

E-NEWS

EDITOR'S NOTE – June 2023

The E-News is the monthly newsletter of CUHMA, the primary outlet to share news/announcements, upcoming events, abstracts of recent publications, job postings, professional perspectives, and images of relevant professional scenes. Submission of applicable content is welcome. New issues are released on the last business day of each month. Past issues are available at <https://cuhma.ca>. Direct correspondence to info@cuhma.ca.

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NEWS/ANNOUNCEMENTS

Jules Verne-Inspired Submarine *Defender* Found

The Bridgeport Connecticut-based Lake Torpedo Boat Company designed and built a 28 m long submarine in 1907 - *Defender* - that was inspired by Jules Verne's novel *Twenty Thousand Leagues Under the Sea*. The company was unsuccessful in securing a contract with the US Navy and the prototype languished despite efforts to repurpose it. The craft was eventually scuttled by the US Army Corps of Engineers in 1946 at an undisclosed location. The resting place was found in Long Island Sound on April 16 by a group of wreck hunting divers, at a depth in excess of 50 m. Efforts will continue to document the wreck. Visit:

<https://www.nbccconnecticut.com/news/local/local-divers-find-submarine-at-bottom-of-long-island-sound/3015299>

Obituary - Michael Bennett, Hyperbaric Physician

The field of hyperbaric and diving medicine is small but close knit worldwide. Michael H. Bennett, MB BS (UNSW), DA (Lond), MM (Clin Epi) (Syd), FFARCSI (Dublin), FANZCA, MD (UNSW), ANZCA Dip Adv DHM, SPUMS Dip DHM, FUHMS, died suddenly at the end of April. Mike was Conjoint Professor of Medicine, University of New South Wales, based at the Prince of Wales Hospital in Sydney. He was highly respected internationally for his commitment to diving and hyperbaric medicine, notably in promoting academic rigor through his focus on epidemiology and critical evaluation. He was responsible for the publication of multiple systematic reviews of hyperbaric oxygen treatment for the Cochrane

Database. He is survived by his wife Susan Bennett. Visit: <https://www.unsw.edu.au/staff/michael-bennett>.

Rebreather Forum 4 Consensus Statements

One of the deliverables planned for the RF4 conference was a set of consensus statements that reflect the collective view of meeting participants. A more complete record of the discussion will be captured in the proceedings published later this year. The 28 statements, organized into categories of "safety," "research," "operational issues," "education and training," and "engineering," are now available:

<https://gue.com/blog/rebreather-forum-4-consensus-statements>.

Obituary - René Théophile "Phil" Nuytten

Canada lost a major figure in diving with the death of Phil Nuytten on May 13. Born in Vancouver on August 13, 1941, Phil committed his life as an entrepreneur and inventor developing tools to explore the ocean and support space initiatives. His companies Can-Dive and Nuytco contributed one-atmosphere diving systems (DeepWork, Newtsuit, Exosuit) and many innovations. He was a recipient of the Order of British Columbia in 1992 and was appointed an Officer of the Order of Canada in 2016. Visit:

<https://www.gg.ca/en/multimedia/videos/2022/phil-nuytten-officer-order-canada>.

<https://divemagazine.com/scuba-diving-news/deep-sea-pioneer-phil-nuytten-dies-at-the-age-of-81>.

Titanic Detailed in Digital Twin 3D Mapping

The British deep-sea mapping company Magellan has completed a detailed digital twin of the Titanic based on 715,000 images captured in the UNESCO-protected heritage site at 3800 m depth. The Titanic sank on its maiden voyage in 1912 and the wreck was discovered in 1985. For more:

<https://www.bbc.com/news/science-environment-65602182>.

<https://arstechnica.com/science/2023/05/take-an-eye-popping-3d-tour-of-the-titanics-digital-twin>.

UPCOMING EVENTS

UHMS Annual Scientific Meeting 2023

The Undersea and Hyperbaric Medical Society annual scientific meeting will be held June 16-18 in San Diego, CA. Visit: <https://www.uhms.org>.

AHDMA Annual Scientific Meeting 2023

The Asian Hyperbaric and Diving Medical Association annual scientific meeting will be held July 13-16 in Kota Kinabalu, Sabah, Malaysia. For further information visit: <https://ahdma.org>.

UMC Introductory Diving Medicine Course

Undersea Medicine Canada is offering a Level 1 'Introductory Course in Diving Medicine - Fitness to Dive' September 18-22 in Quebec City, QC. An optional half-day pre-course will be held September 17 for those wanting additional preparation for the program. For more information visit: <https://underseamedicine.ca>.

WMS Diving and Environmental Medicine CME

The Wilderness Medical Society is holding a continuing medical education course September 30-October 07, 2023 in Cayman Brac (travel on Saturdays on both ends). Each of six days includes four hours of interactive lectures and two tank boat dives. Visit: <https://wms.org/DM23>.

International Congress of Hyperbaric Medicine

The 20th ICHM will be held November 02-04, 2023 at the Windsor Barra Hotel in Rio de Janeiro, Brazil, hosted by the Brazilian Society of Hyperbaric Medicine. The ICHM is generally held every three years, and is unusual in not being linked to any single institution. There will be simultaneous translation of speeches and question and answer periods. Website details available soon.

RECENT PUBLICATIONS

Blogg SL, Tillmans F, Lindholm P. The risk of decompression illness in breath-hold divers: a systematic review. *Diving Hyperb Med.* 2023 Mar 31;53(1):31-41. doi: 10.28920/dhm53.1.31-41.

Introduction: Breath-hold (BH) diving has known risks, for example drowning, pulmonary oedema of immersion and barotrauma. There is also the risk of decompression illness (DCI) from decompression sickness (DCS) and/or arterial gas embolism (AGE). The first report on DCS in repetitive freediving was published in 1958 and from then there have been multiple case reports and a few studies but no prior systematic review or meta-analysis. Methods: We undertook a systematic literature review to identify articles available from PubMed and Google Scholar concerning breath-hold diving and DCI up to August 2021. Results: The present study identified 17 articles (14 case reports, three experimental studies) covering 44 incidences of DCI following BH diving. Conclusions: This review found that the literature supports both DCS and AGE as potential mechanisms for DCI in BH divers; both should be considered a risk for this cohort of divers, just as for those breathing compressed gas while underwater.

Demir N, Kayhan B, Sumen SG, Sonmez M, Tukenmez Dikmen N. Electrophysiological Effects of Hyperbaric Oxygen Treatment on The Healthy Retina. *Cutan Ocul Toxicol.* 2023 May 23;1-9. doi: 10.1080/15569527.2023.2217250. Online ahead of print.

Purpose: The study aimed to investigate the electrophysiological effects of hyperbaric oxygen treatment (HBOT) on the retina after ten sessions in healthy eyes. Methods: This prospective, interventional study evaluated forty eyes of twenty patients who were treated with HBOT of ten sessions with the diagnosis of an extraocular health problem. All patients underwent a complete ophthalmologic examination, including assessments of best-corrected visual acuity (BCVA), slit-lamp and pupil-dilated fundus examinations, full-field electroretinography (ffERG) measurements before and after HBOT within 24 hours of the 10th session. The ffERG was recorded according to the International Society for Clinical Electrophysiology of Vision protocol using the RETI-port system. Results: The mean age of patients was 40.5 years ranging from 20 to 59 years. Thirteen patients were administered HBOT for avascular necrosis, six patients for sudden hearing loss, and one patient for chronic osteomyelitis of the vertebra. BCVA acuity was 20/20 in all eyes. The mean spherical refractive was 0.56 diopter (D), and the mean cylindrical refractive error was 0.75 D. Dark-adapted b-wave amplitude in 3.0 ERG was the only variable for the b-wave that showed a statistically significant decrease ($p=0.017$). The amplitude of the a-waves in dark-adapted 10.0 ERG and light-adapted 3.0 ERG reduced significantly ($P=0.024$, $P=0.025$). The amplitude of N 1-P 1 in light-adapted 30 Hz Flicker ERG also demonstrated a statistically significant decrease ($P=0.011$). Implicit times did not differ significantly in any of the ffERG data ($P>0.05$). Conclusions: HBOT caused the deterioration of a-wave and b-wave amplitudes in ffERG after ten treatment sessions. The results showed that photoreceptors were adversely affected in the short term after HBOT treatment.

Fothergill DM, Borrás E, McCartney MM, Schelegle E, Davis CE. Exhaled breath condensate profiles of US Navy divers following prolonged hyperbaric oxygen (HBO) and nitrogen-oxygen (Nitrox) chamber exposures. *J Breath Res.* 2023 May 19. doi: 10.1088/1752-7163/acd715. Online ahead of print.

Prolonged exposure to hyperbaric hyperoxia can lead to pulmonary oxygen toxicity (PO_2_{tox}). PO_2_{tox} is a mission limiting factor for special operations forces divers using closed-circuit rebreathing apparatus and a potential side effect for patients undergoing hyperbaric oxygen (HBO) treatment. In this study, we aim to determine if there is a specific breath profile of compounds in exhaled breath condensate (EBC) that is indicative of the early stages of pulmonary hyperoxic stress/ PO_2_{tox} . Using a double-blind, randomized "sham" controlled, cross-over design 14 US

Navy-trained diver volunteers breathed two different gas mixtures at an ambient pressure of 2 ATA (33 fsw, 10 msw) for 6.5 hours. One test gas consisted of 100% O₂ (HBO) and the other was a gas mixture containing 30.6% O₂ with the balance N₂ (nitrox). The high O₂ stress dive (HBO) and low O₂ stress dive (nitrox) were separated by at least seven days and were conducted dry and at rest inside a hyperbaric chamber. EBC samples were taken immediately before and after each dive and subsequently underwent a targeted and untargeted metabolomics analysis using liquid chromatography coupled to mass spectrometry (LC-MS). Following the HBO dive, 10 out of 14 subjects reported symptoms of the early stages of PO₂ tox and one subject terminated the dive early due to severe symptoms of PO₂ tox. No symptoms of PO₂ tox were reported following the nitrox dive. A Partial Least-Squares Discriminant Analysis of the normalized (relative to pre-dive) untargeted data gave good classification abilities between the HBO and nitrox EBC with an AUC of 0.99 (±2%) and sensitivity and specificity of 0.93 (±10%) and 0.94 (±10%), respectively. The resulting classifications identified specific biomarkers that included human metabolites and lipids and their derivatives from different metabolic pathways that may explain metabolomic changes resulting from prolonged HBO exposure.

Peppas S, Palaodimos L, Nagraj S, Kokkinidis DG, Tiwari N, Kharawala A, Mojadidi MK, Mojadeddi S, Ntaios G, Faillace RT, Tobis JM. Right-to-left shunt in divers with neurological decompression sickness: a systematic review and meta-analysis. Healthcare (Basel). 2023; 11(10):1407. doi: 10.3390/healthcare11101407.

Objective: The aim of this study was to assess the association between the presence of a right-to-left shunt (RLS) and neurological decompression sickness (NDCS) and asymptomatic brain lesions among otherwise healthy divers. **Background:** Next to drowning, NDCS is the most severe phenotype of diving-related disease and may cause permanent damage to the brain and spinal cord. Several observational reports have described the presence of an RLS as a significant risk factor for neurological complications in divers, ranging from asymptomatic brain lesions to NDCS. **Methods:** We systematically reviewed the MEDLINE, Embase, and CENTRAL databases from inception until November 2021. A random-effects model was used to compute odds ratios. **Results:** Nine observational studies consisting of 1830 divers (neurological DCS: 954; healthy divers: 876) were included. RLS was significantly more prevalent in divers with NDCS compared to those without (62.6% vs. 27.3%; odds ratio (OR): 3.83; 95% CI: 2.79-5.27). Regarding RLS size, high-grade RLS was more prevalent in the NDCS group than the no NDCS group (57.8% versus 18.4%; OR: 4.98; 95% CI: 2.86-8.67). Further subgroup analysis revealed a stronger association with the inner ear (OR: 12.13; 95% CI: 8.10-18.17) compared to cerebral (OR:

4.96; 95% CI: 2.43-10.12) and spinal cord (OR: 2.47; 95% CI: 2.74-7.42) DCS. RLS was more prevalent in divers with asymptomatic ischemic brain lesions than those without any lesions (46.0% vs. 38.0%); however, this was not statistically significant (OR: 1.53; 95% CI: 0.80-2.91). **Conclusions:** RLS, particularly high-grade RLS, is associated with greater risk of NDCS. No statistically significant association between RLS and asymptomatic brain lesions was found.

CUHMA-ACMHS is the Canadian voice for the advancement of hyperbaric and diving medicine throughout our country and beyond. Our activities include continuous medical education for physicians, nurses, respiratory therapists and anyone involved in the fields of hyperbaric and diving medicine. We are also promoting dissemination of clinical research, publishing position statements, liaising with related professional associations and government agencies. Our main goal is advocating on behalf of our patients. Our vision is to be the reference for the development and delivery of hyperbaric and diving medicine in Canada and beyond. Our mission is to promote excellence in hyperbaric and diving medicine through leadership in education, promotion of best practices and advocacy for our patients. Our values are excellence, leadership, collaboration, communication, and integrity.

Canadian Undersea and Hyperbaric Medical Association

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