

E-NEWS

EDITOR'S NOTE – September 2024

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

CUHMA Board of Director Elections

Elections for the CUHMA board of directors will be held this fall. Now is the time to consider whether to nominate yourself or others for board service. More information will be coming soon.

WDHOF Scholarships and Training Grants

The Women Divers Hall of Fame administers a range of scholarships and training grants related to diving, up to a maximum of \$5000^{US}. Some are restricted to women and some are open to all applicants. The submission period for the 2025 cycle is September 01 through October 31. Visit: <https://www.wdhof.org/scholarships/scholarship-descriptions>.

UPCOMING EVENTS

EUBS Annual Scientific Meeting 2024

The 48th annual scientific meeting of the European Underwater and Baromedical Society will be held September 16-20 in the port city of Brest, France. Visit: <https://eubs2024.sciencesconf.org>

Divescapes Scuba Conference 2024

The Divescapes scuba conference and exhibition will be held October 18-19 at the Deerfoot Inn and Casino in Calgary, AB. The Alberta Underwater Council program includes international speakers, workshops, and trade show booths. Visit: <https://www.divescapes.ca>.

Canadian Association of Wilderness Medicine 2024

CAWM was founded in 2020 as a non-profit organization with the goal of connecting Canadian practitioners and researchers with an interest in wilderness medicine, and in promoting the field as an area of focus and specialization. The fifth annual conference will be held in hybrid form November 01-03 in Halifax, NS, with pre-conference courses October 30-31. Visit: <https://cawm.ca/cawm2024>.

DEMA Show 2024

The Diving Equipment & Marketing Association (DEMA) show will be held November 19-22 at the Las Vegas Convention Center in Las Vegas, NV. The long-standing industry event promises 500 exhibitor booths, educational seminars, and a variety of evening events. Visit: <https://www.demashow.com>.

RECENT PUBLICATIONS

Breen ID, Stepanek J, Marks L, Yale K, Mesinkovska N, Swanson D. Clinical significance of mottling rashes in diving decompression sickness. *Aerosp Med Hum Perform.* 2024; 95(9):695-702. DOI: 10.3357/AMHP.6454.2024. PMID: 39169485.

INTRODUCTION: Decompression sickness (DCS) is a medical condition caused by outgassing of dissolved nitrogen following rapid ascent by divers and aviators. Cutaneous DCS, historically termed cutis marmorata (CM), presents as a predominantly truncal reticular violaceous-to-dusky eruption. The prevailing theories for its pathogenesis include: localized cutaneous outgassing, paradoxical embolism across a right-to-left shunt (RLS), and brainstem emboli disrupting autonomic control of cutaneous microcirculation. **METHODS:** We conducted a systematic review of reports of cutaneous DCS to investigate relationships among CM, RLS, and neurological sequelae to better elucidate the mechanism of CM. A literature search examining reports of cutaneous DCS yielded 31 eligible studies, comprising a pooled total of 128 patients. **RESULTS:** Of the patients with documented workup, 84% showed evidence of RLS with CM. Subsequently 18 patients underwent percutaneous closure of intracardiac RLS with no recurrence of DCS. Of the patients with documented neurological evaluations, 57% experienced both CM and neurological DCS manifestations. The coexistence of RLS and neurological

symptoms with CM was noted in numerous cases; exact percentages of overlap cannot be stated due to data unavailability. DISCUSSION: Our results indicating the striking coexistence of RLS and neurological sequelae in CM patients is supportive of the paradoxical embolism theory of pathogenesis. The frequent coincidence of CM with RLS and neurological symptoms raises concern that CM may signify vulnerability to devastating systemic gas emboli. CM has historically been considered trivial and self-limiting; however, our results support reappraisal of its clinical significance and potential reclassification to the more severe subtype.

Deney A, Lairez O, Coulange M, Riu B, Hunt J. Recurrent decompression sickness and late permeabilization of patent foramen oval closure prosthesis: a diver's dilemma-case report. Eur Heart J Case Rep. 2024 Jul 31;8(8):ytac371. doi: 10.1093/ehjcr/ytac371. eCollection 2024 Aug.

Background: Decompression sickness (DCS) is a well-known risk associated with scuba diving, particularly in people with right-to-left shunt, such as patent foramen oval (PFO). Herein, we present a unique case of late PFO permeabilization after closure. Case summary: A 26-year-old male diver was diagnosed with DCS following a dive at 36 m. He underwent PFO closure with a STARFLEX® prosthesis. Ten years later, the patient was presented with recurrent manifestations suggestive of DCS. The performed diagnostic work-up detects a permeabilization of the implanted prosthesis, and he was treated with a conservative approach. Discussion: This case highlights the challenges in the management of PFO in divers and raises concerns about the long-term efficiency of PFO closure and the impact of diving-related factors on prosthesis patency.

Goto K, Miyazaki S, Oyaizu T, Negishi M, Ikenouchi T, Yamamoto T, Kawamura I, Nishimura T, Takamiya T, Tao S, Takigawa M, Yagishita K, Sasano T. The impact of hyperbaric oxygen treatment for cardiovascular implantable electronic devices. J Arrhythm. 2024 May 20;40(4):958-64. doi: 10.1002/joa3.13070.

Introduction: The safety of hyperbaric oxygen treatment (HBO₂) in patients with cardiovascular implanted electronic devices (CIED) remains unclear. Methods: We conducted a retrospective analysis of seven CIED patients (median age 79 [73-83] years, five males [71.4%]), including five with pacemakers and two with implantable cardioverter defibrillators (ICD), who underwent HBO₂ between June 2013 and April 2023. During the initial session, electrocardiogram monitoring was conducted, and CIED checks were performed before and after the treatment. In addition, the medical records were scrutinized to identify any abnormal CIED operations. Results: All seven CIED patients underwent HBO₂ within the safety pressure range specified by the CIED manufacturers or

general pressure test by the International Organization for Standardization (2.5 [2.5-2.5] atmosphere absolute × 18 [5-20] sessions). When comparing the CIED parameters before and after HBO₂, no significant changes were observed in the waveform amplitudes, pacing thresholds, lead impedance of the atrial and ventricular leads, or battery levels. All seven patients, including two with the rate response function activated, exhibited no significant changes in the pacing rate or pacing failure. Two ICD patients did not deactivate the therapy, including the defibrillation; however, they did not experience any arrhythmia or inappropriate ICD therapy during the HBO₂. Conclusion: CIED patients who underwent HBO₂ within the safety pressure range exhibited no significant changes in the parameters immediately after the HBO₂ and had no observable abnormal CIED operations during the treatment. The safety of defibrillation by an ICD during HBO₂ should be clarified.

Johnson G, Tabner A, Tilbury N, Wesson A, Hughes GD, Elder R, Bryson P. Development of an algorithm to guide management of cardiorespiratory arrest in a diving bell. Resusc Plus. 2024 Jul 18;19:100724. doi: 10.1016/j.resplu.2024.100724. eCollection 2024 Sep.

Aim: The management of cardiorespiratory arrest in a diving bell presents multiple clinical, technical, and environmental considerations that standard resuscitation algorithms do not address, and no situation-specific algorithm exists. The development and testing of an algorithm to guide the management of cardiorespiratory arrest in a bell is described. Methods: An iterative approach to algorithm development was used. Phase 1 involved a small multidisciplinary group and took place in a simulation centre and a decommissioned diving bell. The algorithm was then refined in a purpose-build simulation complex with repeated simulation by a group of divers, and with input from industry experts. ALS principles were followed unless contextual or technical factors necessitated deviation. Results: Clinical and technical aspects of the resuscitation are addressed. Key priorities that conflict with standard ALS principles are: prioritisation of rescue breaths; use of mechanical CPR when available; and the provision of CPR with the casualty in a seated position where necessary. Conclusion: This is the first algorithm to guide the delivery of resuscitation in a diving bell. It incorporates adapted ALS principles and available data concerning compression technique effectiveness, and was informed by industry and clinical expertise. It provides guiding principles that can be adapted to setting-specific needs, and we would encourage its industry-wide international adoption.

Kalaw FGP, Chartrand N, Wedekind L, Chen JS, Lin AC, Koretz Z, Meller L, Oca M, Jagadeesh V, Wilson K, Walker E, Freeman WR, Toomey CB. Evaluation of retinal arterial occlusion and its visual and systemic

prognosis after hyperbaric oxygen therapy. Retina. 2024 Aug 14. doi: 10.1097/IAE.0000000000004253.

Purpose: To evaluate the systemic and ocular outcomes of patients with branch retinal artery occlusion (BRAO) and central retinal artery occlusion (CRAO) after hyperbaric oxygen therapy (HBOT). Methods: This is a single-institution study of 75 subjects diagnosed with BRAO (28, 37.3%) and CRAO (47, 62.7%) who visited the emergency department or stroke clinic. Twenty-seven (36%) subjects received HBOT on initial presentation (BRAO-14.3%, CRAO-48.9%). The primary outcome was the best corrective visual acuity (BCVA) change in non-HBOT and HBOT subjects. Secondary outcomes included subsequent development of an acute cerebrovascular accident (CVA)/stroke or neovascular glaucoma (NVG). Results: Overall BCVA did not change from the initial presentation to the final timepoint (logMAR 1.5) in either the conservative management or HBOT cohorts for either BRAO subjects (non-HBOT-logMAR 0.4 vs. 0.6, $p=0.658$; HBOT-logMAR 0.1 vs. 0.4, $p=0.207$) or CRAO subjects (non-HBOT-logMAR 2.1 vs. 2.2, $p=0.755$; HBOT-logMAR 2.1 vs. 2.0, $p=0.631$). Seven (9.3%) subjects developed CVA (BRAO: non-HBOT-4.2% and HBOT-25.0%, $p=0.207$; CRAO: non-HBOT-16.7% and HBOT-4.3%, $p=0.348$) and five subjects (6.7%) developed NVG (BRAO: non-HBOT-4.2% and HBOT-0%, $p=1.00$; CRAO: non-HBOT-16.7% and HBOT-0%, $p=0.109$). Conclusions: Our findings suggest that HBOT does not significantly improve BCVA or mitigate the subsequent development of stroke and NVG in patients with RAOs.

Maguire BJ, Hughes LM, Sellers AJ. Risks for enlisted Navy divers compared to other enlisted sailors: an examination of illnesses that may be associated with exposure to contaminated water diving. Mil Med. 2024; 189(Supplement 3): 592-7. doi: 10.1093/milmed/usae197.

Introduction: Illnesses among Navy divers degrade readiness, decrease manpower levels, and increase costs for medical care. Prior research has shown that Navy divers have high rates of the types of illnesses that might be because of diving in contaminated water. The objectives of this study were to examine medical records of U.S. Navy Sailors from 2016 to 2022 and determine if divers have higher incidence rates of health conditions that might be associated with contaminated water diving compared to non-divers. Materials and methods: For this retrospective cohort study, we used data from the Defense Medical Epidemiology Database (DMED). The DMED is operated by the Armed Forces Health Surveillance Division and uses data from the Defense Manpower Data Center to classify occupations. The DMED provides free online access to a de-identified subset of data contained within the Defense Medical Surveillance System. The population was US Navy enlisted males, aged 25 to 29 years. Divers were compared to non-divers using 8 selected diagnoses that may reasonably be associated with diving in contaminated

water. Results: During the study period, the database contained a total of 5,474 diver and 827,406 non-diver person-years. Of the 8 diagnoses, the ones with the largest number of cases for divers were upper respiratory infections with 128 and ear disorders with 62. The relative risks (RRs) for divers compared to non-divers were higher for otitis externa (RR=1.44; confidence interval=1.03, 2.01) and for ear disorders (RR=1.15; confidence interval=0.89, 1.47); for the other 6 diagnoses, the divers had lower rates than the non-divers. Conclusions: The high RRs found for otitis externa and ear disorders support the need to devote resources to better understand the reasons for these higher risks and to develop, test, and implement targeted risk-reduction strategies. Future studies should attempt to link verified contaminated water exposures with adverse health outcomes and calculate risks based on criteria such as age and dive factors.

Maldonado F, Reis da Silva A, Ramos R, Gaio-Lima C, Castro A, Ferreira AP, Camacho Ó, Teixeira C. Effects of hyperbaric oxygen therapy in the treatment of patients with central retinal artery occlusion: a retrospective study. Cureus. 2024 Aug 5;16(8):e66196. doi: 10.7759/cureus.66196. eCollection 2024 Aug.

Background: Central retinal artery occlusion (CRAO) results in sudden, painless vision loss. As an analogous condition to acute ischemic stroke, CRAO is an ophthalmological emergency, but a standardized treatment is lacking. Hyperbaric oxygen therapy (HBOT) has been widely used in spite of the inconsistent results reported. Purpose: To report the visual acuity (VA) outcomes in all patients submitted to HBOT with non-arteritic CRAO in a tertiary center. Methods: This retrospective study included all adult patients with CRAO and symptoms lasting for less than 24 hours who were prescribed HBOT in the Hyperbaric Medicine Unit of a Portuguese hospital from March 2009 to February 2023. Patient demographic information, medical history, ophthalmologic evaluation, hospital of referral, time until HBOT, supplementary treatments, number of HBOT sessions, adverse effects, and patient subjective VA gain were collected. All patients were subjected to 90-minute HBOT sessions with 100% oxygen at 2.4 ATA. The primary outcome was VA change (dif-logMAR) before and after treatment. A clinically significant visual improvement was defined as a dif-logMAR \geq 0.3. Data were analyzed using IBM SPSS Statistics for Windows, Version 29 (Released 2021; IBM Corp., Armonk, New York, United States) ($p<0.05$ is considered significant). Results: A total of 114 patients were included in this study; 68% (n=77) were male, with a mean age of 69 years, and were subjected to a median number of seven HBOT sessions. No serious adverse effects from HBOT were reported. The mean time delay from symptoms to treatment was 12 hours, and best-corrected visual acuity (BCVA) at baseline was counting fingers or worse in 84% (n=96) of the patients. A dif-

logMAR \geq 0.3 occurred in 46% (n=52) of the patients, and 58% (n=66) reported subjective VA improvement after the treatment. A significant improvement between BCVA before HBOT (2.12 \pm 0.74) and after HBOT (1.67 \pm 0.74) was observed. The VA outcome was found to be related to the total number of sessions, age, obesity, supplementary treatments, and cherry-red spot (CRS) at presentation. There were no significant effects of the time delay from symptoms to treatment in the explanation of the VA outcome. Conclusions: HBOT appears to be safe and has a beneficial effect on VA outcomes in patients with non-arteritic CRAO, particularly depending on the number of sessions. Patient factors such as age, obesity, and the presence of CRSs also appear to influence the VA outcome.

Tanaka H, Rees JR, Zhang Z, Ptak JA, Hannigan PM, Silverman EM, Peacock JL, Buckey JC. Emerging indications for hyperbaric oxygen treatment: a registry cohort study. Interact J Med Res. 2024 Jul 30. doi: 10.2196/53821. Online ahead of print.

Background: Hyperbaric oxygen (HBO₂) treatment is used across a range of medical specialties for a variety of applications, particularly where hypoxia and inflammation are important contributors. HBO₂ may be useful for new indications not currently approved by the Undersea and Hyperbaric Medical Society (UHMS) because of its hypoxia-relieving and anti-inflammatory effects. Identifying these new applications for HBO₂ is difficult because individual centers may only treat a few cases and not track outcomes consistently. The web-based International Multicenter Registry for Hyperbaric Oxygen Therapy captures prospective outcomes data for patients treated with hyperbaric oxygen (HBO₂) therapy. These data can then be used to identify new potential applications for HBO₂, which has relevance for a range of medical specialties. Objective: Although hyperbaric medicine has established indications, new ones continue to emerge. One objective of this registry study is to identify cases where HBO₂ has been used for conditions falling outside of current UHMS-approved indications and present outcomes data for them. Methods: This is a descriptive study based on a web-based, multi-center, international, registry of patients treated with HBO₂. Centers agree to collect data on all patients treated using standard outcome measures and send deidentified data from individual centers to the central registry. HBO₂ treatment programs in the United States, United Kingdom, and Australia participate. Demographic, outcome, complication, and treatment data, including pre- and post-treatment quality of life questionnaires (EQ-5D-5L) are collected on individuals referred for HBO₂ treatment. Results: Out of 9726 patient entries, 378 individuals were treated for 45 emerging indications. Post-acute sequelae of COVID (PASC) (149/378 40%), ulcerative colitis (47/378 12.4%), and Crohn's disease (40/378 11%), accounted for 62% of total

cases. Calciphylaxis (20/378 5.3%), frostbite (18/378 4.8%), and peripheral-vascular-disease related wounds (12/378 3.2%) accounted for a further 13.2%. PASC patients reported significant improvement on the Neurobehavioral Symptom Inventory (NSI pre 30.6, NSI post 14.4, p<0.001). Crohn's disease patients reported significantly improved quality of life (EQ-5D pre 53.8, post 68.8) and 5 reported closing a fistula. Ulcerative colitis patients showed strong trends toward improved quality of life and lower reported lower scores on a bowel questionnaire examining frequency, blood, pain, and urgency. A subset of calciphylaxis and arterial ulcer patients also reported improvement. Conclusions: HBO₂ is being used for a wide range of possible applications across various medical specialties for its hypoxia-relieving and anti-inflammatory effects. Results show statistically significant improvements in patient-reported outcomes for inflammatory bowel disease and PASC. HBO₂ is also being used for frostbite, pyoderma gangrenosum, pterygium, hypospadias repair, and facial filler procedures. Other indications show evidence for improvement and the case series for all indications is growing in the registry.

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.

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