THE WORLD AS IT IS

WELCOME
EUROPEAN JOURNAL OF UNDERWATER AND HYPERBARIC MEDICINE

John Knight

Key Words

Diving theory, general interest, hyperbaric research, physiology, diving medicine.

The SPUMS Journal congratulates the European Underwater and Baromedical Society (EUBS) for producing the first issue of the European Journal of Underwater and Hyperbaric Medicine (EJUHM) and looks forward to many years of international co-operation. The EUBS Newsletter, edited by Dr Peter Mueller, has undergone a transformation into a quarterly Journal, published in English, with an International Editorial Board of 32 drawn from 21 countries. SPUMS members can take pride in the fact that Dr Mueller, who is a member of SPUMS, when he was appointed Editor of the EUBS Newsletter last year, told the Editor that his aim was to turn the EUBS Newsletter into a Journal like the South Pacific Underwater Medicine Society Journal. Dr Mueller is to be congratulated on persuading the Committee of EUBS to back his ideas and on the content of the first issue.

Included in this issue are well worth reading papers by David Elliott (Medical Assessment of Fitness to Dive) and Valerie Flook (The Physics and Physiology of Decompression). The thrust of her paper is that off gassing and bubbles are controlled by physics rather than by supersaturation, and that the basic physics of off gassing were published in 1963.[1] The Editor has always been amazed that so little attention has been paid, in the underwater medical literature, to the asymmetry between gas uptake and gas excretion which has been known to anaesthetists as far back as 1956, when he started his anaesthetic education, as the explanation of why induction of anaesthesia with nitrous oxide was faster than the recovery time. Dr Flook's paper, part of a *Back to Fundamentals* series, should be read by all divers interested in the risks of bubble formation. Dr Mueller deserves congratulation on the standard of production of the European Journal of Underwater and Hyperbaric Medicine. There appears to be only one typographical error, a standard that the SPUMS Journal has hardly ever achieved!

Reference

1 Mapleson WW. An electrical analogue for uptake and exchange of inert gases and other agents. *J Appl Physiol* 1963; 18: 197-204

OZTEK 2000
AUSTRALIAN DIVING TECHNOLOGIES CONFERENCE

Lynn Taylor

Key Words

Decompression illness, equipment, meeting, mixed gas, rebreathers.

Richard Taylor again organised a successful OZTek conference in Melbourne, with the help of David Strike and Barry Heard. The topics for the general meeting were of interest to all divers, even if they had no intention of using high tech equipment. Those interested in rebreathers had displays and workshops as another part of the conference while the general subjects were being presented.

On the Friday night the decks of the *Polly Woodside* were covered with drinkers celebrating the start of OZTek 2000. A wonderful place to meet old friends and new speakers.

Developments in decompression theory

In his introduction Chris Parrett, creator of the Abyss decompression software, referred to the 4 goals of deep decompression recreational diving. To dive deeper, for longer, with shorter deco stops and to experience no decompression illness (DCI). A daunting task.

Chris took us through an explanation of the Reduced Gradient Bubble Model (RGBM) theory which is used for his latest version of Abyss. Much of the physics is complex, but the focus is on micronuclei, bubbles, and the surfactants that stabilise them. In utilising this theory to calculate decompression algorithms, the goal is to keep the bubbles in their tiny stable micro-nuclei state. The decompression profiles produced by RGBM calculations incorporate deeper decompression stops than most other algorithms. These attempt to maximise the rate of inert gas elimination by incorporating a maximal ascent to the first stop, establishing the greatest possible tolerable inert gas pressure gradient in tissues, which may well cause bubbles to form before the first stop. The RGBM is designed to minimise the chance of "exciting" bubble micronuclei into growth; hence, the focus is on a reduced gradient. The deeper early stops, perhaps surprisingly, produce reduced time at the shallower stops, and an overall reduction in decompression time.

The first of Chris' algorithms, the Abyss 100 required 524 minutes of decompression for a dive to 84 m for 250 minutes. To improve safety Abyss 120 required 705 minutes of decompression for the same dive. The last of his tissue supersaturation algorithm, the Abyss 150 required 1,426 minutes of decompression for the same same. However using the new Abyss RGBM model only requires 413 minutes of the same level of, presumed, safety. The RGBM theory is incorporated in the algorithm used in both the SUUNTO and ABYSS dive computers.

An interesting theory discussed by Chris involves the concept that micronuclei can be “crushed”. The theory is that surfactant molecules coat the surface of micronuclei, otherwise they would disappear because of surface tension effects. Pressure at depth is thought to squash these molecules together so that they compete with each other for space and eventually ‘pop-off’. The micronuclei bubble is now de-nucleated and the bubble seed is eliminated. This is the (unsubstantiated) theory supporting a short deep ‘bounce’ or ‘crush’ dive at the start of a day’s diving activities.

Developments in cave diver rescue and training

Lamar Hires told us that between 1950-1998 there have been over 450 diving fatalities in the overhead environment (439 male + 21 female) with 401 being in the USA and 19 in Australia. In the 1990s, most of these divers have been trained to cave diver level or above. Fatalities have largely been due to errors in switching to the wrong gas mix at the wrong depth. But losing the line in a blackout situation still causes deaths. Lamar Hires is a volunteer cave rescuer and he presented details of an underwater cave rescue and recovery clinic he has developed where cave divers can gain practical experience in rescue and recovery techniques. His description of one rescue where two buddies, expecting to probe deep into the cave, lost contact in nil visibility within minutes of entering the cave was rivetting. The rescue was due to the lost diver’s sitting quietly for over three hours waiting to be rescued. Her confidence was misplaced in the first attempt to find her as the rescuers did not ask her buddy the right questions and assumed that they had separated well inside the cave. Lamar Hines reinterviewed him and established the fact that they had not found the line into the cave, so were close to the entrance. When she heard the divers enter the water she started tapping her tank and led her rescuer to her position in a cave off and above the entry.

Recompression chambers in the South Pacific

Divers Alert Network (DAN) are undertaking an international project to register all recompression facilities and gather information on location, contact number, staff experience and chamber capabilities. As part of this process, DAN will be evaluating all chamber standard operating procedures for dealing with an emergency.

Bob Ramsay has been involved in setting up chambers in Papua New Guinea (Por Moresby) and Vanuatu (Santo) in the last few years. Now if you get bent on the *President Coolidge* you no longer have to be evacuated to Australia.

In Australia there are 12 registered facilities and 2 in New Zealand (Devonport Naval Base and Christchurch).

Aspects of the pathophysiology of decompression illness

Dr Simon Mitchell, in a wide ranging review, discussed the classification of decompression illness (DCI), the mechanisms of bubble formation (with examples of their effects in some organ systems) and the major risk factors associated with DCI.

His presentation focussed on the formation of bubbles in the tissues and blood from dissolved inert gas (traditionally called decompression sickness, DCS) and started with a basic explanation of how bubbles form. Inert gas is absorbed into blood and tissues during exposure to increased pressure; bubbles then form during/after ascent when the pressure of the dissolved gas in the blood/tissues exceeds ambient pressure (supersaturation). Quite how bubble formation and growth is initiated is unknown. Surface tension at the gas-fluid interface creates an immense physical force that resists de novo bubble formation. In theory, such force cannot be overcome by the degree of supersaturation achieved in a conventional dive. In reality, venous bubbles have been detected in man after air saturation dives to only 3.5 m. These dissonant observations gave rise to the theory of pre-formed “micronuclei”. These minute bubbles, whose source is uncertain and which may be stabilised by surfactants, act as seeds which grow in conditions of inert gas supersaturation. In animal experiments venous bubbles are detectable within minutes of a dive, peak at 25 minutes and are stable for 1-2 hours. A similar time course for bubble detection has been described in humans.

Dr Mitchell mentioned that exercise during pressure exposure hastens the absorption of inert gas in those tissues whose perfusion is increased during work, so increasing decompression requirements and the risk of DCI. However, mild exercise during decompression enhances inert gas elimination, reduces decompression requirements and venous bubble formation, and so reduces the risk of DCI. Gentle finning on a safety/deco stop is advantageous. Strenuous post-dive exercise, such as pulling up an anchor line, has been shown to increase the risk of DCI.

The relationship between cold and DCI is complex and depends upon the timing of the cold exposure. If a diver is cold from the start of a dive, data suggests that bubble formation and the risk of DCI is reduced, probably as a result of decreased blood perfusion and reduced on gassing.

If a diver is warm and peripherally well perfused initially and then becomes cold and poorly perfused during the dive, the risk of DCI is increased. Exposure to excessive cold after a dive is associated with an increase risk of DCI (perhaps due to reduction in perfusion and off gassing). However, active re-warming (such as a hot shower) has been linked with the precipitation of DCI, probably due to a sudden rush of bubbles from a reduction in gas solubility in the rapidly warmed superficial tissue.

Other presentations

Bernie Chowdhury, the publisher of Immersed, discussed the scuttling of the German fleet at Scapa Flow in the Orkney Islands at the end of WW1. The description of how Ernest Cox's determination to salvage some of the ships was carried out successfully, although he knew nothing of diving or salvage, but was able to think latterally. The ships had been scuttled not torpedoed so he reasoned that if all the deck and side openings could be closed the ships could be refloated. Among other things, to provide dry working conditions he had old boilers rivetted together and used them as vertical coffer dams on the decks. In another presentation Bernie recounted his experiences in Icelandic diving where one water filled lava tunnel had been largely closed by the effects of plate tectonics in the year between two visits. His diving had to be done in a Superlite helmet, which made using normal recreational diving gear with a separate mask and mouthpiece a bit difficult. The reason for this was an unhealed perforated eardrum. In the dry in the helmet water could not get into the middle ear. The price was not being able to put his head back very far. What people will do to get into icy water in foreign parts!

Gary Gentile described how the expedition, on which he was the only American among Brits, managed the supply problems, gas supplies and Anglo-Irish race relations (rescue three fishermen from their sinking boat on the first day's diving), using tri-mix, on the *Lusitania*.. He explained the design and use of a floating deco-stop station, which allowed safe decompression while drifting in the strong currents. His fortnight's "holiday", working and diving from 0700 to 2300 every day, only cost him some $US2,000 for travel, accommodation, food, gas supplies etc. His transatlantic air fare was only few hundred dollars extra.

Keith Gordon, from New Zealand, who recently spent days waiting for sea conditions suitable for a dive using tri-mix on the wreck, described the sinking of the *Niagara* in 1941 and the recovery of most of the estimated 590 gold bars on board using grabs directed by a diver in a one-atmosphere bell.

David Applerley described the cave structure of the Pearce Resurgence, in New Zealand, which he dived using an Inspiration closed-circuit rebreather reaching depths of 125 m. There is more to this story as they did not reach the end. The approach to the dive site is by helicopter!

Noel Taylor gave us a guided tour of 8 diveable wrecks at Guadalcanal and briefly reviewed the spectacular diving that the Solomon Islands has to offer. He then described the history behind the sinking of the troop ship *President Coolidge* off Santo and from there went to Bikini and its wrecks. Well off the beaten track nitrox or rebreathers are recommended as the best wrecks are deep.

The OZTek Industry Achievement Award was presented to Kevin Denlay, in recognition of his development and promotion of technical diving within Australia and the South Pacific.

The OZTek Australasian Technical Diver of The Year was awarded to David Apperley, in recognition of having done the most to extend the range of technical diving within the Australian and South Pacific region in the past 12 months.

All in all, an excellent, informative and entertaining two days. Plans are afoot for OZTek 2001.

Lynn Taylor is a PADI IDC Staff Instructor and a DAN O_2 instructor. She came to New Zealand, from England, in 1994 and soon found a passion for diving. Her interests in the technical and medical aspects of diving have stemmed from her science and research background, BSc and PhD, and hence her interest in OzTeK. Her address is 26 Barker Rise, Browns Bay, Auckland, New Zealand. Telephone + 64-9-367-2948. Fax +64-9-367-2500. E-mail <ltt21040@GlaxoWellcome.co.uk>.