceptible to infectious diseases prevalent in the tropics and be visiting areas with limited medical care should they require it. Immunosuppressed travellers include those with HIV infection; those on immunosuppressive medications or with underlying immunosuppressive illnesses; those with specific immunodeficiencies such as asplenia; and pregnant women. Each groups has specific concerns. As a general rule, live virus vaccines are contraindicated in these individuals – these vaccines include yellow fever, measles/polio/rubella, varicella, BCG and oral typhoid, cholera and polio. Inactivated vaccines are not contraindicated, but individuals with immune suppression may have less than adequate antibody responses. Specific infectious disease risks have been identified, for example visceral leishmaniasis has been recognised as an opportunistic infection in those with HIV infection. Individuals with asplenia are particularly vulnerable to malaria. Malaria is also severe in pregnant women, and they are specifically vulnerable to serious complications should they contract hepatitis E. It is essential that individuals with immunosuppressive conditions seek medical advice well in advance of their overseas travel, ideally with a travel medicine specialist who can accurately advise them on their level of risk and recommend the most appropriate preventive programme for them.

Introduction

The immunosuppressed traveller presents a number of unique concerns when preparing to travel to less developed countries. Certain vaccinations may be contraindicated, whilst others may provide less than adequate protection. Immunosuppressed individuals may be more susceptible to infectious diseases prevalent in the tropics and they may be visiting areas with limited medical care should they require it. However, after careful consideration of an individual's itinerary, many people with immunosuppressive conditions can safely enjoy the excitement and challenge of such travel. Preparation should commence as early as possible and should be thorough.

The first question that must be asked of the immunosuppressed traveller is whether the trip can be made adequately safe with appropriate vaccinations and other preventive measures. Whilst no trip may be made 100% safe (as indeed life itself cannot be 100% safe), a reasonable risk–benefit analysis must be made in conjunction with the individual such that they can make an informed decision as to the level of risk they are prepared to take. Once it has been decided that the trip will go ahead, one must address appropriate vaccinations, and preventive measures for other potential health risks relevant to their destination.

There are three essential questions that must be asked before advising vaccinations to any of these travellers:

- is the vaccine necessary?
- is the vaccine safe?
- will the vaccine work?

For convenience, the immunosuppressed traveller will be considered in four categories:

- immunosuppressed, not HIV infected, travellers;
- HIV infected travellers;
- travellers with conditions causing limited immune deficits, eg. asplenia;
- pregnant travellers.

Each category presents unique issues for consideration.

The immunosuppressed, not HIV infected, traveller

Immunosuppression may result from a number of conditions including congenital immunodeficiency and malignancies, or as a result of medications such as high-dose corticosteroids, alkylating agents or anti-metabolites.[1] Treatments and conditions not considered to cause immune deficiency include:

- short-term (< two weeks), low dose (< 20 mg prednisolone or 1 mg dexamethasone daily) steroids;
- maintenance or replacement steroid treatment at physiological doses;
- inhaled, intra-articular or topical steroids;
- malignancy that is in remission and if the patient has not received chemotherapy for at least three months.

Travellers who are considered to be immunosuppressed must be assessed on an individual basis to decide the degree of immunosuppression before decisions are made regarding vaccine administration and other preventive measures.

VACCINATION

There are no additional risks involved with administering killed or inactivated vaccines to immunocompromised

individuals.[1] In some cases, however, immune response to the vaccines may be suboptimal, and extra doses or more frequent boosters may be required.

In general, live vaccines are contraindicated for immunosuppressed individuals.These include oral polio, oral typhoid capsules, oral cholera, yellow fever, BCG, MMR and varicella.[1] There is a risk that virus replication may be enhanced in immunosuppressed individuals after the administration of attenuated live virus vaccines.[2] Oral polio vaccine given to children with congenital immune deficiency has resulted in severe, progressive neurologic involvement.[1] Oral polio vaccine should also be avoided in household contacts or medical personnel in close contact with immunosuppressed individuals, as the vaccine virus can be excreted in the recipient's stool and urine for four to six weeks after vaccination.

The HIV infected traveller

With the advent of highly-effective anti-retroviral combination therapies, there are increasing numbers of HIV infected individuals who are contemplating travel to less developed countries. Studies on the safety and efficacy of vaccines in HIV+ve individuals are limited. Once again, the questions must be asked on an individual basis – is this vaccine necessary, is it safe and will it be effective?

As a result of quantitative and qualitative defects in the CD4 lymphocytes, and B-lymphocyte dysfunction, vaccinations may be less immunogenic in the HIV infected individual.[3] This reduced antibody response may manifest as lower seroconversion rates, lower antibody levels, an accelerated loss of antibodies or diminished conversion of IgM to IgG.[4] As the degree of diminished response is generally in proportion to the degree of immunosuppression, measurement of CD4 count and the HIV viral load is an essential part of the pre-travel assessment.

In general, individuals with a CD4 count of greater than 200 will develop antibodies. As antibody responses are better in individuals in the early stages of disease and in those with higher CD4 counts, consideration should be given to enquiring of HIV+ve individuals if they have any intention of travelling in the future. If they are planning some overseas travel it seems sensible to recommend vaccination at an earlier stage of their disease, when they are more likely to mount an adequate antibody response.

VACCINATION

Inactivated vaccines appear to be well tolerated, however some studies have shown a small, transient increase in viral load after the administration of influenza, tetanus toxoid and hepatitis B vaccines. No permanent effect on the CD4 count or apparent clinical progression was seen.[3] However, decreased efficacy of vaccines may occur. One small study showed a seroconversion rate of only 77% to hepatitis A vaccine in HIV+ve individuals, as compared to 99% in those uninfected.[5] As expected, those with lower CD4 counts were less likely to seroconvert. Another study showed only a 64% seroconversion rate after hepatitis A vaccination in individuals with a CD4 count of less than 200.[6] Similarly decreased seroconversion rates and antibody levels have been demonstrated for Japanese B encephalitis vaccine[7] and rabies vaccine in HIV infected individuals.

In addition to any recommended inactivated travel vaccines, pneumococcal pneumonia vaccine is recommended for HIV+ve individuals,[3] as is an annual flu vaccination.[8]

Care should be taken before administering any live vaccines. BCG is definitely contraindicated.[1] Tuberculosis is, however, a well known opportunistic infection in HIV+ve patients, so consideration should be given to pre- and post-travel Mantoux testing for high-risk individuals.

Measles vaccination is recommended for HIV infected children and susceptible adults who are not severely immunocompromised (ie. CD4 > 200). Measles remains a risk in many travel destinations. Recent outbreaks have also occurred in many developed countries such as New Zealand, Australia, Ireland and Italy. As vaccination rates drop below critical levels in the UK, public health departments are gearing up for an epidemic. In 1999, nearly 75% of measles cases in the United States occurred either as a direct result of travel, or secondary to an imported case.

Measles is a devastating disease in the HIV infected person, with a 40% case fatality rate reported in the USA.[9] There is, however, a small risk associated with administration of the vaccine, and there has been one death recorded as a result of measles pneumonitis secondary to vaccination.[10] HIV infected adults who already have measles antibodies prior to HIV infection, whether from natural infection or vaccination, maintain good antibody levels even as their immunosuppression progresses.[11]

When considering measles vaccination in an HIV infected individual, one should check the disease activity in the destination, and if there is a risk, check the individual's antibody level before making a recommendation.

Yellow fever vaccination may be required for entry into yellow fever-endemic or -infected countries. A careful analysis of the individual's itinerary should be made in order to assess the absolute need for vaccination. The vaccine is contraindicated in those with symptomatic HIV disease or CD4 counts of less than 200. It is considered safe in those with a CD4 count of greater than 500 and is administered to such individuals if required.

The decision to vaccinate should be a collaborative one between the individual's infectious diseases physician, the travel medicine specialist and the traveller. Individuals should be advised against visiting an area of yellow fever

disease transmission if they are unable to be vaccinated, as the disease has a case fatality rate of 20–40%, with no specific treatment available. Beyond these concerns regarding vaccine efficacy and safety, there are several other issues of particular concern to the HIV infected traveller.

GASTROINTESTINAL INFECTIONS

As a result of decreased CD4 lymphocytes within the intestinal lamina propria, and diminished non-specific defence mechanisms, HIV infected individuals are theoretically more susceptible to gastrointestinal infections. Gastrointestinal infections are the most common of travel-related ailments, with up to 50% of travellers on a two-week trip developing traveller's diarrhoea.[12]

HIV infected individuals are considered more susceptible than most to the following pathogens – *Campylobacter jejuni, Salmonella spp., Shigella spp., Cryptosporidium, Cyclospora, Isospora belli, Cytomegalovirus* and *Microsporidium spp*.[3] In particular, they may have significant trouble clearing *Salmonella* infections, and *Cryptosporidium* is a well recognised opportunistic infection in HIV infection. There are, however, no data to suggest they have any increased risk of contracting *Giardia lamblia, Entamoeba histolytica*, hepatitis A, *Enterotoxigenic E coli* or viral enteropathogens.

RESPIRATORY AND OTHER INFECTIONS

Respiratory infections are the second most common cause of illness in travellers, and HIV infected individuals are more susceptible to invasive disease with *Streptococcus pneumoniae* and *Haemophilus influenzae*.[13] Hence it is recommended that HIV infected travellers receive pneumococcal and influenza vaccines even if they are not travelling. The pre-travel consultation may be a good opportunity to ensure compliance with this recommendation. Of great concern are potentially serious opportunistic infections such as *Mycobacterium tuberculosis* and *Legionella*.

Certain vector-borne diseases are now recognised as opportunistic infections. In particular, visceral leishmaniasis, a sandfly-borne disease endemic in many parts of the world including the Mediterranean, rural India, parts of South America and the Middle East, has been shown to run a complicated and protracted course in HIV infected individuals.[14] Fortunately, other vector-borne diseases such as malaria and dengue fever don't appear to pose any increased risk to this group of travellers.

SKIN PROBLEMS

Various skin disorders, including drug reactions are common in HIV infected individuals. One small study found that 28% of the cohort developed skin complaints, the most common of which were excessive sunburn and excessive reactions to insect bites,[15] compared with around 5% of skin-related health problems in non-HIV travellers.[16] Clearly, it is essential for HIV infected individuals to be adequately insured, to have contact details for the most reliable medical facilities at their destination, and to carry a well stocked medical kit for use to treat common travel-related illness.

The asplenic traveller

Asplenic individuals (functional or anatomic) are a group that show a limited immune deficiency. There are no vaccines that are contraindicated in this group of travellers. The pre-travel consultation is once again an opportunity to ensure that they are current with all recommended vaccines. In addition to the standard vaccinations suggested for their destination, asplenic individuals should be up to date with pneumococcal, Haemophilus influenzae b, meningococcal and influenza vaccines.

Of particular concern for asplenic patients is their dramatically-increased susceptibility to malaria. They should be aware of their risk, take the best possible anti-malarial medication available and be meticulous with personal protective measures, such as insect repellent, mosquito nets and appropriate clothing. One should consider prophylactic antibiotics for the duration of travel.[17]

The pregnant traveller

Pregnancy is a state of relative immunosuppression, with cell-mediated immunity in particular being decreased. The pregnant traveller faces a number of risks that may be classified as:

- risks associated with pregnancy itself, eg. miscarriage, thrombosis;
- risks associated with the act of travel, eg. motor vehicle accident, travellers thrombosis, etc.;
- risks associated with a particular destination, eg. infectious diseases, high altitude, etc.[18]

The second trimester is considered the safest time for pregnant women to travel, when the woman usually feels at her best and is at least risk of miscarriage or premature labour. There are a number of relative contraindications to travel in pregnancy (see Table 1) and it is incumbent upon the advising doctor to ensure that women in these categories fully understand the potential risks they are taking, not only for themselves but also for the health of their fetus. It is advisable to take an ultrasound prior to travel to ensure there is a viable intrauterine pregnancy and to establish the expected date of delivery.

In terms of general care, the pregnant traveller should ensure she has adequate travel insurance, and be aware of medical clinics at her destination at which she can continue to receive antenatal care, and emergency facilities should they be required. She may suffer from any of the typical problems of pregnancy and should be prepared to manage these. She should be made aware of symptoms that require immediate medical attention, such as per vaginal bleeding

TABLE 1
RELATIVE CONTRAINDICATIONS TO INTERNATIONAL TRAVEL DURING PREGNANCY
(adapted from Lee[26])

Obstetric risk factors
- history of miscarriage
- incompetent cervix
- history of ectopic pregnancy
- history of premature labour or premature rupture of membranes
- history of or existing placental abnormalities
- threatened abortion or per vaginal bleeding (current pregnancy)
- multiple gestation
- history of toxaemia, hypertension or diabetes in pregnancy
- primagravida over 35 or under 15
- assisted reproduction

General medical risk factors
- history of thromboembolic disease
- severe anaemia
- chronic medical condition requiring ongoing interventions
- congenital or acquired heart disease

Potentially hazardous destinations
- chloroquine-resistant malaria endemic
- yellow fever endemic areas
- areas with outbreaks of any life-threatening food-, water- or vector-borne disease

or abdominal pain. Motor vehicle accidents are a significant cause of morbidity in travellers, and pregnant women are particularly susceptible.

VACCINATION

In terms of vaccinations, live virus vaccines should be avoided in pregnant women. Advise women against getting pregnant for three months after administration of these vaccines. Theoretically, there is a risk that live virus vaccines could cross the placenta and cause infection in the fetus. However, retrospective studies on women inadvertently vaccinated with live rubella or polio vaccines during pregnancy have failed to show any evidence of increased risk of foetal malformations.[19] Therefore, inadvertent vaccination of a pregnant woman with a live vaccine should not be regarded as a reason to consider a termination.[20]

In regards to inactivated vaccines, each should be considered on an individual basis after examining the exact itinerary and style of travel that the woman will be undertaking. Whilst there are no theoretical risks associated with administration of inactivated vaccines during pregnancy, there is a lack of data to unequivocally guarantee their safety. Table 2 lists current recommendations regarding vaccinations in pregnancy.

Malaria is a serious disease in pregnant women and can result in significant maternal and fetal morbidity and mortality. Clinical disease with severe complications including cerebral malaria, massive haemolysis, and acute renal failure is more common in pregnancy.[21] Spontaneous abortions, stillbirths, pre-term deliveries, low-birth-weight infants and congenital infections are also a risk.

Chloroquine is considered safe in pregnancy, however there are few areas of the world in which chloroquine is still an effective anti-malarial (parts of the Middle East and Central America only). Proguanil (Paludrine) is also considered safe and may be taken in combination with chloroquine to offer increased protection. However, there are few areas of the world where this combination is considered to offer adequate protection. Additionally, proguanil is an anti-folate, so folate supplements must be taken in conjunction with it. Mefloquine (Lariam) is now considered safe in the second and third trimesters, but there is conflicting opinion on its safety during the first trimester.[22] General opinion still holds that mefloquine should be avoided in the first trimester unless the circumstances are exceptional. Doxycycline is definitely contraindicated and there is not yet enough evidence to support the safety of Malarone, hence

TABLE 2
CURRENT RECOMMENDATIONS FOR VACCINES IN PREGNANCY[25]

Vaccine	Type of vaccine	Use
BCG	Live	No
Cholera oral	Live*	No
Hepatitis A	Inactivated virus	If indicated
Hepatitis B	Recombinant	If indicated
Influenza	Inactivated virus	If indicated
Japanese B	Inactivated virus	Seek advice
MMR	Live	No
Meningitis	Polysaccharide	If indicated
Pneumococcal	Polysaccharide	If indicated
Polio, inactivated	Inactivated virus	If indicated
Polio, Sabin	Live	No
Rabies	Inactivated virus	If indicated
Tetanus/diphtheria	Toxoid	If indicated
Typhoid Vi antigen	Polysaccharide	If indicated
Typhoid capsules	Live	No
Varicella	Live	No
Yellow Fever	Live	No

*In Australia, Orochol is used and this is a live vaccine. In New Zealand, Dukoral is used and this is *not* live, however it is rarely indicated.

it cannot be recommended.[23]

The World Health Organisation advises pregnant women to avoid travel to areas with chloroquine-resistant malaria.[24] If she must travel, she should be fully aware of the risk she is taking and must ensure that she takes extra precautions to avoid being bitten by mosquitoes. This will also help to avoid other vector-borne diseases such as dengue fever.

TRAVELLER'S DIARRHOEA

Traveller's diarrhoea is the most common health problem afflicting travellers and presents particular problems in pregnancy. Dehydration as a result of diarrhoea could lead to inadequate placental blood flow, so pregnant women should be extra vigilant about their food and water intake. If they develop diarrhoea, they should ensure they remain adequately hydrated, and seek medical attention early in the illness if they are vomiting. Drugs routinely used in the treatment of diarrhoea such as loperamide and the fluoroquinolone antibiotics (eg Norfloxacin and Ciprofloxacin) are not recommended during pregnancy. If necessary, Azithromycin is considered relatively safe and is an effective antibiotic for many of the bacterial causes of diarrhoea (particularly Campylobacter).[25]

OTHER CONSIDERATIONS

Hepatitis E is a food- and water-borne virus that can have devastating consequences if contracted during pregnancy. It is a rare disease in travellers, however maternal and fetal mortality rates of up to 33% have been reported in women living in endemic countries during the third trimester.

Most commercial airlines will allow travel up to the 32nd week of pregnancy only, so travel plans should allow for this. There is no risk of fetal hypoxia in commercial flights. Pregnant women should wear compression stockings, drink plenty of non-alcoholic drinks and move their legs frequently on long-haul flights to decrease the risk of thrombosis. Finally, an individually-prepared medical kit with medications that are considered safe in pregnancy is strongly recommended to manage minor health problems.

References

1 Centers for Disease Control and Prevention. Recommendations of the Advisory Committee on Immunization Practices (ACIP): use of vaccines and immune globulins for persons with altered immunocompetence. *MMWR* 1993; 42; 1-18

2 Mitus A, Holloway A, Evans AE, Enders JF. Attenuated measles vaccine in children with acute leukemia. *Am J Dis Child* 1962; 103: 243-248

3 Van Gompel A, Kozarsky P, Coleblunders R. Adult travelers with HIV infection. *J Travel Med* 1997; 4: 136-143

4 Wilson ME, von Reyn CF, Fineberg HV. Infections in HIV-infected travelers: risks and prevention. *Ann Intern Med* 1991; 114: 582-592

5 Hess G, Clemens R, Bienzle U et al. Immunogenicity and safety of an inactivated Hepatitis A vaccine in anti-HIV positive and negative homosexual men. *J Med Virol* 1995; 46: 40-42

6 Neilsen G, Bodsworth NJ, Watt N. Response to hepatitis A vaccination in human immunodeficiency virus-infected and -uninfected homosexual men. *J Infect Dis* 1997; 176: 1064-1067

7 Rojanasuphot S, Shaffer N, Chotpitayasunondh T et al. Response to JE vaccine among HIV-infected children, Bangkok, Thailand. *Southeast Asian J Trop Med Public Health* 1998; 29: 443-450

8 Centers for Disease Control and Prevention. Prevention and control of influenza. Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR* 1995; 44: 1-22

9 Karp CL, Neva FA. Tropical infectious diseases in human immunodeficiency virus-infected patients. *Clin Inf Dis* 1999; 28: 947-963

10 Angel JB, Walpita P, Lerch R et al. Vaccine-associated measles pneumonitis in an adult with AIDS. *Ann Intern Med* 1998; 129: 104-106

11 Zolopa AR, Kemper CA, Shiboski S et al. Progressive immunodeficiency due to infection with human immunodeficiency virus does not lead to waning immunity to measles in a cohort of homosexual men. *Clin Inf Dis* 1994; 18: 636-638

12 Steffen R, Rickenbach M, Wilhelm U et al. Health problems after travel to developing countries. *J Infect Dis* 1987; 156: 84-91

13 Wallace JM, Rao AV, Glassroth J et al. Respiratory illness in persons with human immunodeficiency virus infection. *Am Rev Respir Dis* 1993; 148: 1523-1529

14 Dereure J, Reynes J, Pratlong F et al. Visceral leishmaniasis in HIV-infected patients in the south of France. *Bull World Health Organ* 1995; 73: 245-246

15 Simons FM, Cobelens FG, Danner SA. Common health problems in HIV-infected travelers to the (sub)tropics. *J Travel Med* 1999; 6: 71-75

16 Hill DR. Health problems in a large cohort of Americans traveling to developing countries. *J Travel Med* 2000; 7: 259-266

17 Working Party of the British Committee for Standards in Haematology Clinical Haematology Task Force. Guidelines for the prevention and treatment of infection in patients with an absent or dysfunctional spleen. *Br Med J* 1996; 312: 430-434

18 Batchelor T. A pregnant traveller. *Aust Fam Phys* 2002; 31: 461-463

19 Harjulehto-Mervaala T, Aro T, Hiilesmaa VK et al. Oral polio vaccination during pregnancy: lack of impact on fetal development and perinatal outcome. *Clin Inf Dis* 1994; 18: 414-420

20 Munoz FM, Englund JA. Vaccines in pregnancy. *Infect Dis Clin NA* 2001; 15: 253-272

21 Kozarsky P, Van Gompel A. Pregnancy, nursing, contraception and travel. In: DuPont, Steffen eds.

Textbook of travel medicine and health. Hamilton, Ontario: B C Decker, 1997: 316
22 Phillips-Howard PA, Steffen R, Kerr L et al. Safety of mefloquine and other antimalarial agents in the first trimester of pregnancy. *J Travel Med* 1998; 5: 121-126
23 Schlagenhauf P. *Travellers malaria*. Hamilton, Ontario: B C Decker, 2001: 306.
24 World Health Organization. *International Travel and Health 2002*. Geneva, Switzerland: World Health Organization, 2002: 138
25 Kuschner RA, Trofa AF, Thomas RJ et al. Use of azithromycin for the treatment of Campylobacter enteritis in travelers to Thailand, an area where ciprofloxacin resistance is prevalent. *Clin Infect Dis* 1995; 21: 536-541
26 Lee RV. The pregnant traveller. *Travel Med Int* 1989; 7: 51-58

Dr Trish Batchelor, MB,BS, FRACGP, MPH (Trop Med), is the Medical Adviser to The Travel Doctor TMVC, New Zealand. Trish was the principal guest speaker at the SPUMS ASM, Port Vila, Vanuatu, May, 2002.
Currently she is working as a medical officer at the CIWEC Travel Medicine Centre, PO Box 12895, Durbar Marg, Kathmandu, Nepal
E-mail: <trishb@mos.com.np>

Resources for travel medicine

Trish Batchelor

Key words
Travel medicine, World Wide Web, medical society, textbook, medical journal

Abstract
Travel medicine is becoming recognised as a sub-specialty of both General Practice and Infectious Diseases. There are a number of related resources for those who are interested in developing their interest in the area. Societies such as the International Society of Travel Medicine, the Wilderness Medicine Society and the International Society of Mountain Medicine all maintain peer-reviewed Medline-indexed journals for their members and run international conferences. Information is presented on useful textbooks and web sites.

Introduction

Travel medicine is becoming recognised as a sub-specialty of both General Practice and Infectious Diseases. There are a number of useful textbooks, courses and societies available for those with an interest in travel medicine. Additionally, the World Wide Web provides many useful sites of reference. There are also a number of computer software programs that provide accurate and up-to-date country-by-country travel health information.

Societies and journals

The International Society of Travel Medicine (www.istm.org) is the largest society dedicated to travel medicine and has 1,200 members from 53 countries. Every two years it holds a world congress – the next will take place in New York in May 2003. *Journal of Travel Medicine* is part of ISTM membership.

The Wilderness Medical Society (www.wms.org) is an American-dominated society that focuses on all aspects of wilderness medicine, in particular high altitude medicine, diving medicine and wilderness toxicology. It runs a number of well organised courses and conferences throughout the year in the United States. *Wilderness and Environmental Medicine* is part of WEM membership.

The International Society of Mountain Medicine (www.ismmed.org) is dedicated to high altitude medicine. The membership is a mixed group of American, European and South American physicians. An international symposium is held every two years, the next being held in Tibet in 2004. *High Altitude Medicine and Biology* is part of ISMM membership.

The Australasian College of Tropical Medicine (www.tropmed.org) has a Faculty of Travel Medicine. Information can be found on their website.

Clinical Infectious Diseases often features relevant articles.

Textbooks

There are a number of useful textbooks dedicated to travel medicine. Useful information can also be gathered from various infectious diseases and parasitology texts.

The most useful texts are as follows:

Manual of Travel Medicine. Tilman Ruff and Alan Yung. Published by the Victorian Infectious Diseases Service at the Royal Melbourne Hospital, 1999 . This text is written by two well known infectious diseases physicians from Melbourne who have a special interest in travel medicine. It is logical and practical and represents the best text in the Australian context.

The Textbook of Travel Medicine and Health. Edited by Robert Steffen and Du Pont. Published by BC Decker,

2nd edition 2000. This is the original text on travel medicine, recently revised. For those with more than a passing interest it is definitely recommended.

International Travel and Health. Published by the World Health Organisation, 2002. This book is essential if you are administering yellow fever vaccination. It gives country-by-country information on yellow fever and malaria, and provides some basic general travel medicine advice.

Health Information for International Travel. Published by the American Centers for Disease Control, 2002. This book has good sections on each vaccine and a number of travel-related issues such as the pregnant traveller. It is, however, American so some recommendations differ to those in Australasia.

National Health and Medical Research Council Australian Immunisation Procedures Handbook. 7th edition. 2000. Published by NHMRC. This book gives good general information about all vaccines licensed in Australia, but is not specifically a travel health book and so gives no country-specific information.

Wilderness Medicine. Edited by Paul Auerbach. Published by Mosby, 2001. St Louis, Missouri. This huge text is the definitive work on wilderness medicine and is great reading.

Web sites and web based journals

www.who.int/ith/ – the World Health Organization book, *International Travel and Health* can be downloaded from this site.

www.who.int/wer/ – the *WHO Weekly Epidemiological Report*. This gives useful information on disease outbreaks, influenza activity and so forth.

www.whosea.org – the WHO South East Asia Regional Office. This site has excellent information on malaria in SE Asia.

www.cdc.gov – front page for the US Centers for Disease Control (CDC). The travellers' health section is very useful.

www.cdc.gov/travel/blusheet.thm – this section of the CDC site is essential if you are a yellow fever vaccinator. It provides information on the regions currently infected with yellow fever.

www.cdc.gov/travel/ybint.htm – from here you can download the CDC book *Health Iinformation for International Travel*.

www.cdc.gov/mmwr – *Morbidity and Mortality Report* from the CDC. It has numerous relevant articles.

www.cdc.gov/ncidod/eid – *Emerging Infectious Diseases*. This journal is dedicated to emerging infectious diseases and often has interesting articles.

www.dpd.cdc.gov/dpdx/Default.htm – an excellent parasitology site.

www.healthgov.au/puhlth/cdi/cdicur.htm – Australian Public Health Department surveillance data. It has a section on travel health.

www.eurosurveillance.org/eurosurv/index.htm – European disease surveillance information.

www.jcu.edu.au/school/phtm/PHTM/putravle.htm#comprehensive – and excellent site for links on travel health.

www.dfat.gov.au – for security advice from the Australian Department of Foreign Affairs.

www.istm.org – International Society of Travel Medicine.

www.ismmed.org – International Society of Mountain Medicine.

www.wms.org – Wilderness Medicine Society.

www.ciwec-clinic.com – an excellent site for information on Nepal, altitude and diarrhoea (and my contact).

www.traveldoctor.com.au – Australia and New Zealand's largest group of travel medicine clinics – this site has updates, vaccine information, etc.

www.tourismconcern.org.uk – various issues related to the impact of tourism on host countries.

www.ippg.net – the International Porter Protection Group. A non profit organisation working to raise the awareness of trekkers and mountain climbers to the issue of porter welfare in the high altitude tourism industry.

Commercially available computer programs

Walkabout MD – specifically designed for Australia. More information available at www.traveldoctor.com.au

Travax Encompass – an American program. This has a very good update system, with comments on recent articles of interest from experts in the field. Contact www.shoreland.com

Exodus – an Irish program. There are two options, information only, or a practice management option. More information available at www.exodus.ie

Gideon – a program that provides country-by-country epidemiological data on infectious diseases as well as a diagnostic algorithm for infectious diseases. More information can be found at www.cyinfo.com

Programs such as Medical Director contain some very basic travel medicine information. However, they are inadequate for anyone who has more than a passing interest, and contain some significant inaccuracies.

Dr Trish Batchelor, MB,BS, FRACGP, MPH (Trop Med), is the Medical Adviser to The Travel Doctor TMVC, New Zealand. Trish was the principal guest speaker at the SPUMS ASM, Port Vila, Vanuatu, May, 2002.

Currently she is working as a medical officer at the CIWEC Travel Medicine Centre, PO Box 12895,
Durbar Marg, Kathmandu, Nepal
E-mail: <trishb@mos.com.np>

The world as it is

A footbridge too far: not quite belly up in the stream

David Muirhead

Key words
Envenomation, first aid, injuries, toxins, pain, marine animals, snorkelling

I always prefer a melodramatic title and this personal account of an Estuary Catfish envenomation surely deserves one. Okay, it was really a minor incident, one experienced often by fishermen, waders and boaties all around our coasts (though few would set themselves up for punishment as foolishly as I did!) but in my usual self-serving way I will henceforth overlook this inconvenient truth and dwell on my pain and suffering to hopefully emerge (are you yet convinced?) the gracious loser in a mighty battle between fish and man.

Enough, enough! It is Easter Monday (24/4/00), late afternoon, incoming tide with clear seawater flooding into the Onkaparinga Estuary at Southport Beach, Noarlunga, South Australia. After a quick swim in the sea, the Southern Sea Garfish (*Hyporhamphus melanochir*), Black Bream (*Acanthopagrus butcheri*), and Tommy Roughs (*Arrlpis georgiana*) milling around the fishers' baits under the footbridge several hundred metres inland look good in the clean water so I decide to grab my snorkelling gear and have a lazy drift snorkel to finish a relaxing day.

Right at the mouth there is a two metre deep gutter in against the low cliff with plenty of the above fish active from surface to seafloor. As I skim over shallow clear sand carried along by the 2 knot current, I pass healthy schools of big Yellow-eye Mullet (*Aldrichetta forsteri*) with occasional smallish Tommy Roughs. Further in, the bottom has low patches of rock and some areas of filamentous green algal turf and here a tightly packed school of at least 100 Striped Perch (*Pelates octolineatus*), better known to fishers as Trumpeter, moves past me swimming strongly towards the sea.

There is the odd adult Silver Whiting (*Sillago bassensis*) moving around on the bottom in twos and threes and even one pair of juvenile King George Whiting (*Sillaginodes punttara*), about 15 cm long, near the footbridge. A few juvenile Zebrafish (*Girella zebra*) shelter among the slightly larger rocks in the main channel, and I see an unusual long thin fish, about 25 cm long which I have never seen before, moving quickly past me into the current, right on the bottom. I later identify it as a Beaked Salmon (*Gonorynchus greyi*), not a species we hear a lot about, but quite distinctive in profile. It is also known as Sandfish, Sand Eel and Sharkwhiting.

I congratulate myself on my decision to embark on this snorkel, as I am really enjoying myself and wondering what I might see if I drift further up the estuary past the footbridge. So far the only hazards have been fishing lines and by staying midstream and scanning the banks ahead on either side to spot the fishermen I had easily avoided their hooks. But then I came upon a large Estuary Catfish (*Cnidoglanis macrocephalus*) resting on the sandy bottom in the middle of the channel in waist-deep water, its broad head facing into the tide. They grow to over 60 cm and this one was about 50 cm.

I became curious when it showed no inclination to flee but I soon saw why, it had a hook in its mouth and was dragging a heavy sinker on a 20 cm trace, hard work for a fish this size. I had no way of telling how long it had carried this burden, but I knew that its survival prospects were poor. I also knew that this species is good eating, but has venomous spines and must be handled with respect when caught.

Thinking I had the advantage over this unfortunate fish I decided to kill two birds with one stone, save it from a probably slow death by starvation, and catch myself a tasty dinner. I reasoned that I could grab the sinker and quickly stand up, suspending the fish out of the water at arm's length where it would dangle harmlessly on the trace. It would then be easy to carry it to the bank, or if it was too animated I could fling it there, and then dispatch it humanely with a rock. But too late I was reminded that our best-laid plans often go astray.

As soon as I grabbed the sinker with my left hand the catfish swam right at me and skilfully managed to jab me in the right forearm with one of its pectoral fin spines. I was partially protected by a 3 mm neoprene surf suit, and I would probably otherwise not have tried this stunt, but I felt almost immediate burning, aching pain of moderate intensity throughout the whole arm diffusely up to my shoulder, and promptly let go the sinker.

After sizing up the situation for half a minute and realising with relief that I had no discernible systemic symptoms such as weakness, light headedness, palpitations, breathlessness, tongue swelling or chest tightness, I began to feel quite hostile towards this clever if desperate creature, and I moved towards it again as it resumed its position on the sand. But it too was in a foul mood and albeit instinctively it then surprised me by repeatedly swimming upward towards me making passes in which it was clearly trying to repeat its first and only successful defensive strike (perhaps the fisherman responsible for this fish's predicament had cut the line after receiving similar treatment!)

At first I thought I was becoming paranoid but each time I moved towards it, it repeated the same threatening action. Although the pain was not getting worse I now decided, slow learner that I am, to make discretion the better part of valour and left the water, sans captive catfish, with seemingly no one on the banks or footbridge any the wiser concerning my ignominious retreat.

I ruefully walked back to our friends' nearby holiday accommodation overlooking the river mouth, and after getting out of my wetsuit in a hot shower I obtained virtually immediate pain relief by immersing my arm in a bucket of very hot water, as is the well-documented first aid for most mild to moderate fish spine or barb envenomations, including stingray barbs.

Within seconds of removing my arm from the bucket the pain would return at the same intensity and there was an increasingly unpleasant additional component involving a burning sensation exacerbated by touching or rubbing the forearm. So I spent two hours sitting in front of the TV thanking various attendants (initially fascinated, but later bored!) for their boiled-kettle deliveries and occasional bucket-decanting manoeuvres so necessary to top up the bucket and maintain adequate water temperature.

There was a seemingly trivial puncture wound in the back of my forearm, but the skin of the forearm had a generalised mottling which lasted about 24 hours, localised mild swelling to a diameter of about 8 cm, and diffused but very mild forearm swelling lasting about 48 hours. I was slightly feverish and "weak and wobbly" on the Tuesday (Anzac Day) but by Wednesday, when I returned to work I felt well apart from minor tiredness which however was not easily explained by my modest activity levels over Easter. This had resolved in another day or so.

Minor local swelling (2 mm elevation, diameter 2 cm) has persisted till today (15/5/2000), ie some three weeks, but apart from very slight tenderness directly over the puncture site there has been no real pain since day one, only a mild ache which did not limit use of the arm or hand at all.

However the tiny (1–2 mm diameter) puncture wound, which bled only weakly during the first few hours and only ever looked mildly inflamed, took about a week to develop a dry scab and was very itchy from about day 7 to day 14. It is now only occasionally itchy but retains a tiny, slightly depressed scab and so has not yet completely healed.

Despite this event I can recommend this snorkel site as being refreshingly different (and although I didn't know it then, Phillip Hall and other Marine Life Society of South Australia members have also snorkelled here) and I hope to repeat it next summer or autumn, possibly with a camera.

This article is reprinted with kind permission from *Marine Life Society of South Australia* 2000;11:31.

Applying pain theory in fish spine envenomation

David Muirhead

Key words
Envenomation, first aid, injuries, toxins, pain, marine animals

Abstract
Personal experience of catfish spine envenomation leads the author to question the long-accepted heat-labile toxin denaturation hypothesis as explanation for the established and very effective first aid treatment using hot water immersion of the envenomed limb. An alternative hypothesis compatible with contemporary pain theory is proposed.

Pain hypotheses in current usage, including Gate Control theory and Diffuse Noxious Inhibitory Control (DNIC) theory, have evolved substantially from observations that interference stimuli such as vibration, heat or cold, applied to the peripheral skin can induce pain relief at remote anatomical sites.

Have we overlooked the obvious in continuing to accept the hypothesis, entrenched in the diving medical community,[1,2,3] that heat-labile properties of fish spine toxins explain the well-documented analgesic effectiveness of hot water limb immersion in fish spine envenomation? A literature search has revealed a remarkable paucity of papers addressing this issue. Those that do, appear to assume that the proven heat lability of the few fish toxins so far analysed is the actual mechanism.

In April 2000, the author received a minor envenomation by an Estuary Catfish, *Cnidoglanis macrocephalus*, while snorkelling in an estuary south of Adelaide as described above.

As a South Australian coastal general practitioner, with occasional experience of treating mostly minor marine fish-spine injuries, I am familiar with the core first aid management using hot water (approx 46ºC) immersion of the affected limb. I expected excellent pain relief as I placed my envenomed right forearm into a bucket of hot water,

after first testing the water with my contralateral hand to avoid burns.

My confidence was vindicated, with almost instantaneous pain relief. But I was puzzled as to why, if the hot water was indeed inactivating the toxin, the pain would recur so promptly and at the same intensity upon removal of my arm from the hot water. I initially reasoned that until all the venom had been denatured, pain would continue, but this begged the question: why the dramatic pain relief within seconds of immersion in the first place? Perhaps the toxin is reversibly inactivated by heat? It might be capable of reconstitution with falling temperature, at least until persistent exposure to heat effects a more permanent decomposition, for example by allowing irreversible binding of component molecules to tissue substrate.

This explanation fails to address the fact that whilst both my puncture wound and those of patients I'd treated by hot water immersion were small in external appearance, there could be little doubt that the sting had penetrated to a depth of at least some millimetres into the soft tissues. Diving medical texts recommend that water used for pain relief be in the 45–50ºC range, yet human tissues other than perhaps the dermis, necrose before reaching these temperatures.

It seems improbable that exposure of the cutaneous portion of a puncture wound to such temperature would be capable of raising more deeply embedded subcutaneous or intramuscular residuae to temperatures sufficient to inactivate toxin without also causing significant tissue necrosis to the full depth of the puncture wound. This would in itself be very painful and thus defeat the objective. Further, all the fish spine wounds I've successfully treated by this method have been accompanied by sufficient localised oedema and serosanguinous ooze to make it unlikely in the first place that hot water could traverse the length of the puncture track, again discrediting this theory.

If one reviews current pain theory,[4,5] support for the role of Gate Control and DNIC pain theories in fish spine envenomation may be found in the extensive range of fish species whose spine envenomations are known to respond to hot water immersion. This is specifically with regard to local pain relief as opposed to any systemic sequelae of envenomation. It even appears probable that envenomations from creatures in other phyla such as Cnidaria [6] will respond to thermal treatment, and application of icepacks is already an accepted first aid analgesic measure for jellyfish stings.

Examples do exist in the marine environment of identical or nearly identical toxins being utilized defensively by phylogenetically disparate organisms, notably tetrodotoxin in puffer fishes (vertebrates) and blue-ring octopi (invertebrates). However, it seems improbable that hundreds, even thousands of marine animal species share toxins so similar that they are all inactivated by such a conveniently small elevation in temperature.

A comprehensive worldwide literature search via Medline dating back to 1966, has failed to find a single study whose specific aim was to demonstrate heat-labile properties of non-scorpaeniform fish spine venoms. A limited number of papers were found purporting to delineate haemolytic, dermonecrotic, oedema-promoting, vasospastic, and lethal components of catfish venom and skin toxins.[7]

These include studies of the oriental catfish (Plotosus lineatus),[8] North American species,[9,10] and the comparative toxicity of two catfish genera Ictalurus and Schilbeodes.[11] None of the above studies addressed heat-lability.

As long ago as 1966, Pacy in his review of Australian catfish injuries proposed, largely on the basis of a single case report involving a long-tailed catfish (Family Plotosidae, genus Plotosus), that the venom had vasospastic properties as well as possibly transient neurotoxic effects.[12]

Pacy stated:

> "Fish venoms tend to become rapidly inactive by change of pH (Wiener, 1960) and therefore instantaneous irrigation of the wound channel with sodium bicarbonate solution…is likely to destroy much of the poison."

and:

> "As stingray venom is destroyed by temperatures above 60ºC the possibility of this applying to catfish venom cannot readily be excluded. However, it is the great symptomatic relief that indicates hot bathing."

Pacy refers to earlier work specifically on stingray venom, and the quoted minimum temperature of 60ºC needed to destroy venom would seem to negate the relevance of heat-lability as the major reason for the effectiveness of hot water immersion in stingray envenomation.[13,14]

However, Pacy's case report does contain the following statement:

> "The patient repeatedly tried to take her hand out of the hot water, in order to get some sleep, but immediately the hand was withdrawn, the pain returned within a few seconds, disappearing only after renewed immersion."

This account perfectly matches my own experience, and is supported by a prospective observational case series of 22 fish stings, at least eight of which were from catfish, where hot water immersion treatment was completely effective in 73% of cases.[15]

The Estuary Catfish (*Cnidoglanis macrocephalus*) is the only marine member of the Plotosidae family known to occur in southern Australia, but most northern Australian catfish-spine injuries are also due to this family.[16]

The 'Poisindex Managements'[17] first aid treatment guidelines for catfish state:

> "HOT WATER – The injured part should then be submerged in hot water at as high a temperature as the patient can tolerate without injury (less than 113 degrees F or 45 degrees C), for 30 to 90 minutes or more."

However, none of the three references provided contain proof of heat-lability of catfish venom. Indeed, Sutherland and Tibballs[18] in their chapter titled *Venomous fish other than stonefish*, state:

> "Little is known about the nature of the venoms, which are associated with the spines of the many stinging fish found in Australian waters...Most of these fish venoms are presumably unstable in heat, and the aim of such treatment is to inactivate the venom present superficially and under the skin."

The text *Venomous and Poisonous Marine Animals, a Medical and Biological Handbook*,[16] while covering in considerable detail many aspects of catfish envenomation, contains only one direct comment on the possible heat-labile nature of fish venoms:

> "Fish venoms are predominantly unstable large proteins (Halstead 1988). As such molecules are dissociated with changes in pH and temperature, hot-water immersion might cause denaturation of the venom in the tissues. However, the return of pain on extraction of the part from hot water casts some doubt on this rationale. The analgesic efficacy of hot-water immersion for venomous fish injuries cannot be disputed and should always be adopted by first-aiders as a first measure for pain relief in venomous fish stings."

In summary, certain facts emerge concerning catfish envenomation. Most (probably all) catfish of the Plotosidae family contain venom apparatus and are a common cause worldwide of fish spine envenomations in humans. No scientific study has ever demonstrated heat-lability of catfish venom (to the best of my knowledge).

Might not the Gate Control and DNIC theories of pain explain the underlying mechanism for fish spine envenomation analgesia by hot water immersion?

Kakigi and Watanabe have shown that interference stimulations using vibration, active and passive movements of the hand or foot, noxious warming by hot water (46ºC) and noxious cooling by ice water (0ºC) all caused significant reduction in pain perception in normal human volunteers who were experiencing painful stimulation of either ipsilateral or contralateral hand or foot via CO_2 laser.[5] Specifically, they noted markedly reduced pain amplitude using noxious warming and cooling stimulation applied to the peripheral skin close to and remote from the site where laser stimulation was applied.

They deduced that, since the hot and cold stimuli mainly ascend through the small fibres, this pain relief could be better accounted for by DNIC theory than Gate Control theory, and they refer to clinical studies indicating that the site responsible for DNIC is the brainstem. Whilst an account of DNIC theory is beyond the scope of this paper, its application in the above study is clearly relevant to the phenomenon of hot water analgesia in fish spine envenomation, particularly as the study used water at 46ºC as the noxious stimulus. Further, standardised pain scores three to six minutes after taking the hand from the hot water (after-effect) did not show any significant change from the control session, consistent with my personal experience of rapid return of pain following arm removal from hot water.

Two questions are posed. Has hot water immersion been trialled for above-water envenomations, such as arachnids, hymenoptera and arthropods? Some of these toxins are heat-stable so a demonstrable efficacy would challenge the role of heat-lability as already discussed. Interestingly, although application of hot packs to jellyfish stings has been found to have only mild analgesic effect, immersion of the affected part in hot water has been found to be very effective.[6]

Secondly, would hot-water immersion of the contralateral limb also be effective in marine fish spine envenomations, or even an upper limb immersion where the lower limb is envenomed, or vice versa?

In conclusion, an extensive literature search has failed to find evidence supporting the denaturation theory. Further research is needed to investigate the mechanism(s) underlying pain relief by hot water immersion of the affected limb following fish spine envenomation. The author hypothesises that modern pain theory provides a better explanation than heat denaturation of toxins.

Acknowledgements

I thank Ms Eva McLusky without whose insight this article would not have been written, and Ms Sandra Mangion, formerly Clinical Pharmacist of DATIS (Drugs & Therapeutic Information Service, Repatriation General Hospital, Daw Park, S.A.), for help with the literature search.

References

1 Hawdon GM, Winkel KD. Venomous marine creatures. *Aust Fam Physician* 1997; 26: 1369-1374
2 Judd M, White J. A South Australian handbook on bites and stings: the animals, the injuries, first aid. *Women's and Children's Hospital*, *The South Australian Museum, The Advertiser* 1994 (revised 2000). Adelaide: 41-42
3 Fulde G. Emergency medicine quiz. *Current Therapeutics* 2001; 57: 96.
4 Power I. How to treat: Management of acute pain – Pt 1 *'Australian Doctor Pull-out Section' Australian Doctor* 9 March 2001: III
5 Kakigi R, Watanabe S. Pain relief by various kinds of

interference stimulation applied to the peripheral skin in humans: pain-related brain potentials following CO_2 laser stimulations. *J Peripher Nerv Syst* 1996; 1: 189-198
6 Taylor G. Are some jellyfish toxins heat labile? *SPUMS J* 2000; 30: 74-75
7 Mann JW 3rd, Werntz JR. Catfish stings to the hand. *J Hand Surg [Am]* 1991; 16: 318-321
8 Shiomi K, Takamiya M, Yamanaka H, et al. Hemolytic, lethal and edema-forming activities of the skin secretion from the oriental catfish (Plotosus lineatus). *Toxicon* 1986; 24: 1015-1018
9 Scoggin CH. Catfish stings. *JAMA* 1975; 231: 176-177
10 Burnett JW, Calton GJ, Morgan RJ. Catfish poisoning. *Cutis* 1985; 35: 208
11 Birkhead WS. The comparative toxicity of stings of the ictalurid catfish genera Ictalurus and Schilbeodes. *Comp Biochem Physiol* 1967; 22: 101-111
12 Pacy H. Australian catfish injuries with report of a typical case. *Med J Aust* 1966; 2: 63-65
13 Russel FE, Fairchild DM, Michaelson J. Some properties of the venom of the stingray. *Med Arts Sci* 1958; 12: 78 (Quoted in Pacy)
14 Halstead BW. *Dangerous marine animals*. Cambridge, Maryland: Cornell Maritime Press: 1959. (Quoted in Pacy)
15 Isbister GK. Venomous fish stings in tropical northern Australia. *Am J Emerg Med* 2001; 19: 561-565
16 Williamson JA, Fenner PJ, Burnett JW, Rifkin JF. *Venomous and poisonous marine animals: a medical and biological handbook*. Sydney: University Of New South Wales Press; 1966.
17 Klasco RK (Ed): POISINDEX™ System. MICROMEDEX, Greenwood Village, Colorado (Healthcare Series Vol 110 expires 12/2001).
18 Sutherland SK, Tibballs J. *Australian animal toxins*. 2nd ed. Melbourne: Oxford University Press; 2001.

David Spencer Muirhead, MB BS, Dip RACOG FRACGP is a General Practitioner in full-time practice at Rose Street Clinic, 1 Rose St. Glenelg SA 5045.
Phone: *+61-08-8295-2167*
Fax: *+61-08-8376-0906*
E-Mail: *<dmuirhea@bigpond.net.au>*

On being a patient in a hyperbaric chamber

John Knight

Keywords
General interest, hyperbaric oxygen, osteoarthritis, hip arthroplasty, medical conditions

I remember as a medical student hearing a consultant say soon after the patient, a nurse, was asleep, "We will have to take extra care. Unexpected things go wrong with nurses and doctors, especially if they have red hair." As far as I know there are no statistics to confirm or deny this edict.

Just before I turned 65, I had my osteoarthritic left hip replaced. Some of my acquaintances suggested, tongue in cheek, that I should make a claim against the Royal Australian Navy on the grounds that dysbaric osteonecrosis had occurred as a result of my naval diving (four dives, one using an oxygen rebreather, none over 6 m). Unfortunately, there was a strong family history of osteonecrosis of the hip, so I could not consider indulging in creative litigation.

My post-operative course was smooth for five months. Then I developed acute pain in the left hip. To shorten a long story, four months later infection was diagnosed and I started on flucloxacillin. Within three days I no longer needed analgesics.

A year later, three weeks after stopping flucloxacillin, the pain came back. Back to flucloxacillin and the pain went but my mobility was quite impaired. I was advised strongly to undergo hyperbaric oxygen therapy (HBOT). So off I went to the Alfred Hospital Hyperbaric Medicine Unit, via an assessment panel of two orthopaedic surgeons, and an infectious diseases and a hyperbaric physician. The prescription was 40 sessions of an hour at 2.5 bar (absolute) (15 msw). With the HBOT went three antibiotics, flucloxacillin, sodium fucidate and rifampicin.

I joined a group of patients – the number varying depending on whether or not anyone was a stretcher case – none of whom were still being treated when I finished. The diagnoses included diabetic and other chronic ulcers resistant to all treatment, decompression sickness, radiation necrosis and osteonecrosis. The maximum number for the chamber was six patients and one hyperbaric nurse. Before we were allowed to climb into the chamber, we had to change out of everyday clothes into cotton theatre garb, to avoid static sparks. Getting into the chamber was awkward as the circular door of the chamber was 900 mm in diameter. For many the only option was to crawl through. There was a special hoist for stretchers, which reached into the chamber and deposited the stretcher and patient onto a bunk. The other patients sat on the opposite bunk.

Treatment in a multiplace recompression chamber is dull. The only excitement happens during compression, when

some people have difficulty clearing their ears. At this point, the nurse tells the technician driving the chamber to stop the descent. You watch your fellows struggle to clear. It is interesting that patients still have so much trouble, when it is possible to teach almost all budding divers how to autoinflate in a few minutes.

After reaching 'bottom' (the technicians who run the chambers are all ex-commercial divers!), on go the oxygen hoods, which have a latex seal around the neck. It has to be tight or chamber air might be entrained, reducing the efficiency of oxygen therapy. I found that the fresh oxygen flow needed to be above the 15 $l.min^{-1}$ that the rotameters were set at and the inlet close to my mouth to prevent CO_2 build up in the large volume of the clear plastic hood. The hoods and the noise of the oxygen flow and ventilation of the chamber interfere with conversation for most of the treatment. Then, off with the hood for an air break and a cuppa! Now you can scratch your nose at last. The hood goes back on for the second period and then you're into a half-hour decompression. During this, the attendant also breathes oxygen from a mask. The hoods and masks have overboard dumps; the expired oxygen goes through the pressure hull to prevent oxygen build up in the chamber.

On the way down, thin theatre clothes are quite adequate as pressurising warms the chamber. While at treatment pressure one can cool off if the chamber is vented often. Coming up is chilly, as the temperature drops considerably. One cannot put a sweater on as the hood with its pipes covers your head. Draping a blanket round your shoulders is comforting but not really adequate for warmth. Oddly enough, having a treatment six days a week soon brings on acclimatisation, and by the third or fourth week of treatments one hardly notices the cooling.

At the Alfred there are various card games for people to amuse themselves. Most people read their way through the treatment, including myself, except for the time I left my specs outside the chamber!

We all benefitted. I lost much of my stiffness and my mobility improved during the first week and I continued to improve for the rest of the time, although it was not so dramatic. A man who had had an ulcer on his leg for 25 years was overjoyed that it was healing well at the end of 14 treatments. Another patient, whose irradiated bladder bled almost continuously, bled only occasionally after three weeks of treatments. His life had been transformed.

There are drawbacks to HBOT. One is shut, closely packed, in a small space. One is hooded so you cannot touch your face. Coughs and colds interrupt treatment. HBOT also affects the lenses in our eyes. After a number of treatments, the near point comes closer and the far point also moves in. You become myopic, especially if you are over 60. Having a Scots mother, I could be classed as "careful", so I used public transport to and from home.

After a couple of months of treatment I collected the family car from the garage after a service. With my bi-focals on I could not read the number plate of the car in front. Taking them off, everything came into focus. I still needed glasses to read, but not to watch the television. My eyes had dropped 30 years of ageing! Unfortunately, they aged again when I stopped HBOT, and three months later I was back to using my usual glasses.

The final drawback to HBOT is that results are not guaranteed for osteomyelitis. Pain recurred eight months later and four months after I stopped antibiotics. Despite long-term triple antibiotic therapy, bone scans continued to show evidence of infection. Relief from ongoing discomfort came from indomethacin in large doses. This led to osteolytic side effects and collapse of my opposite hip, requiring an emergency right total hip replacement. Bone scans at the time showed no evidence of infection in the left hip. Three months later I underwent revision arthroplasty of my left hip, seven years after my original surgery. There were no signs of infection at surgery but plenty of osteolysis.

There are a number of morals to this story. The first is that when a doctor becomes a patient he or she cannot afford to stop thinking about the whys and wherefores of treatment problems. No one, surgeons especially, likes to admit that something has gone wrong. Obvious answers like infection can be disregarded as "unlikely", especially if the X-rays show no evidence of loosening around the prosthesis.

Another is that HBOT can change your life dramatically if you have the right ailments. However, prosthetic joint infections are notoriously difficult to cure. Antibiotic failure is common and from my experience dosage is often not raised at retreatment. My final dosage of flucloxacillin was 1 g five times a day, which worked despite my physican's worries about my liver function.

A third is that self treatment can lead to trouble, especially if the product description in the packet does not mention unusual side effects. Although I had seen several orthopaedic surgeons, none mentioned the osteoporotic effects of non-steroidal anti-inflammatory drugs, nor did my GP or the pharmacists who liberally dispensed hundreds of indomethacin suppositories over the years. This side effect was not in my pharmacist's reference books in 2001. The final moral is that all doctors have gaps in their pharmacological knowledge.

Acknowledgements

Thanks to David Young, FRACS, for transforming my life with two operations and information about indomethacin.

Dr John Knight is a retired anaesthetist and until June 2002 was the Editor of the SPUMS Journal.

Articles of interest reprinted from other journals

An investigation of ear trauma in divers including ear barotrauma and ear infection (Abstract only)

S E Mawle and C A Jackson

Abstract

A sample of 142 divers including technical, recreational and instructors were examined via postal questionnaire to determine prevalence of ear barotrauma, related barotrauma symptoms and middle ear infection. Sixty four percent of divers reported symptoms of barotrauma, which included pain (47.9%), temporary deafness with tinnitus (27.5%) and vertigo (9.9%). The prevalence of middle ear infection was present in over a third of the total sample (37.3%), and were significantly more prevalent in the left ear than the right ear ($p = 0.016$). Consistently wearing a hood when diving was associated with greater barotrauma symptoms than wearing a hood only in cold conditions ($p < 0.01$). A significant relationship was found between barotrauma symptoms and diver separation ($p < 0.01$), and the implications are discussed with relevance to the finding that nearly 27% of divers reported incidents involving separation from buddies when diving.

Reprinted with kind permission from the European Journal of Underwater Hyperbaric Medicine 2002;3(1):47–50

S E Mawle and C A Jackson work at the Institute of Occupational Health, University of Birmingham, Edgbaston, United Kingdom

Editor's Commentary:

Only 142 of 300 questionnaires were returned completed. Of these, over 70% of divers reported ear clearing difficulties at some time in their diving career. Using a weighting system, based on the number of years diving and the frequency with which they dived, 30 divers reported clearing problems more than 10% of the time, and in 10 this was on almost all dives. Some divers may have confused symptoms of ascent barotrauma with alternobaric vertigo, which is often not associated with barotrauma. No clear distinction is made between external and middle ear infections, all are reported as middle ear in origin. The infection rates seem surprisingly high for middle ear infections, adding to the suspicion that some of these may have been external infections. The association with wearing a hood is interesting, and the authors speculate on the possible causes for this association, most particularly tight fitting hoods. A similar investigation in Australasia would make a good SPUMS Diploma project for someone.

Key words
Ear barotrauma, ear infection, diving

The early days of hyperbaric research in Adelaide

Brian Hills

Key words
Diving, history, decompression illness, aviation, pearl divers

In 1963, as a young Senior Lecturer in the Department of Chemical Engineering at Adelaide University, I went over to the staff club one day for my usual lunch when it was my good fortune to sit next to the late Dr. Hugh LeMessurier. It was not long before we were enthralled in a discussion of how to prevent the formation of bubbles in divers and aviators which had much in common with my thesis topic of how unwanted bubbles formed in nylon melts during the spinning process. Hugh - or Lem, as we all called him - was a member of the Physiology Department funded by the Department of Civil Aviation (D.C.A.) and R.A.A.F. who had supplied a large hypobaric chamber located behind the Medical School. This was seldom used because the vacuum pump was very large and noisy, but well do I remember entering it to have my minimum bends altitude determined as 23,000 feet.

When we first met, Lem had just returned from an expedition to Thursday Island where he had recorded depth *vs* time profiles for the decompression of pearl divers, some of which had led to the bends while others had not. It was clear that the then standard Haldane calculation method underlying the Royal Naval and U.S. Naval diving tables could not explain the different outcomes. This was clearly a fascinating intellectual challenge, and I soon switched the 'bubble' topic of my Ph.D. thesis from nylon melts to deep-sea divers.

About that time the once-massive pearl shell industry centred around Broome had collapsed as plastics took over the button industry, and the only ray of hope for keeping profitable industry in the far North of Australia was culture pearls. The first 'farm' had just been set up at Kuri Bay. This was also a time of confrontation with Indonesia in which the uninhabited North looked very vulnerable - at least to the government of the day.

The Kuri Bay venture was a three-way deal in which a New York company marketed the culture pearls, a Japanese company contributed their surgical expertise derived from the cold water and small oysters native to Japan, while an Australian company supplied the oysters. In the warm tropical waters of WA where tides of 45 feet or more bring abundant nutrients, these oysters grow very rapidly and to a large size. However, the project hit a snag when there were two deaths amongst the divers and the Department of Primary Industry (D.P.I.) in Canberra requested the R.A.N. to investigate, which they did. Predictably, perhaps, the report went back to Canberra that the pearl divers were not following the navy manual and, in particular, were not following standard (Haldanian) decompression procedures. The Australian company retorted that, if they used naval tables - even the fastest U.S.N. tables - they would go bankrupt, and so the D.P.I. was left with a real problem.

They then considered that maybe two boffins could go up to Broome and, under the guise of a research project, find out what the pearl divers were really doing, so they approached Lem and myself. To do this we bought all the old W. W.II torpedo depth-and-roll recorders from an Army and Navy surplus store in Rundle Street and modified them to record a whole day's diving up to 300 feet.

When Lem and I arrived in Broome, we realised that we were just in time to put on record a most remarkable distillate of human experience and suffering arising from decompression. At one time (1890-1950) there had been as many as 800 luggers with two divers per lugger operating out of Broome alone, amounting to at least 300 million dives. By the time we arrived in Broome in 1963, there were only eight luggers operating, while many of the others rotted on the shores of Roebuck Bay. However, the remaining divers still followed the decompression procedures evolved by trial and error over the previous century.

Unlike naval divers who are paid a fixed salary, pearl divers and their ancestors were paid according to the quantity of pearl shell which they harvested. Thus, they had a great incentive to minimize decompression time during which they were suspended in the ocean out of reach of the oyster beds. There was no evidence of any medical, mathematical or scientific input to their decompression schedules but, purely by trial and error, they had devised a most remarkable means of decompressing. The price paid by their predecessors, however, was about 3,000-4,000 deaths, many more cases of residual neurologic injury and countless cases of limb bends. To this day, the major sites of interest at Broome and Thursday Island are the divers' graveyards. The decompression was administered to each Japanese diver by his Malay tender who wore a wrist watch but estimated depth simply by the length of lifeline unwound from a coil on the deck. Fortunately, I had lived in Malaya and could converse with the tenders whose divers only developed the bends when their account differed from what our instruments had recorded. They only seemed to get into trouble when they were shallower than intended - the discrepancy usually explained by strong tides. Otherwise, it was remarkable how they could decompress safely in two thirds of the time prescribed by the U.S.N. tables or about half the time once the U.S.N. divers pursue their normal practice of moving over two columns. The whole secret to their success lay in much deeper initial stops.

By this time I had switched my Ph.D. topic to decompression sickness and had realised that the wording accompanying Haldane's calculation method did not say the same thing as the equations he used to formulate diving tables. Haldane and subsequent naval tables were based upon the axiom that the bends-free diver must be bubble-free. Even in the 1960s there was the occasional mention of "silent bubbles" but, if my work is remembered at all, let it be that I was the first to appreciate the very different mathematics needed to calculate decompression tables if the gas phase is present. This is demonstrated qualitatively by the diver who develops a case of the bends during ascent. Now knowing that he has bubbles, you would move him deeper as a treatment. On the other hand, if those bubbles had not become manifest as the bends, you would continue to take him shallower, assuming that he was bubble-free.

This led to my "Thermodynamic" or "Zero-supersaturation" approach to formulating decompression schedules which, although derived applying complex mathematics to a system at phase equilibrium, provides a scientific basis on which to produce profiles closely resembling those of the pearl divers.

We needed to test these tables, so the D.C.A. funded a chamber and compressor located at the back of the Chemical Engineering Department in which we subjected goats to our new profiles and those of the pearl divers. Needless to say, these animals often escaped and could usually be found devouring the best flower beds on campus.

In the meantime, we had sent a report to Canberra confirming that the pearl divers had empirically devised better decompression methods than the Navies, and all they needed was better instrumentation in measuring depth. This pleased the D.P.I., who allowed the Australian company to carry on with its economically viable diving schedules and enabled the culture pearl industry to survive its embryo status at Kuri Bay and progress to the large flourishing industry it is today. These days diving no longer plays the

vital role it did in the 1960s when we performed our studies since the technology has now been developed for culturing oysters.

My thesis, including the distillate of human experience acquired from the pearl divers, was refereed by Sir William Paton, Chairman of the Pharmacology Department at Oxford, who recommended award of a Ph.D. with distinction. However, Adelaide University does not differentiate higher degrees in this way, but the Libraries Board of South Australia published the thesis and copies were soon sold out. This encouragement led me to switch from Engineering to the Biomedical Sciences, although it meant leaving Adelaide - a move for which my wife has never forgiven me, and I can understand why.

While at Adelaide, I was invited by the Royal Navy to spend a short sabbatical at Gosport using their animal facility to convince them of the value of introducing much deeper stops to their decompression schedules than advocated by 'Haldanian' calculation methods or U.S. Navy variations thereof. They were impressed by the results and, as a first step towards introducing the new concept into operational diving, added the time spent at 10 feet to the 20-foot stop for air dives and surfaced directly from 20 feet. This first change alone reduced the R.N. bends rate by 75%.

However, as Associate Professor of Surgery at Duke University assigned to the Hyperbaric Unit, there was much scope to test and develop tables for much deeper dives on heliox as needed in the recovery of offshore oil which was rapidly evolving at that time. At Duke I was able to make several discoveries including the ability of dissolved gases to induce osmosis and the finding that bubbles formed by decompression in many tissues were coated by the same surface-active phospholipid (SAPL) known as surfactant in the lung.

Later moving to the North Sea as Professor of Occupational Medicine at both Dundee and Aberdeen Universities, it was interesting to find numerous copies of my thesis turning up in Scotland and Norway. As a consultant to several diving companies, it was surprising how often a troublesome diving table could be fixed not by the popular practice of adding even more time to a long 10 foot stop, but by introducing one or two short deeper stops at the start of decompression. This is exactly consistent with pearl diving practice.

In those early days in Adelaide analysing the decompression profiles of the pearl divers, many workers in the field regarded air as one gas and so, theoretically, they soon ran out of driving force for eliminating nitrogen from tissues during ascent. It was then that I realised that metabolic consumption of O_2 produced what we termed an "inherent unsaturation" in tissue and deduced that this provided the driving force for nitrogen elimination. We demonstrated this in animals and published it a year before Behnke deduced it independently as the much publicised "oxygen window" for decompression.

In recent years my research has been focussed upon SAPL which we discovered as the lubricant in the joint, the corrosion inhibitor in the stomach and, maybe, the substance masking irritant receptors in the bronchi whose erosion causes asthma, and at other sites where we had found bubbles forming in divers. However, in searching for SAPL as lamellar bodies we also found them in the spinal cord where such nuclei - so conducive to bubble formation - would be most unwelcome in a deep-sea diver. Spinal decompression sickness remains the great fear in air diving.

One worrying aspect of our discovery of the inherent unsaturation/oxygen window in Adelaide has always been the implication that, if you substitute O_2 for N_2 at the alveolar level, you do not make the same substitution at the tissue level. Hence, in HBOT, does the additional O_2 really reach the tissues or does some other mechanism - such as oxygen-induced osmosis - break the vicious cycle by relieving oedema? Once enthralled by hyperbarics, you can never leave behind the fascinating questions which it continues to pose.

This article is reprinted with kind permission of the Editor and Author, from *Offgassing* 2002; 33: 8-9

Professor Brian Hills, PhD, is now Director of the Paediatric Respiratory Research Centre, at the Mater Children's Hospital, Brisbane, Australia.

Letters to the Editor

30 years of SPUMS index encoded as an Endnote™ library

Dear Editor,

One of the problems the diving and hyperbaric medicine community faces on a daily basis is that many extremely valuable publications are not easily accessible. Much exciting data are published but not indexed on electronic search engines such as Embase or Medline. Finding published information on a particular topic is often dependent upon the number of people you talk to and what they remember. E-mail discussion lists such as the ANZHMG list therefore come into their own by offering exposure to a large group of interested colleagues.

The SPUMS Journal itself has been indexed on Embase since 2000. A CD-ROM* is available from SPUMS that includes an index of all material published from 1970 to 2000 (a total of 2,744 citations). The available index is however written as a tabbed data file for conversion into a Microsoft Access Database or Microsoft Word and is as such not particularly user friendly.

I have re-arranged the available index and have written a filter to convert the index into an Endnote™ library. Endnote™ is one example of a number of computer programs that facilitate research and publishing in a tremendous way. Produced by ISI Researchsoft (http://www.endnote.com/enhome.htm), the latest version of Endnote™ (Version 6) allows the user to search bibliographic databases on the Internet, organise references and images in a database, and automatically create a reference list formatted for any specified journal via its "Cite While You Write" (CWYW) function. It has advanced import and export functions, 28 customisable reference types with 40 fields for entering reference and image data, and stores up to 32,000 records per database.

The program comes with an extensive manual (either in book format or on CD). It took me less than two hours to get up and going. Much learning is done by actually writing your next publication and trouble-shooting as you go (an easy task with the existing help function and the manual). The SPUMS Endnote™ library has eased my own research tremendously and it may be of help to anyone trying to find a particular topic in previous SPUMS publications. I have not, however, cross-checked all references with the real publications and will take no responsibility for the correctness of the information included in the library.

I am very happy to make the library publicly available and hope that this represents a step closer to a combined infrastructure for research and knowledge in our field. I do hope that in the near future we will be able to up- and download similar databases in one place (maybe the SPUMS web site?) to make life easier for us all, and our patients.

Stephan Neff
Hyperbaric Fellow, Hyperbaric Medicine Unit
Royal Adelaide Hospital, North Terrace, SA 5000
E-mail: <neff3@bigpond.com>

*CD-ROMs containing back copies and the index of the SPUMS Journal from the first issue in May 1971 to December 2000, can be purchased from the SPUMS Administrator, C/o ANZ College of Anaesthetists, 630 St.Kilda Road, Melbourne, Victoria 3004, Australia.
Price $Aust25.

Editor's note:
This matter was discussed at the recent ANZHMG Annual Meeting in Christchurch. It is proposed to build on Dr Neff's efforts in a collaborative manner between the Australasian hyperbaric units, since much valuable research in the diving medicine field has been published in non-indexed form. Meanwhile, his commendation of this software is endorsed by others.

Reverse dive profiles

Dear Editor,

I refer to Guy Williams' presentation at Madang 2001, on reverse profile diving.[1] The following week, I was diving at Tufi and I had occasion to test this thesis. I had done two reef wall dives in the morning, maximum depth 30 metres, duration 60 minutes on each dive. In the afternoon, I wanted to dive the wreck of a patrol boat located in the fiord just off the jetty at a depth of 50 metres. None of the others in the group were interested in this dive, so I went down with a divemaster/guide who had not dived that day.

It took 3 minutes to reach the wreck at 50+ metres and I spent 10 minutes taking photographs. By this time, my computer was well into the red zone, signalling 20 minutes decompression time. The divemaster told me later his computer indicated one minute to decompression time when I signalled to ascend.

I took 4 minutes to reach 20 metres, where I spent 2 minutes, 2 minutes to 10 metres resting 4 minutes, then it took 21 minutes at 5 metres before my computer came back into the green and I considered it was safe to surface. I felt no after effects from the dive, but recorded a high residual nitrogen level starting my first dive next morning.

Air consumption was interesting. I had a 90 cubic foot tank filled to 3600 psi and a redundant 20 cubic foot tank filled

to 3000 psi. A 'hang' tank was located at 5 metres. I was down to 1500 psi at the start of the ascent, 730 psi at 5 metres and I surfaced with 180 psi left. I could have switched to my reserve tank, but was curious to see if I could complete the dive on one tank.

I suppose the moral of this story is that you can do reverse profile dives safely, but you pay for it with long decompression times and a high residual nitrogen level.

W F Brogan
City Beach, W A

Reference

1 Williams G. Reverse dive profiles. *SPUMS J* 2002; 32: 109-110

Reply

The presentation re reverse dive profiles related to the blanket prohibition of reverse dive profiles – reverse dive profiles may not be always the most efficient use of dive time. The recommendations relate to dives less than 40 metres and differentials less than 12 metres – divers need to plan repetitive dive profiles to make the most efficient use of dive time.

Guy Williams
Rosebud Medical Centre, Victoria

Editor's note:
The sequence of dives described by Dr Brogan is outside that usually associated with recreational scuba diving.

Neurological symptoms developing while diving

Dear Editor,

We were interested to read the article by Bateman and Sawyer[1] reprinted in this journal (*SPUMS J 2002; 32: 60).* In this brief case report, a single MRI film of the cervical spine of a young woman who suffered presumed decompression illness whilst diving in Egypt, is presented. The report notes that she had an unsustained improvement in her neurological symptoms and signs with recompression therapy. The report goes on to say that on the basis of this MRI, a diagnosis of transverse myelitis was made and the patient then treated with steroids.

There are a number of issues that this case raises.

First, the MRI appearances of cervical spine lesions in decompression illness are characteristically lenticular in appearance, as is the one demonstrated, and often occupy several dermatomes, as is also the case here. It has been our experience that where significant lesions like this are present, there are almost certainly other lesions within the central nervous system, either in the lower spinal column or within the cranium. It would be interesting to know whether such multiple lesions were present, since this would exclude a transverse myelitis of a non-diving aetiology. Without that additional information the diagnosis of a non-diving transverse myelitis cannot be made.

The second issue is the one of recompression therapy. We do not know whether this was a single treatment, what type of treatment was administered and whether there was any follow-up hyperbaric therapy. In our experience, it is not uncommon for signs and symptoms to relapse to some degree in severe cases, even following an extended Royal Navy Table 62 or other major initial hyperbaric treatment. A varying pattern of gradually diminishing neurology is one that would be familiar to all those who have treated this condition. Therefore, neither the relapse nor indeed the supposed response to steroids precludes the diagnosis remaining that of decompression illness.

We remain unconvinced by the data presented that this woman suffered from anything other than neurological decompression illness.

F Michael Davis
Medical Director

D Boon von Ochsee
Specialist Anaesthetist
Hyperbaric Medicine Unit, Christchurch Hospital, New Zealand

Reference

1 Bateman RM, Sawyer RN. Neurological symptoms developing while diving. *Brit Med J* 2001; 323: 242

Medical conditions and diving deaths

Dear Editor,

The strongly-worded statement regarding medical conditions, specifically asthma, and their contribution to scuba diving fatalities made by Davis et al[1] cannot be allowed to go unchallenged. The authors base their statement on the presence of medical conditions established by history or at autopsy that were "believed to have contributed to the death". No data are given in the paper, however, as to the basis of this belief and the authors could not supply me with any further details when I contacted them. These details are apparently simply not available.

The problem here is that the argument is a circular one. Suppose one believes that the human foreskin is an important route of nitrogen excretion. One then would

conclude that circumcision is an absolute contraindication to diving. A survey of post-mortem findings in dead scuba divers could well find that a significant proportion of the males had in fact been circumcised, confirming the original hypothesis. Unfortunately this is the logic that is applied to asthma and indeed other medical conditions such as pulmonary adhesions.

Davis et al state that there are no good data to support the view that it may be safe to allow asthmatics to dive. There are no data to suggest that this view is incorrect. What is clear is that out of the total number of scuba dives and snorkelling expeditions performed in New Zealand over a 20-year period, only a handful of cases could be found in which asthma *possibly* contributed to a fatality (and I would again emphasise that no evidence is presented that this interpretation is correct). The limited information we have suggests that the prevalence of asthma in scuba divers is much the same as in the general population, so what we can say is that the absolute risk of diving with asthma in New Zealand over this 20-year period was minute.

Authors must resist the temptation to over-interpret their data to support their own beliefs (for example I would interpret their data as demonstrating the relative safety of diving with asthma). Davis et al's paper unfortunately does not contain any information that contributes meaningfully towards the debate as to the safety or otherwise of diving with asthma or other medical conditions.

Graham Simpson
Director of Thoracic Medicine, Cairns Base Hospital
Adj. Associate Professor, James Cook University

Reference

1 Davis M, Warner M, Ward B. Snorkelling and SCUBA diving deaths in New Zealand, 1980–2000. *SPUMS J* 2002; 32: 70-80

Reply

In our analysis of 184 diving drownings, there were 10 divers with asthma.[1] In six of those, asthma was recorded as a contributory cause of death. We state "These preventable deaths would *seem* to support the views of Edmonds and others that take a prescriptive attitude to this disease" (the italics are mine), and "A fifth of scuba divers and a quarter of snorkellers drowning had an underlying contributory medical condition such as asthma." For these statements, one of which draws attention to a current controversy and the other is a statement of fact drawn from coroners' reports, Dr Simpson castigates us for making more of our data than it is worth. I would suggest that this is rather what Dr. Simpson is doing in his letter. We consider the analogy to circumcision to be facetious, contributing little to the constructive debate he wishes.

He has misunderstood what we meant by being unable to supply him with further details. The individual case files are in the confidential possession of Water Safety NZ, and only general descriptive data were extracted in an anonymous manner. Therefore, without re-examining every file in the series we cannot provide him with any further information than exists in our database. The beliefs he is concerned about are those stated in the Coroners' autopsies and the subsequent hearings into the deaths.

The fact that a sizeable minority of these divers had underlying medical conditions that constituted a relative or absolute contraindication to diving is cause for concern. The figures quoted are in line with those reported for chronic medication use in Australian and US divers in this issue by Taylor et al.[2] Taylor et al have recently reported similar rates of disease in Australian divers.[3] Where asthma is concerned, recent work from Buffalo demonstrates that asthmatics immersed post-exercise have reduced airflow and absence of Phase IV, indicative of air trapping.[4]

The simple fact is that some divers with serious medical conditions died from their disease whilst diving and might not have done so in other circumstances. Therefore, ipso facto, these were preventable deaths. Whether there is only one asthmatic or epileptic in the group or 20 is irrelevant. There are sound theoretical reasons to continue a cautious approach to asthma in scuba diving until such time as Dr Simpson and others provide practical epidemiological data to the converse. I look forward with great interest to publishing such data in the SPUMS Journal in the future.

F Michael Davis
Medical Director
Hyperbaric Medicine Unit, Christchurch Hospital.

References

1 Davis FM, Warner M, Ward B. Snorkelling and scuba deaths in New Zealand, 1980-2000. *SPUMS J* 2002; 32: 70-80
2 Taylor S, Taylor D McD, O'Toole KS, Ryan CM. Medications taken daily and prior to diving by experienced scuba divers. *SPUMS J* 2002; 32: 129-135
3 Taylor D McD, O'Toole KS, Ryan CM. Experienced, recreational scuba divers in Australia continue to dive despite medical contra-indications. *WEM* 2002; 13: 187-193
4 Leddy JJ, Roberts A, Moalem J, Curry T, Lundgren CEG. Effects of water immersion on pulmonary function in asthmatics. *Undersea Hyper Med* 2001; 28: 75-82

SPUMS notices

South Pacific Underwater Medicine Society Diploma of Diving and Hyperbaric Medicine

Requirements for candidates

In order for the Diploma of Diving and Hyperbaric Medicine to be awarded by the Society, the candidate must comply with the following conditions:

1 The candidate must be a financial member of the Society.
2 The candidate must supply evidence of satisfactory completion of examined courses in both Basic and Advanced Course in Diving and Hyperbaric Medicine at an approved institution.
3 The candidate must have completed the equivalent (as determined by the Education Officer) of at least six months' full-time clinical training in an approved Hyperbaric Medicine Unit.
4 The candidate must submit a written research proposal in a standard format for approval by the Education Officer before commencing their research project.
5 The candidate must produce, to the satisfaction of the Education Officer, a written report on the approved research project, in the form of a scientific paper suitable for publication.

Additional information

The candidate must contact the Education Officer to advise of their intended candidacy, seek approval of their courses in Diving and Hyperbaric Medicine and training time in the intended Hyperbaric Medicine Unit, discuss the proposed subject matter of their research, and obtain instructions before submitting any written material or commencing a research project.

All research reports must clearly test a hypothesis. Preference will be given to reports of original basic or clinical research. Case series reports may be acceptable if thoroughly documented, subject to quantitative analysis, and the subject is extensively researched and discussed in detail. Reports of a single case are insufficient. Review articles may be acceptable if the world literature is thoroughly analysed and discussed, and the subject has not recently been similarly reviewed. Previously published material will not be considered.

It is expected that all research will be conducted in accordance with the "Joint NH&MRC/AVCC statement and guidelines on research practice" (available at http://www.health.gov.au/nhmrc/research/nhmrcavc.htm). All research involving humans or animals must be accompanied by documentary evidence of approval by an appropriate research ethics committee. It is expected that the research project and the written report will be primarily the work of the candidate.

The Education Officer reserves the right to modify any of these requirements from time to time.

The Education Officer's address is Dr David Doolette, Department of Anaesthesia and Intensive Care, The University of Adelaide, Adelaide, South Australia 5005. Telephone +61-(0)8-8303-6382. Fax +61-(0)8-8303-3909. E-mail: <David.Doolette@adelaide.edu.au>.

Key words
Qualifications

SPUMS PRIZE

FOR THE BEST PAPER PRESENTED AT THE HYPERBARIC TECHNICIANS AND NURSES ASSOCIATION SCIENTIFIC MEETING 2002

The South Pacific Underwater Medicine Society wishes to congratulate Dale O'Halloran, of the Wesley Hospital Hyperbaric Medicine Unit, Brisbane, for his paper, 'Education of technical officers', which won the SPUMS Prize for the best paper presented at the Hyperbaric Technicians and Nurses Association Scientific Meeting, Christchurch, 2002.

LATE DISTRIBUTION OF SPUMS J 32(2)

Some members will have realized that John Knight's final issue was a month or so late in arriving. This was due to problems, not in our control, with the mailing house employed by the Society to distribute the journal.

The current issue is also about a month late due to the transfer of the editorial office from Melbourne to Christchurch.

We apologise for these delays and anticipate being back to normal for the first issue in 2003.

ERRATUM

In the paper by Davis et al, Snorkelling and scuba diving deaths in New Zealand, 1980–2000, *SPUMS J* 2002; 32: 70-80, there is an error in the bottom paragraph, left-hand column of page 74. The second sentence should read "One diver surfaced in a shipping lane and was hit by a powerboat." The words "suicide soon after related to the accident" were incorrectly inserted.

Minutes of the Annual General Meeting 2002

held in Vanuatu on 23 May 2002

Opened: 1800 hours

Present: All members attending the Annual Scientific Meeting

Apologies: Dr B Trytko, Dr S Mitchell, Dr D Walker, Dr M Bennett

1 Minutes of the previous meeting
Minutes of the previous meeting have been posted on the notice board.
Motion that the minutes be taken as read and are an accurate record. Proposed Dr J Knight, seconded Dr D Vote, carried.

2 Matters arising from the minutes
None.

3 Annual reports
3.1 President's report
3.2 Secretary's report

4 Annual financial statement and Treasurer's report:
Motion that the financial statements be accepted. Proposed Dr J Knight, seconded Mr J Lippman, carried.

5 Subscription fees for the coming year
Proposed Dr D Routley, seconded Dr V Haller, carried.

6 Election of office bearers
Nominations were received for positions of President, Secretary, Treasurer, and the three Committee Members. The Editor, Education Officer and Public Officer are appointed positions.

The new committee will be as follows:

President: Dr Robyn Walker
Immediate Past President: Dr Guy Williams
Secretary: Dr Cathy Meehan
Treasurer: Dr Barbara Trytko
Editor: Dr Mike Davis
Public Officer: Dr Guy Williams
Education Officer: Dr David Doolette
Committee Members: Dr Mike Bennett, Dr Simon Mitchell, Dr Douglas Walker

7 Appointment of the auditor
Motion that David Porter be reappointed auditor for the forthcoming financial year. Proposed Dr G Williams, seconded Dr J Knight, carried.

8 Business of which notice has been given
8.1 Proposed changes to the SPUMS constitution (*SPUMS J* 2002;32:20–21). Dr M Davis spoke for the proposal, nil against. Proposed Dr M Davis, seconded Dr J Knight, carried.

Closed: 1822 hours

President's Report 2002

This year, I am pleased to say, has been a year marked by consolidation and one less dogged by the controversies that have affected previous years. However, a SPUMS era is coming to a close with the resignation of our Editor, John Knight. John, a retired anaesthetist was first introduced to diving medicine in 1955 as a Medical Officer in the Royal Navy. He has been a member of SPUMS since 1973, and since 1975 has been successively a Committee Member, Secretary, President, Assistant Editor, Public Officer and Editor of our Journal. John has worked tirelessly as Editor and is responsible for the quality of what is surely the only high-quality diving medicine journal available worldwide. It was through John's and the efforts of Michael Bennett that the Journal of the South Pacific Underwater Medicine Society is now indexed in EMBASE, the Excerpta Medica database. This listing encourages authors to publish in our Journal and will ensure the Journal's high quality will continue. John remains a life member of the Society and we wish him well in his retirement.

Michael Davis has kindly agreed to take over the reins from John and we as a Society look forward to an enjoyable and productive partnership with him. Mike is a passionate diver and currently divides his time between private anaesthetic practice in Christchurch, New Zealand and as Medical Director, of the Hyperbaric Medicine Unit, Christchurch Hospital. Mike will no doubt continue to 'encourage' you all to contribute to the Journal and I urge you all to support him as you have John Knight.

There has been some discussion internationally of an attempt to combine the publications of the EUBS, UHMS and SPUMS, but to date no official correspondence has been received by the Committee. The Committee is, however, committed to maintaining the focus and quality of our Journal and to continuing to serve the needs of the diving medical population.

Chris Acott also retires from the Committee this year, but I am sure he will continue to play an important role in the Society's activities. Chris, also a previous Past President, has contributed enormously to the running of the Society

and in particular to the success of previous Annual Scientific Meetings. I thank him again for his enthusiasm and commitment in bringing together this year's workshop on morbidity and mortality associated with diving equipment problems.

This year, for the first time in many years, the Annual Scientific Meeting will not break even financially. The events of 11 September had not occurred when we made an exclusive booking for the whole of Iririki Island resort, and we did not foresee that international and Australian travel would be so affected. The number of delegates this year is smaller than usual, although those that have attended have benefitted from the wonderful presentations of our guest speaker, Trish Batchelor. However, due to some detailed and intensive negotiation by Allways Travel, the loss will not be as large as initially feared. The Committee will take the lessons learnt from this ASM into consideration when planning future meetings.

The Society does, however, remain in a sound financial position as evidenced by the Treasurer's report. I would like to thank all Committee members for their contributions over the last 12 months and in particular our Treasurer, Barbara Trytko, and our Administration Officer, Steve Goble. Their jobs are often time consuming, thankless and not visible to the masses, however their efforts keep the Society functional. I would encourage you all to consider offering some time to the running of the Society. New blood encourages change, innovation and questioning of current practice. I have accepted the position as President for a second three-year term. However I do not believe nominating a third time would be in the best interests of the Society and we will be searching for a successor.

Next year's meeting is in Palau and I look forward to seeing as many of you as possible there.

Robyn Walker
President, SPUMS

Audit report to the members of the South Pacific Underwater Medicine Society

I have conducted various tests and checks as I believe are necessary considering the size and nature of the Society and having so examined the books and records of The South Pacific Underwater Medicine Society for the year ended 31 December 2001 report that the accompanying Income and Expenditure and Balance Sheet have been properly drawn up from the records of the Society and gives a true and fair view of the financial activities for the year then ended.

Dated 24 April 2002
Level 3, Suite 304, 20 Bungan Road
Mona Vale, New South Wales 2103

David Porter
Chartered Accountant

THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY BALANCE SHEET AS AT 31 DECEMBER 2001

	2001	2000
MEMBERS' FUNDS		
Balance at 1 December 2001	109,208	85,664
Surplus/(Deficiency) for year	9,580	23,544
	$118,788	$109,208
represented by:		
CURRENT ASSETS		
ANZ Bank 1998 ASM Account	9,287	7,402
ANZ Access Cheque Account	17,431	35,632
ANZ VZ Plus	89,707	61,585
Sundry loan	1,456	4,141
GST recoverable	907	448
NET ASSETS	$118,788	$109,208

These are the accounts referred to in the report of D S PORTER, Chartered Accountant, Mona Vale 2103.
Dated 24 April 2002

THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY STATEMENT OF INCOME AND EXPENDITURE FOR THE YEAR ENDED DECEMBER 2001

	2001	2000
INCOME		
Subscriptions & Registrations	99,519	129,132
Interest	3,519	3,795
Advertising & Journal sales	180	491
ASM 2001	28,900	23,150
Sundry Income	121	-
	$132,239	$156,568
EXPENSES		
ASM costs	36,499	37,855
Bank adjustment	-	2,183
Secretarial wages	12,816	11,066
Stationery & Printing	5,948	435
Journal	28,287	34,196
Postage & Facsimile	2,446	1,789
Conferences & Telephone	3,514	6,386
Computer Equipment	2,095	5,677
Miscellaneous/Subscriptions	1,449	1,439
Bank Charges	4,687	4,387
Audit	3,600	1,219
Editors honorarium	16,310	15,857
ASM 2002 costs	313	7,100
Insurance	4,695	3,435
	$122,659	$133,024
SURPLUS FOR THE YEAR	$9,580	$23,544

These are the accounts referred to in the report of D S PORTER, Chartered Accountant, Mona Vale 2103.
Dated 24 April 2002

THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY MOVEMENTS ON BANK BALANCES FOR THE YEAR ENDED 31 DECEMBER 2001

	2001	2000
OPENING BALANCES		
ANZ bank - 1998 ASM account	7,402	612
- Access Cheque account	35,632	3,119
- VZ Plus	61,585	77,976
	104,619	81,707
add, **RECEIPTS**	132,828	156,568
	237,447	238,275
less, **PAYMENTS**	121,022	133,656
CLOSING BALANCES		
ANZ bank - 1998 ASM account	9,287	7,402
- Access Cheque account	17,431	35,632
- VZ Plus	89,707	61,585
	$116,425	$104,619

NOTE
Receipts and Payments above may include Balance Sheet items which are not included in the Income and Expenditure statement.

Secretary's Report 2002

SPUMS currently has 856 financial members. There are 122 members with membership renewal outstanding. Last year, 68 new members joined, and so far this year 27 new members have joined. We are committed to keeping the membership healthy and happy.

Our main focus for this year will be to improve the SPUMS web site. Steve Goble, the SPUMS administrator, is working hard on this. We have had some problems with functionality but they are being addressed.

I would like at this stage to thank Dr John Knight, for his years of hard work and dedication to the SPUMS Journal. Dr Knight has retired this year after many fruitful years as the editor of the Journal. Prior to this post, he held just about every other position on the Committee. We will all miss John's involvement with the Society.

I would also like to thank Dr Chris Acott for his many years as a SPUMS Committee Member and frequent convenor of the SPUMS ASM. Chris' hard work has resulted in many successful Annual Scientific Meetings. Chris will, I am sure, continue to have an involvement with SPUMS.

I would also like to thank all the other committee members for their dedication throughout the year, especially Dr Robyn Walker, our President. I look forward to another year working together.

Finally, I would like to welcome Dr Mike Davis as the new SPUMS Editor. I know that Mike will be a very valuable asset to SPUMS. The 2003 Annual Scientific Meeting will be held in Palau, Micronesia. I look forward to meeting you all again there.

Catherine Meehan

Secretary, SPUMS

Minutes of the SPUMS Executive Committee Meeting 2002 held in Vanuatu on 18 May 2002

Opened: 1515 hours

Present: Drs R Walker (President), G Williams (Immediate Past President), C Meehan (Secretary), J Knight (outgoing Editor), Dr C Acott (Committee Member), Dr M Davis (incoming Editor) for part of the meeting

Apologies: Drs B Trytko (Treasurer), D Doolette (Education Officer), S Mitchell, D Walker (Committee Members), D Smart (ANZHMG Representative)

1 Minutes of the previous meeting (February 2002)
Moved that the minutes be accepted as a true record. Proposed Dr R Walker, seconded Dr J Knight, carried.

2 Matters arising from the minutes

2.1 Update on the SPUMS administration by S Goble
SPUMS membership is down by about 20 per cent this year. The possible reasons for this were discussed. It was suggested that a questionnaire be sent to all the members who had not renewed in order to get some feedback on their reasons for not renewing and any suggestions they may have on ways of improving the benefits of membership. There was also discussion about a membership drive. It was decided that there should be an article about and information on joining SPUMS in medical or diving journals. Dr R Walker volunteered to send articles to Dive Log and Sports Diver; Dr C Meehan to Medical Observer and Australian Doctors Weekly; Dr C Acott to Dan SEAP, Padi, SSI, and Naui journals; and Dr J Knight would do an editorial. All of these to go to Dr Walker and Dr Meehan for circulation. Dr Acott will take journals to the "Congress on drowning" in Amsterdam. It was also suggested that SPUMS should endeavour to have its web site link on as many related sites as possible.

2.2 Update by Education Officer - Nil at hand.

2.2.1 Update on NZ Chapter. There is still some question as to whether there are funds outstanding from the Chapter. Dr R Walker will discuss this with the NZ ex-secretary, Dr Alistair Leggett.

2.3 Update from ANZHMG
Representative not present.

2.4 Update from incoming and outgoing Editors, Dr J Knight and Dr M Davis
Dr Davis and Sarah Webb recently visited Melbourne. They went through the procedure involved with putting the journal together. They had discussions with the current printers of the journal, on how the printing would best be done. It was suggested that the journal be assembled in NZ, then sent to Snap Printing in "pdf" format, and then the normal procedure would be followed. SPUMS will need to buy appropriate software such as the full Adobe Acrobat reader, FrontPage, and Photoshop or similar for use with pictures.

All the Journal's mail is still to go to college and then to be forwarded to NZ. The Editor's email address "spumsj", will be linked directly to Dr Davis in NZ. The mechanisms of finance and payments will need to be sorted out. It is preferable to keep all accounts solely in Australia, with the necessary two signatures. The contract for Dr Davis has not been finalised. There will need to be a budget. The June journal is now with the printer. Dr Davis will do the September journal. Dr J Knight will assist till then.

2.5 The letter with regard to "minimum age and fitness to dive" was published on the 4 May 2002 in the MJA. The final version will be forwarded to the Secretary.

2.6 Insurance on the equipment held by committee members. Three year insurance has been purchased for the new laptop. Insurance may be able to be purchased from the same company for the other SPUMS owned electronic equipment that is required at the conference.

2.7 Letter to TSANZ re Respiratory fitness to dive, asthma and diving, has been sent.

2.8 Further discussion was held regarding the suggested Underwater Medical Societies Federation. There has been no formal approach to SPUMS to date. There was discussion about the UHMS in Sydney and the extent of SPUMS involvement. It was suggested that SPUMS sponsor a talk, and run a workshop prior to conference. A suggested topic for the workshop was "Diving in remote areas and the practicalities of managing a diving accident in a remote area", similar to the workshop held at the SPUMS ASM in New Zealand. Dr Mike Bennett will discuss these issues with UHMS at their next meeting.

2.9 Further discussion was held with regard to the letter from Sushma Malhotra, Sport Information Resource Centre. Dr J Knight has written a response. There is no further information to date.

2.10 Letter from Santo requesting some teaching sessions. There is no further information to date.

2.11 Details of new laptop were presented.

3 Annual Scientific Meetings

3.1 2002 ASM, Iririki Island, Vanuatu
There are 92 registrations fully paid. There may be a couple still to come in. Of these, 59 are full registrants. There will be no loss of monies with regard to the registration fees as the fee was calculated based on a lesser number of attendants. However, there is still the problem of SPUMS having requested full occupancy, with many rooms not filled. Ten of these unoccupied rooms will be taken out of circulation to be upgraded during this week. Unfortunately, the remaining unoccupied rooms will be charged for. SPUMS will need to cover the financial shortfall out of general funds.

3.2 2003 ASM, Palau
There will be only one international speaker in order to keep the registration fee as low as possible. Due to the US dollar exchange rate, this will be an expensive conference. The registration fee will need to be around $600–700. The registration fee will be based on about 50–60 full registrants, in view of the smaller attendance this year.

3.3 2004 ASM
Suitable venues were discussed. As the ASM will follow on after the 2004 UHMS, which is to be held in Sydney, venues within easy travelling distance from here were discussed. These included the possibility of a larger live aboard boat, or a venue in Thailand. Dr Guy Williams has volunteered to be the convener.

4 Treasurer's report

The accounts are at the auditor. Finances were discussed and it was decided that the membership fees would need to be increased this year. The full membership will increase to $132 including GST and the associate membership to $66 including GST.

5 Correspondence

5.1 Letter from Italian Association of Hyperbaric Technicians was discussed.

6 Other business

6.1 Article in a recent Medical Forum was discussed. A member had sent a copy of the article to SPUMS. There was concern that the mention of SPUMS in the article may suggest that SPUMS endorsed the diving activities described within the article. R Walker agreed to write to the author and to Medical Forum clarifying this.

6.2 An increase in the wages of the Administrator and the Editor in line with the current CPI index was approved.

There being no further business, the meeting was closed.

ANZHMG Annual General Meeting

Freemantle Hospital
Thursday 20 September 2001, 0900 hours

1 Present
Mike Bennett (Chair), Jan Lehm, Bob Wong, Harry Oxer, Simon Mitchell, Margaret Walker, Barb Trytko, Aaron Bellette, Greg Emerson, Ian Millar, Alistair Gibson, David Wilkinson

2 Apologies
David Smart (Secretary), Brian Spain, Robyn Walker

3 Minutes of previous meeting
Minutes of the previous annual general meeting held in Brisbane in September 2000 were accepted as an accurate record of events.

4 Business arising
No issues identified.

5 Outgoing Chairman's remarks
The retiring Chairman, Dr Mike Bennett, gave credit to the ANZHMG as a system that works. While the SIG of the ANZCA is and will be important, the function of the ANZHMG had been of great use in such situations as the Medicare review. There have been a number of achievements over the life of this executive; principal among them was the list of accepted indications for HBOT. This list is a powerful tool in demonstrating sound clinical governance and should feature as a central pillar to future considerations. Its usefulness in the Medicare issue was stressed. Also stressed was the need to support the HTNA, especially at the ASM. Dr Oxer's role in promoting involvement some 10 years ago was recognised. It is up to all of us to encourage further involvement.

6 Election of Chairman and Secretary
Dr David Smart was the only nomination for Chair (proposed Dr Wong, seconded Dr Bennett) and was declared Chairman of the ANZHMG. Dr David Wilkinson was the only nomination for Secretary and was accepted in this role.
In the absence of Dr Smart, Dr Wilkinson assumed the chair. Celebration was made to the glorious nature of democracy, and gratitude paid to the work of the outgoing executive.

7 MSAC review
Dr Bennett gave a review of the state of play. The MSAC review was complete and signed off by the Minister with a restricted number of indications attracting reimbursement. This will be incorporated into the Medicare Benefit Schedule book for November 2001. Appeal has been made to MBCC to consider the addition of interim item numbers for some other indications. Dr Mitchell is preparing this submission, the consideration of which must be finalised by May 2002. Dr Bennett mentioned the PoW unit was expecting a visit by the Director-General of the HIC (NSW) on his return – the purpose of this visit was not known.

8 HOTFIG and Australian Standard
Drs Millar and Bennett have been involved in these groups. The Australian Standard is looking to define requirements for compressed air workers, separated into Therapeutic Facilities (which encompasses our facilities) and Tunnels and Caissons. A new draft of the Standard applicable to our practice is expected soon.
Dr Bennett added that cleaning of the oxygen supply piping is a current concern (information presented at scientific meeting). Also technician training may be an issue.
Dr Wilkinson raised the concern about obesity, and the fact that AS2299.1 makes the statement that obesity increases the risk of DCI. It could not be recalled if the wording had been changed in the proposed standard for therapeutic facilities.

9 SIG
Dr Wong reported that the SIG-endorsed certificates are progressing slowly. The Cardiothoracic SIG have questioned the status of these certificates with Transoesophageal Echocardiography in mind. Our discussions continue with a view to an initial grandfathering period if certain criteria are met.

10, 11 Training in diving and hyperbaric medicine
Dr Millar reported that the dates circulated for the SIG/ANZHMG course to be run in Melbourne coincide with the F1 Grand Prix, making accommodation almost impossible. After discussion, it was agreed to schedule for 22 April to 3 May 2002. Dr Mitchell, in a rare moment of pessimistic reflection, questioned whether we would still be around then.
Action: Dr Millar to circulate revised dates of course.

12 List of approved indications for HBOT
It was recognised that this document is important and requires regular review. It was agreed to have it as a standing item on the agenda, and to add a date of last revision for referencing. No changes to list at this time.
Action: Dr Bennett to date list and recirculate.

13 Hboevidence.com
Drs Bennett and Millar spoke that this is the web site allowing access to the database of RCT and critical appraisals. It has not always been accessible, however this is being worked on.

14 UHMS 2004

Dr Bennett confirmed that the UHMS meeting will be held in Sydney in 2004, with the date yet to be confirmed. Need to avoid conflict with other meetings, such as World Congress of Anesthesiology (April) and ANZCA ASM (May). Considering either May or September.

15 Other business

ICHM 2002: Dr Oxer reminded all that this meeting will be held in San Francisco, October 2002.

HBOT in the treatment of radio-induced lesions in normal tissue: This interesting meeting will be held in Portugal in late October 2001. Apparently no one from this group attending.

Cleaning of oxygen supply lines: Dr Bennett commented that a build up of debris in the oxygen supply line had been identified in chambers at HMAS Penguin and at PoW. This was being corrected. It was brought to the attention of other units, and suggested it could be incorporated into the preventative maintenance schedule.

Accreditation of units: Dr Bennett questioned whether we should consider such a process. A sub-committee will consider the need and possible options, made up of Drs Trytko, Bennett, Wong and Wilkinson.
Action: Sub-committee to arrange meeting.

Awards: Dr Wong formally acknowledged the awards bestowed on two of our colleagues. Dr Bennett received the Albert Behnke Award at the UHMS 2001 meeting. Dr Mitchell was cited with the most influential paper published in the neuroprotective literature worldwide in the year 2000.

National dataset: Dr Millar expressed a desire for the treatment data amalgamated from all of our units to be able to answer specific queries. Such as number of patients with diabetes, or number of treatments given for radiation cystitis. No consensus reached at this point.

No further business.

Meeting closed at approximately 1110 hours.

Dr David Wilkinson

Honorary Secretary,
ANZHMG

MSAC review of hyperbaric oxygen treatment

Editor's comment: The ANZHMG have been very preoccupied in the past two years with the recent determination by the Medical Services Advisory Committee (MSAC) on Medicare benefit payments in Australia for hyperbaric oxygen therapy. This has a potentially major impact on some hyperbaric facilities, and there have been grave misgivings regarding the processes used in the consideration of this determination.

This matter has been drawn to the attention of the Australian Medical Association (AMA) in the letter below, which is reproduced here with the approval of the Chairman and Secretary of the ANZHMG. The AMA is now taking up this matter with the Federal administration. It was felt important to advise Australian SPUMS members of what is happening because of the wider implications for medical practice in Australia of MSAC's change in approach.

7th August 2002
AMA State Council
Dear Sirs,

Re: MSAC review of Hyperbaric Oxygen Treatment

We wish to bring to your attention a disturbing change in Medicare processes that may significantly impact the clinical practice of medicine beyond just the field of Hyperbaric Medicine. Hyperbaric Oxygen (HBO) treatment has been an accepted treatment for a number of conditions for many years. Medicare has reimbursed this treatment via item numbers 13020, 13025 and 13030. Reimbursement has previously been restricted to "comprehensive hyperbaric medicine facilities" as defined in the Medicare Benefits Schedule book. This essentially limits rebateable HBO treatments to a restricted list of indications in an established hospital facility with "multiplace" hyperbaric chambers (capable of containing several people simultaneously, and capable of complex delivery of care including managing critical care patients).

In 1999, the Medicare Services Advisory Committee (MSAC) was asked by a private individual to consider granting a specific Medicare item number for HBO treatment provided in a "monoplace" hyperbaric chamber. These monoplace chambers accommodate only one person and can potentially be used outside of an established hospital environment. There is minimal difference in therapeutic action or side effects of monoplace delivery of HBO compared with multiplace. For reasons that are unclear, MSAC itself determined to respond to this application by initiating a review of the entire field of Hyperbaric Medicine. This was not requested in the initial application.

The mission of MSAC to strengthen evidence-based health care in Australia is admirable and is supported by the

Australian and New Zealand Hyperbaric Medicine Group (ANZHMG). However, we are concerned about the manner of the MSAC-initiated review of Hyperbaric Medicine, which has resulted in reduced availability of this treatment for patients who had previously been funded by Medicare. **In raising our concerns with MSAC, we were disturbed to find there was no mechanism for appeal if the findings were in dispute.** Such a denial of natural justice is contrary to usual Government process.

MSAC has previously only reviewed new technologies on application. That is, medical services that do not have an item number but wish to apply for Medicare funding. With the HBO review, MSAC has opened the door to reviewing existing (funded) technologies. The change in direction by MSAC during the recent HBO review should be of significant concern to the whole medical profession. This unannounced change in MSAC practice led to some hastily changed words in the executive summary of MSAC's Hyperbaric Oxygen Therapy Assessment Report to refer to "new and **existing** technologies". The claim to reviewing existing technologies was not reflected in earlier drafts of the HBO report or an examination of the MSAC website, which continually refers only to "new technologies". There are also inconsistencies in the MSAC report's conclusions regarding HBO clinical evidence which require an appeals process for appropriate debate. If MSAC are going to initiate any review to existing item numbers and services, a process of appeal must be available. Health agencies performing such tasks in other countries recognise this and describe a transparent process of appeal for stakeholders if recommendations are disputed.

MSAC actually stated to Hyperbaric Physicians at the outset that there would be an opportunity for review of the recommendations of the report, however when completed, the report was released as a *fait accompli*, for immediate implementation in the Medicare Schedule.

The decision by MSAC to independently initiate a review of an existing medical treatment and to influence its Medicare funding without an appeals mechanism represents a serious threat to the profession. It has potential to be extended to other disciplines, in a systematic manner. This change in approach is a unilateral decision and is unannounced. We believe it should be vigorously challenged by the AMA.

The process is at odds with the MSAC website and the Assessment Guidelines posted on their website. In reading their Guidelines, the following observations can be made:

- The document itself is titled "MSAC funding for **new** medical technologies and procedures: application and assessment guidelines".

- 1.1 Overview, terms of reference state "new and emerging medical technologies". HBO treatment is neither new nor emerging. "Emerging" is not defined.

- 1.5.1 Who can apply? For "Medicare funding for a **new** medical service".

- 1.5.4 Priority for evaluation is determined in part by "availability of a satisfactory **alternative treatment or technology**". No such consideration made.

- Section 8 Choice of comparator: "MSAC is required to consider **comparative performance** in making its assessment of possible new professional services". Glaringly omitted from the assessment of HBO treatment!

- Part 33.1.1 When assessing the evidence in support of an application "carry out the above steps for the **comparator** in making the comparison".

- 3.5 All about comparing treatments…

The ANZHMG supports and publishes a list of indications for HBO treatment that are evidence-based. A minority of indications are not supported by level I-III evidence. However, these indications are supported by a sequence of scientific evaluation including sound biological reasoning, repeated *in vitro* evidence, controlled animal studies and large case series suggesting benefit over the known natural history of the condition. In many cases there are no other viable treatment options for patients.

The MSAC process applied to Hyperbaric Medicine should be of concern to the broader medical fraternity because:

- MSAC have determined to initiate their own review on their own terms and not be limited to an application.

- MSAC have independently determined to review existing medical treatment.

- If high levels of evidence do not support a medical treatment, it will be removed from the Medicare Schedule without further consideration, and without a clear process of resubmission if new evidence becomes available.

- No appeal process exists if these findings are disputed.

- Contrary to their own assessment guidelines which expect consideration of what alternative therapies exist for a condition, and the comparative evidence of efficacy for these therapies, this comparison was not undertaken for HBO treatment.

HBO therapy will continue as a valid treatment option for a number of conditions, however we as stakeholders feel we have been treated in an unfair and brutally bureaucratic manner. Ultimately, it is our patients who will suffer.

The danger in accepting the recent changes in MSAC process is that it establishes a precedent that could be applied

to any area of medicine with very disruptive consequences. MSAC feel they are justified in this approach, hyperbaric medicine is the test case to allow broader application of this process. The ANZHMG requests that the AMA bring this issue to prominence at Federal level and that the profession should be very wary of working with MSAC in the future.

Dr David Smart
(Chairman, on behalf of ANZHMG)

South Pacific Underwater Medicine Society 31st Annual Scientific Meeting

Theme: "Risk, diving and the pre-dive medical"

Dates: 16 to 26 May 2003
Venue: Palau Pacific Resort, Palau, Micronesia

Workshop: "Designing a pre-diving medical for the 21st Century"

Principal guest speaker: Professor Des Gorman
Conveners: Drs Cathy Meehan and Michael Bennett

Contact: Dr Cathy Meehan, <cmeehan@ozemail.com.au>

Book reviews

STARS BENEATH THE SEA

Trevor Norton

288 pages, paperback
ISBN 0-09-940509-1, 2000
London: Random House
Price: $20

Trevor Norton is Professor of Marine Biology at Liverpool University. This book is not about echinoderms however, though some of its protagonists appear to share the survival qualities of that hardy phylum. *Stars Beneath the Sea* is in fact a potted history of diving and hyperbaric research, seen through a series of personal profiles rather than an organised sequential history. Reading it, we may wonder at the hardihood of some of these pioneers from the 'good old days' before colour coordinated accessories, when a diver had to invent and make most of his own gear, and "divers had the bends for breakfast".

It is a pleasure to find an academic who agrees with Dr Carl Edmonds that with a little humour a book full of facts may become a pleasure to read. The book introduces the early naturalists with milk churns on their heads, plodding along the sea floor in leaden sandals, while assistants worked above sweating over car foot-pumps. The story goes on to the skin divers who seized the idea of air supply to become thoughtless predators and looters of wrecks. It then traces their personal evolution towards photography, study and conservation.

The same evolution is seen in the policies of the great museums, who first utilised divers to destroy reefs, and to ship tonnes of coral back to the city to be dried, painted and fitted with wax fish for exhibition.

Chapters are devoted to the heroic research and self-experimenting of the Haldanes and of Horace Wright, who subjected themselves to ordeals bordering on the masochistic. There is a good coverage of the pioneers of underwater still and cine photography, including the filming of Jules Verne's *Twenty Thousand Leagues Under the Sea*, complete with large rubber octopus. There is also an interesting account of the development of marine archaeology in the Mediterranean.

Who could forget the late, balding, Charles Bebe, resembling "an alert egg" as he emerged from the water? Or the late Jack Kitching, so unconcerned by personal appearance or nutrition that "if he had been a chicken, you wouldn't have eaten him"? Of course, much history had to be omitted, but at least we learn that probably the first scuba club was called 'The Bottom Scratchers'.

To compensate for omissions, Norton has provided twelve pages of references for further reading and research. Norton is himself a keen diver, and his enthusiasm comes through in the text. In contrast to the weighty volumes usually reviewed in these columns, *Stars beneath the sea* is a mere $20 paperback, but it is a recommended read, if only for its deluge of facts and anecdotes with which to amuse ones companions between dives, or at dinner.

There is a small criticism in the quality of the photographs, many of which have lost contrast in the copying. They have the dull, grotty look so often seen in publications of local history. It is a much greater criticism that the book's value should have been compromised by the omission of an index. I have tried to compile a rough index for my own use. Our Editor has it, and I am sure he will agree to post a copy to any reader who may find it useful.

Jim Marwood

Key words
Book reviews, history, general interest

Editor's note: Dr Marwood's index is available on request.

THE SPORTS DIVING MEDICAL
– A guide to medical conditions relevant to scuba diving

John Parker

2nd Edition, 172 pages, paperback
ISBN 0 9587 118 6 0, 2002
JL Publications, PO Box 387 Ashburton, Victoria 3167 Australia
Available from DAN SE Asia-Pacific, PO Box 384, Ashburton 3147, Australia.
Ph (03) 9886 9166; Fax: (03) 9886 9155
Email: <info@danseap.org>
Price including postage & GST A$45.00 inside Australia, A$52.00 overseas

In 1994, Dr John Parker published the first edition of this very practical and comprehensive guide to the recreational diving medical examination. At that time, the cover notes indicated that Dr Parker's personal experience extended to more than 10,000 diving medicals. Having now performed several thousand more medicals, he has updated and improved the book for its second edition.

This edition opens with a new chapter titled "Risk Assessment and Acceptance". Like the rest of the book, this subject is dealt with in brief, organised, point form paragraphs which are easy to read and refer to. This choice of opening chapter reflects the change towards informed

risk acceptance that is increasingly being demanded by the "consumer" and accepted by many doctors as the appropriate way to approach the diving medical examination. Dr Parker presents this subject in as lucid a fashion as I have come across, and then finishes by listing seven levels of comfort that he has personally identified with respect to his own practice of assessing the risks of diving for various candidates.

As Dr Parker points out, it is acknowledged that medical opinion will vary with the training, experience and personal attitude of different diving medical examiners. Not all will find themselves agreeing with Dr Parker's approach on every issue, either in this chapter or elsewhere in the book. This is not a problem, however, as the text's well thought out notes and "points to ponder" are clearly separated from Dr Parker's personal opinion throughout.

The rest of the book proceeds as previously with an overview of diving, divers, diving physics and the practicalities of a diving medical. This is followed by a detailed coverage of the diving fitness implications of an extraordinary range of conditions and diseases, organised into body system chapters. The material is more detailed than previously and an even wider range of conditions are covered. Each chapter now has its own detailed bibliography and in this edition Dr Parker has addressed the controversial areas of divers who are asthmatic, diabetic or significantly disabled.

This new edition is a worthwhile upgrade for all who have purchased its predecessor. It will be of value to anyone who undertakes diving fitness assessments. Many diving medicine specialists I know keep a copy close at hand in order to check John Parker's notes and opinion before giving their own. If I had to choose to own only one publication on fitness to dive, then this would be it.

Ian Millar

Key words
Book reviews, fitness to dive, medical conditions and problems, medicals, diving

---

REPORT ON AUSTRALIAN DIVING DEATHS, 1994–1998

Douglas Walker

54 pages, paperback
ABN: 67 066 827 129, 2002
JL Publications, PO Box 387 Ashburton, Victoria 3167, Australia
Available from DAN SE Asia-Pacific, PO Box 384, Ashburton 3147, Australia.
Ph (03) 9886 9166; Fax: (03) 9886 9155
Email: <info@danseap.org>
Price including postage & GST A$33.00 inside Australia

This report details the 92 diving and snorkelling-related deaths that occurred in Australia during the years 1994 to 1998 inclusive. They have been published year by year in this Journal.

The report is divided into each year's cases with a table summarising the year. Each case is clearly and succinctly described with sufficient detail to provide interest. A summary of key words about each case is provided in capitals.

Dr Walker's reports make compelling reading each year in the SPUMS Journal. Like many doctors, I recall anecdotes and case studies more easily than study reports. The messages from these cases will be well learned by any reader.

The clarity of the writing is such that an unexpected reader was my 15-year-old son who is a novice diver. He had plenty of questions, which suggested that some of the information might have penetrated his teenage belief that he is bullet proof.

The report will be useful for anyone planning presentations on diving-medical matters. It will also assist dive instructors and diving tourism industry employees to appreciate the hazards and avoidable factors that repeatedly contribute to diving fatalities.

Graham McGeoch

Key words
Book reviews, breathhold diving, scuba, deaths, drowning, case reports

---

OXYGEN FIRST AID (2nd edition)

John Lippmann

160 pages, paperback
ISBN: 0-646-23565-6, 2002
JL Publications, PO Box 387 Ashburton, Victoria 3167 Australia
Available from DAN SE Asia-Pacific, PO Box 384, Ashburton 3147, Australia.
Ph (03) 9886 9166; Fax: (03) 9886 9155
Email: <info@danseap.org>
Price including postage & GST A$29.80 inside Australia

If you thought that oxygen first aid simply meant opening up the cylinder and pulling a mask over the patient's face, then this book is for you. John Lippmann's second Asia-Pacific edition of *Oxygen First Aid* is a comprehensive guide to the provision of oxygen in first aid and emergency care.

Oxygen therapy is pivotal in the initial therapy of any acutely ill or injured patient. This book is targeted at all pre-hospital oxygen providers and anyone providing first aid care. The book evolves logically from initial chapters

and outlines the benefits of breathing elevated oxygen concentrations in specific situations with particular attention to diving injuries. It highlights the adverse effects of oxygen therapy.

There are an interesting couple of chapters on the nuts and bolts of oxygen therapy explaining the storage and handling of oxygen, with discussion on oxygen cylinders, valves and regulators and a detailed account of oxygen delivery systems from nasal prongs to comprehensive closed circuit oxygen devices.

Bullet point, highlighted tables define different forms of oxygen provision to both the breathing and non-breathing victim. Final chapters cover issues like infection risk, care and maintenance of oxygen equipment and legal considerations.

The book is concise, well laid out and easily readable. It is frequently punctuated with both diagrams and photographs demonstrating equipment or procedures. Key information is highlighted in shaded tables and every chapter concludes with a number of searching review questions.

The book covers the topic well, but I did wonder if perhaps oxygen provision has become more complex than it needs to be. My preference would be for a Hudson non-rebreather mask in most patients and to use bag-valve mask for oxygen resuscitation. This would be in keeping with Emergency Departments worldwide and as is taught by life saving organisations.

This book is essential reading for anyone who provides pre-hospital first aid. It serves effectively as an introduction and a reference text for both lay and professional users of oxygen therapy.

Sandy Inglis

Key words
Book reviews, first aid, resuscitation, oxygen

DIVE SAFELY

Health and Safety Executive (HSE) Video.
Format PAL VHS. Running time 37 minutes.
Available from HSE Offshore Division, Lord Cullen House, Fraser Place, Aberdeen, AB25 3UB, Scotland.

Over the last few years there has been an increase in the number of diving accidents in the UK. Readers may remember Alister Wallbank's paper in the June issue, 2001 "Can anybody see me?",[1] which was based on his work on Diver Emergency Surface Location Devices for the HSE Scottish Diving Inspectorate. HSE produced a video based on this work, which has resulted in a 60 per cent reduction of call outs for divers reported missing in the past two years.

Dive Safely was developed to follow on from the preview HSE Scottish Diving Inspectorate video, which ended with the rescue of the diver (usually just the beginning of the process). Frank Murray, Principal Inspector of Health and Safety (Diving - Scotland) has produced this video to further educate divers. UK waters provide the setting, and the rescue procedures are UK procedures – notify the Coast Guard on the emergency radio channel and they will organise the rescue. However, wherever one dives the basic principles are the same: recognise that there is a problem, give first aid and call for help. Throughout the video, the theme of recognition, first aid, rescue and transfer to the nearest hyperbaric facility is repeated.

The video emphasises that good buoyancy control is essential to prevent avoidable ascent problems. All divers should know the basic physiology and the symptoms of decompression illness (DCI) and pulmonary barotrauma and how to recognise them. The HSE recommend the use of a shotline, which allows a diver to control ascent even if in difficulty. Buoyancy tips include how to avoid an inverted ascent when using a dry suit. Practical advice for diving safely includes logging divers in and out of the water, carrying oxygen on board, knowing the rescue procedures and how to contact the emergency services.

Two divers tell the story of their unexpected problems. The first was doing a deep dive on multiple gas mixes. His dry suit zip failed on the bottom and hypothermia forced him to miss a lot of decompression. He ended up being flown by helicopter to the Aberdeen recompression chamber with paraplegia. The other did a simple 35-minute dive early in the morning, then quickly developed quadriplegia. This passed off fairly rapidly and he was able to drive home. He waited three hours before deciding that there might be something wrong and then it took seven hours to get him to a chamber. He was later shown to have a patent foramen ovale, which has been surgically closed.

The problems of reaching a chamber are far fewer in the UK than in Australia, as there are over 20 hyperbaric units shown on the map of the British Isles.

The HSE has done an excellent job of producing this video, which should be viewed by all divers. It is a highly recommended 37 minutes of viewing.

John Knight

References
1. Wallbank A. Can anybody see me? *SPUMS J* 2001;31:116–9.

Key words
Video reviews, safety, scuba, rescue, transport, accidents, decompression illness

DIVING AND HYPERBARIC MEDICINE INTRODUCTORY COURSE

The Alfred Hospital, Melbourne
17 to 28 March 2003

Applications are invited for a two week, full time course aimed at doctors interested in the fields of therapeutic diving and hyperbaric medicine. This includes referring clinicians who wish to gain more knowledge about the field as well as doctors who are involved or may become involved in the operation and supervision of hyperbaric medicine facilities.

The course is jointly presented by:

The Australian and New Zealand College of Anaesthetists Special Interest Group in Diving and Hyperbaric Medicine and
The Australian and New Zealand Hyperbaric Medicine Group

Course Director: Dr Ian Miller

The course has been offered at Prince of Wales Hospital, Sydney in 2000 and 2001 and at The Alfred in 2002 and 2003. The course faculty includes speakers from most of Australia's major hyperbaric units. Significant practical work is included and attendees are strongly encouraged to experience pressurisation in The Alfred's state of the art rectangular, walk-in chambers. A comprehensive set of course notes will be provided.

Topics to be covered include:

Physics and physiology underlying diving and hyperbaric medicine
Decompression illness, gas embolism, gas toxicity
Hyperbaric oxygen mechanisms
Hyperbaric chamber operations and safety
Ventilation and intensive care management under pressure
Application of HBO in "approved indications" such as: radiation tissue damage, diabetic micro-vascular disease, necrotising infections, crush injury, compartment syndrome and acute ischaemias
Evidence-based medicine and information resources
Review of common "off-list" uses promoted by some alternative, paramedical and sports clinics

Course fee: A$1,500 (+GST for Australian registrants)

Credits: Fulfils course requirements for SPUMS Diploma and the forthcoming ANZCA SIG Certificate.
Accredited, via UHMS, for 70 US CME points.

Enquiries to:
Ms Elmarie Celestial or Dr Ian Millar
The Alfred Hyperbaric Service
Phone (03) 9276 2269Fax (03) 9276 3052
Email <hyperbaric@alfred.org.au>

ROYAL ADELAIDE HOSPITAL HYPERBARIC MEDICINE COURSE
Medical Officers Courses

October/November 2002

Basic	21/10/02	to	25/10/02
Advanced	28/10/02	to	1/11/02

Cost

Basic Diving Medicine Course	**$825.00**
Advanced	**$825.00**

For further information or to enrol contact:

The Director, Hyperbaric Medicine Unit
Royal Adelaide Hospital, North Terrace
South Australia 5000.

Telephone	Australia	(08)-8222-5116
	Overseas	+61-8-8222-5116
Fax	Australia	(08)-8232-4207
	Overseas	+61-8-8232-4207

NAVAL HEALTH SERVICES – DIVING MEDICINE COURSE 2002

RNZ Naval Base, Devonport, Auckland,

Saturday 23 to (pm) Tuesday 26 November.

The course introduces candidates to the principles of diving and hyperbaric medicine and focuses on the assessment of an individual's fitness for diving and hyperbaric exposures, and on first aid for the common diving illnesses.

Course recognised by the New Zealand Department of Labour and the United Kingdom Health & Safety Executive.

Cost: $750 (inclusive of GST)
(includes course notes, and refreshments)

A maximum of 15 places will be available on the course and early enrolment is advised. This requires payment of $150 deposit (please make cheques payable to **NZ Defence Force – Navy**). Another course will be offered in 2003.

For further information, including information about accommodation in the Devonport area, please contact:

Angie Smith
Naval Health Services
PO Box 32 901
AUCKLAND
Tel: 09 4455972 Fax: 09 4455973
Email: <angie.smith@nzdf.mil.nz>

BIOMEDICAL SEMINARS DIVING MEDICINE
(Course Director: David Elliott)

Plaza resort, Bonaire, Netherlands Antilles

9 14 February 2003

- covers assessment of fitness for recreational diving
- conforms with the recommendations of the International Marine Contractors Association (IMCA) for training of medical examiners of working divers worldwide
- is suitable for doctors who can no longer be approved by the HSE because they are resident outside the UK
- complies with other national recommendations, eg. India, with an optional supplement of four hours' practical guidance
- covers training and revision training for HSE Approved Medical Examiners in UK
- is based on the agreed training objectives of the EDTC and ECHM
- facilitates the provision of health care delivery for recreational and working divers. After attending this course, physicians should be able to initiate appropriate management of diving accidents until a diving medicine specialist can be consulted

The Royal College of Physicians has approved this course through the Faculty of Occupational Medicine for 24 hours of Continuous Professional Development (CPD) in the UK *(appropriate for all specialities).*

The Undersea and Hyperbaric Medical Society designates this CME activity for 24 credit hours in Category 1 of the Physicians' Recognition Award of the American Medical Association.

The teaching programme, as always, will be intensive and includes:

- underwater physiology.
- medical assessment of fitness for professional and recreational diving.
- diagnosis and management of diving accidents and illnesses.
- medical support of diving operations

For the benefit of those who may wish to go diving, the course will be run for four hours each morning (except on the last day, Friday, when it will be held in the afternoon because of those planning to fly home on Saturday afternoon).

Full details are available from
Biomedical Seminars, 7 Lyncroft Gardens, Ewell, Surrey KT17 1UR, England.
Telephone + (44) 208 393 3318 Fax + (44) 208 786 7036
<Karen@biomedseminars.demon.co.uk>

NOW AVAILABLE

The South Pacific Underwater Medicine Society has produced a CD, readable by at least Windows and Macintosh computers, containing every issue of the Society's Newsletter and Journals as Adobe.pdf documents, from the first issue in May 1971 until and including December 2000. All that is needed to read and print these documents is Adobe Acrobat Reader (version 3 or later) which can be downloaded free from the Adobe web site.

None genuine without this label

The CD also contains the index for the South Pacific Underwater Medicine Society Journal. This runs from 1971 (Volume 1) to December 2000 (Volume 30 No.4).

The index is supplied as a downloadable tab-separated document, which can be entered into the reader's database. It is supplied in RTF (rich text format) and as Windows 97 DOC and TXT for Windows. Macintosh formats are RTF and Word for Mac 5.1.

The CD is available for $Aust 25 (including GST or overseas mailing charge). Cheques or money orders should be made payable to 'South Pacific Underwater Medicine Society'.

Contact: The SPUMS Administrator,
C/o ANZ College of Anaesthetists,
630 St Kilda Road,
Melbourne, Victoria 3004,
Australia

Undersea and Hyperbaric Medical Society 36th Annual Scientific Meeting

Dates: 19 to 21 June, 2003
Venue: Hilton, Quebec City, Canada

Contact: Don Chandler, UHMS,
10531 Metropolitan Avenue, Kingston,
Maryland 20895, USA
E-mail: <uhms@uhms.org>

UHMS web site: http://www.uhms.org

UHMS Great Lakes Chapter Meeting

Date: 2 November 2002
Venue: Burlington at the Canada Centre for Inland Waters

Contact: Ron Nishi,
E-mail: <ron.nishi@dciem.dnd.ca>
Web site: http://www.uhms-glc.ca

European Undersea Baromedical Society 2003 Scientific Meeting Preliminary Notice

Dates: 27 to 31 August 2003
Venue: University of Copenhagen
The Panum Institute
Blegdamsvej 3 C
2200 Copenhagen N
Denmark
Contact: Peter Mueller
Speyerer Strasse 91-93, D-68163,
Mannheim, Germany
EUBS web site: http://www.eubs.org
E-mail <eubs@hbo-mannheim.de>

Preliminary notice: 2004 meeting will be in France.

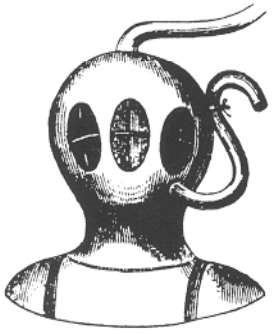
Australian and New Zealand College of Anaesthetists Annual Scientific Meeting

Dates: 3 to 7 May 2003
Venue: Hobart, Tasmania

The Hyperbaric Medicine Special Interest Group will have a session at the ASM on diving and hyperbaric medicine.

Contact: <Robert.Wong@health.wa.gov.au>

THE HISTORICAL DIVING SOCIETY



Registered Charity No 1054184

Little Gatton Lodge
25 Gatton Road
Reigate
Surrey
RH2 0HD
United Kingdom
Tel: 01737 249961
Fax:01384 896079

e mail: info@thehds.com
Web: www.thehds.com

Annual Conference
Date: 2 to 3 November 2002
Venue: Chatham, Kent, UK

HTNA Annual Meeting

Preliminary Notice

Dates: 29 to 31 August 2003
Venue: Hotel Grand Chancellor, Hobart, Tasmania

Contact: Corry van den Broek
Email: <corry.vandenbroek@dhhs.tas.gov.au>

International Congress "Diving in the armed forces today"

Dates: 23 to 27 April 2003
Venue: Cavtat (Dubrovnic), Croatia

Contact: Cdr Nadan M Petri,
2100 Split, IPM,
P O Box 196 (HRM),
Croatia
E-mail: <nadan.petri@morh.hr>

INSTRUCTIONS TO AUTHORS

The SPUMS Journal welcomes contributions (including letters to the Editor) on all aspects of diving and of hyperbaric medicine. Manuscripts must be offered exclusively to the SPUMS Journal, unless clearly authenticated copyright exemption accompanies the manuscript. All manuscripts, including SPUMS Diploma theses, will be subject to peer review. Accepted contributions will be subject to editing.

Contributions should be sent to:
The Editor, SPUMS Journal, C/o Office 137, 2nd Floor, Christchurch Hospital, Private Bag 4710, Christchurch, New Zealand. E-mail:<spumsj@cdhb.govt.nz>

Requirements for Manuscripts
Documents are acceptable on disc or by e-mail. The preferred format is Word 6 for Windows. Illustrations and tables should **NOT** be embedded in the wordprocessor document, only their position indicated. **All tables are to be tab-separated text columns rather than using the tables option, and saved as separate files.** Illustrations should be separate documents in TIFF or EPS format, clearly marked with the format used. **References should be in the correct format, shown below**. Two printed copies of all text, tables and illustrations should be forwarded as well.

The printed copies and electronic files should be double-spaced, using both upper and lower case, on one side of the paper only, on A4 paper. Headings should conform to the format in the Journal. All pages should be numbered. No part of the abstract, text, references or legends to figures should be underlined. Measurements are to be in SI units (mm Hg are acceptable for blood pressure measurements) and normal ranges should be included. All tables should be double spaced on separate sheets of paper. **No vertical or horizontal rules are to be used.**

Photographs should be glossy black-and-white or colour. Slides should be converted to photographs before being sent. Colour reproduction is available only when it is essential for clinical purposes and may be at the authors' expense. Legends should be less than 40 words, and indicate magnification.

Abbreviations do not mean the same to all readers. To avoid confusion they should only be used after appearing in brackets after the complete expression, e.g. decompression illness (DCI) can thereafter be referred to as DCI.

The preferred length for original articles is 3,000 words or less. Inclusion of more than five authors requires justification. Original articles should include a title page, giving the title of the paper and the first names and surnames of the authors, an abstract of no more than 250 words and the text be subdivided into Introduction, Methods, Results, Discussion, Acknowledgements and References. Case reports should not exceed 1,500 words, with a maximum of 10 references. After the references, the authors should provide their initials and surnames, their qualifications, and the positions held when doing the work being reported. One author should be identified as correspondent for the Editor and for readers of the Journal. The full current postal address of each author, with the telephone, facsimile numbers and e-mail address of the corresponding author, should be supplied with the contribution. No more than 30 references per major article will be accepted. Accuracy of the references is the responsibility of authors. Acknowledgments should be brief. Abstracts are also required for all case reports and reviews. Letters to the Editor should not exceed 400 words (including references which should be limited to five per letter).

References
The Journal reference style is the "Vancouver" style, printed in the Medical Journal of Australia, February 15, 1988; 148: 189-194. In this system references appear in the text as superscript numbers.[1,2] The references are numbered in order of quoting. Index Medicus abbreviations for journal names are to be used. Examples of the format for quoting journals and books are given below.

1 Anderson T. RAN medical officers' training in underwater medicine. *SPUMS J* 1985; 15: 19-22
2 Lippmann J, Bugg S. *The diving emergency handbook*. Melbourne: JL Publications, 1985

There should be no full stops after the reference numbers. There should be a space after the semi-colon following the year and another after the colon before the page number and no full stop after the page numbers. Titles of quoted books and journals should be in italics.

Consent
Studies on human subjects must comply with the Helsinki Declaration of 1975 and those using animals must comply with National Health and Medical Research Council Guidelines or their equivalent. A statement affirming Ethics Committee (Institutional Review Board) approval should be included in the text. A copy of that approval should be available if requested.

Copyright
Authors must agree to accept the standard conditions of publication. These grant the SPUMS Journal a non-exclusive licence to publish the article in printed form in the SPUMS Journal and in other media, including electronic form. Also grants the right to sub-licence third parties to exercise all or any of these rights. The South Pacific Underwater Medicine Society Journal agrees that in publishing the article(s) and exercising this non-exclusive publishing sub-licence, the author(s) will always be acknowledged as the copyright owner of the article.

DIVER EMERGENCY SERVICES PHONE NUMBERS

AUSTRALIA
1-800-088-200 (in Australia)
+61-8-8212-9242 (International)
The DES number 1-800-088-200 can only be used in Australia

NEW ZEALAND
0800-4-DES or 09-445-8454 (in New Zealand)
+64-9-445-8454 (International)
The DES number 0800-4-DES can only be used in New Zealand

PROJECT STICKYBEAK

This project is an ongoing investigation seeking to document all types and severities of diving-related accidents. Information, all of which is treated as being **CONFIDENTIAL** in regards to identifying details, is utilised in reports and case reports on fatal and non-fatal cases. Such reports can be freely used by any interested person or organisation to increase diving safety through better awareness of critical factors.

Information may be sent (in confidence) to:
Dr D. Walker
P.O. Box 120, Narrabeen, N.S.W. 2101.

DIVING INCIDENT MONITORING STUDY (DIMS)

DIMS is an ongoing study of diving incidents. An incident is any error or occurrence which could, or did, reduce the safety margin for a diver on a particular dive. Please report any incident occurring in your dive party, but do not identify anyone. Most incidents cause no harm but reporting them will give valuable information about which incidents are common and which tend to lead to diver damage.

Using this information to alter diver behaviour will make diving safer.

To obtain or to return Diving Incident Report forms write to:
DIMS,
30 Park Avenue, Rosslyn Park, South Australia 5072, Australia.

PROJECT PROTEUS

The aim of this investigation is to establish a database of divers who dive or have dived with any medical contraindications to diving. At present it is known that some asthmatics dive and that some insulin dependant diabetics dive. What is not known is how many. How many with these conditions die is known. But how many dive safely with these conditions is not. Nor is the incidence of diving accidents in these groups known.

This project is under the direction of Dr Douglas Walker and Dr Mike Bennett. The investigation has been approved by the Ethics Committee of the Prince of Wales Hospital, Randwick, approval number 01/047.

If you are in such a group please make contact. All information will be treated as **CONFIDENTIAL**
No identifying details will appear in any report derived from the database.

Write to Project Proteus
PO Box 120, Narrabeen, New South Wales 2101, Australia.
E-mail <diverhealth@hotmail.com>

DISCLAIMER
All opinions expressed are given in good faith and in all cases represent the views of the writer and are not necessarily representative of the policy of SPUMS.

Printed by Snap Printing, 166 Burwood Road, Hawthorn, Victoria 3122