CUHMA ACMHS
Canadian Undersea and Hyperbaric Medical Association
Association Canadienne de Médecine Hyperbare et Subaquatique

E-NEWS

EDITOR'S NOTE – November 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.

Neal W. Pollock, PhD
Université Laval

NEWS/ANNOUNCEMENTS

Dear CUHMA members,

Please consider getting involved in the CUHMA Board of Directors. This is a chance to work with Canada's national voice for the hyperbaric and diving medicine community, with the goal of promoting safety, availability, and ethical practice. Nominations can be sent to: info@cuhma.ca

Nominations can be for self or a colleague. The nomination period will close on December 11th at 0800 Eastern standard time (EST). The voting period for the online election will be from December 27th at 0800 EST through December 29th at 2359 EST. Open positions include President-Elect, Vice-President, Secretary, Treasurer, and Director-at-Large.

We look forward to enhancing our annual scientific meeting and continuing the affiliate safety series in the New Year. It is a great time to get involved with CUHMA.

Geoff Zbitnew
President of CUHMA

UPCOMING EVENTS

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.

Boston Sea Rovers 2025

The 71st international ocean symposium and film festival with be held March 15-17 at the DoubleTree by Hilton-Boston North Shore in Danvers, MA. For more information: https://bostonsearovers.com.

AAUS Diving for Science Symposium 2025

The American Academy of Underwater Science Diving for Science symposium will be held March 23-29 in Seattle, WA. The event will be hosted by the University of Washington, the National Oceanic and Atmospheric Administration, and the Seattle Aquarium. Visit: https://aaus.org/annualsymposium.

Canadian Underwater Conference 2025

The Diver Certification Board of Canada (DCBC) will hold the 13th Canadian Underwater Conference & Exhibition March 30-April 01 at the Executive Hotel Vancouver Airport in Richmond, BC. The keynote speaker will be the NASA astronaut Dr. Michael Gernhardt, who has worked across the diving and space environments. Visit: https://www.underwaterconference.ca.

UMC Introductory Diving Medicine Course

Undersea Medicine Canada is offering a Level 1 'Introductory Course in Diving Medicine - Fitness to Dive' May 12-16 at the Atlantic Commercial Diving Centre in Summerside, PEI. An optional half-day pre-course will be held on May 11 for those wanting additional preparation for the program. Visit: https://underseamedicine.ca or contact Dr. Debbie Pestell at drdeb1@ns.sympatico.ca or 902-225-8214 for more information.

RECENT PUBLICATIONS

Arana Ribeiro J, Alpuim Costa D, Gaio-Lima C, Guilherme Gonçalves-Nobre J, Portugal Rodrigues I, Trigo Miranda M, Pinho Vaz C, D'Espiney Amaro C, Camacho Ó. Hyperbaric oxygen therapy in the treatment of late-onset hemorrhagic cystitis after allogeneic hematopoietic stem cell transplantation. Sci Rep. 2024 Oct 21;14(1):24658. doi: 10.1038/s41598-024-74858-8.

Introduction: Hemorrhagic cystitis (HC) is a common complication after allogeneic hematopoietic stem cell transplantation (HSCT), characterized by inflammation and

bleeding of the bladder. Hyperbaric oxygen therapy (HBOT) has been shown to be effective in the treatment of radiation-induced HC. However, the optimal treatment for HC after allogeneic HSCT has not yet been established. Furthermore, limited research has been conducted on the use of HBOT in this setting. This study aimed to evaluate the effectiveness and safety of HBOT in patients with late-onset HC after allogeneic HSCT. Methods: Twenty-five-year (1998-2022) retrospective analysis performed in all consecutive patients with confirmed late-onset HC after allogeneic HSCT treated with HBOT at two centers in Portugal. Medical records were reviewed for clinical and laboratory features, primary indications for allogeneic HSCT, conditioning regimen, and treatment strategies for HC. Patients received 100% oxygen at 2.1-2.5 atmosphere absolute pressure (ATA) for 70-90-minute periods, once daily, five times per week. Complete clinical response was defined as the absence of macroscopic hematuria sustained for at least 2 weeks, and partial response was described as a downgrading in the severity of HC. Statistical significance was considered for values of $p<0.05$. Results: The sample included 61 patients with a mean age of 28.0 (SD 14.2) years, 33 males. Complete response was achieved in 72.1% (n=44) of patients and partial response in 14.8% (n=9). Concerning patients with a complete response, the median number of HBOT sessions was 15.5 sessions (IQR 10.0-26.8). Patients treated with 10 or more sessions of HBOT had a higher rate of complete or partial response (OR 12.5, 95%CI 1.9-83.2, p-value < 0.05). There was no response in 8 (13.1%) patients, and 6 interrupted the treatments early. Only 2 patients suspended the HBOT due to a lack of clinical benefit. Conclusion: Our study supports using of HBOT as an adjunctive treatment for late-onset HC after allogeneic HSCT. Furthermore, 10 or more HBOT sessions delivered seem to impact the rate of HC resolution. Prospective, randomized, and well-controlled trials are needed to establish HBOT's definitive efficacy and safety.

Bartlett NC, Makowski MS, Ellis MC, Natoli MJ, Maggiore GH, Wright MC, Derrick BJ, Moon RE. Effects of submersion on VO_2: comparing maximum aerobic exertion on land and underwater. Undersea Hyperb Med. 2024 Third Quarter; 51(3): 197-211.

Introduction: Submersion results in blood redistribution into the pulmonary circulation, causing changes in pulmonary compliance and increased cardiac preload. Few studies have compared incremental exercise to exhaustion ($VO_{2\ max}$ testing) in a dry environment with exercise underwater. We hypothesized that the physiological effects of submersion would result in lower heart rate (HR), minute ventilation (V_E), and peak oxygen uptake ($VO_{2\ peak}$) compared with dry conditions. Methods: Fourteen male and four female volunteers completed two $VO_{2\ peak}$ testing sessions with approximately two hours between trials: first in the dry laboratory on a cycle ergometer and second while fully submersed in a prone position with zero static lung load. HR was monitored via ECG, and inspiratory and expiratory gas compositions were recorded using a metabolic cart. The tests were terminated once the subject reached exhaustion. Results: Absolute $VO_{2\ peak}$ was lower in the submersed $VO_{2\ max}$ trial (37.1 ± 7.0 $mL\cdot kg^{-1}\cdot min^{-1}$) compared with dry exercise (45.8 ± 8.9 $mL\cdot kg^{-1}\cdot min^{-1}$) $p<0.001$. HR and V_E were also lower in the submersed trial. Conclusions: $VO_{2\ peak}$ while submersed is reduced relative to dry $VO_{2\ peak}$, which may be partly due to a decrease in heart rate and a reduction in V_E.

Druelle A, Castagna O, Roffi R, Louge P, Faivre A, Blatteau JE. Taravana syndrome and posterior reversible encephalopathy syndrome: a microbubble hypothesis for neurological accidents in breath-hold divers. Front Physiol. 2024 Sep 24:15:1478650. doi: 10.3389/fphys.2024.1478650. eCollection 2024.

Breath-hold diving is a challenging activity that can lead to serious and dangerous complications, such as the "Taravana" syndrome. This syndrome is characterized by the onset of neurological symptoms after deep or repeated dives. The main clinical manifestations are cerebral, including stroke and cognitive impairment. The pathophysiology of Taravana syndrome is still widely debated, but the most accepted theory is that it is a specific form of decompression sickness. We have reviewed the main theories explaining the onset of Taravana syndrome and, through the description of a particularly illustrative case of a freediver using an underwater scooter, we have formulated a hypothesis according to which micro-bubbles formed directly in cerebral structures would be at the origin of this syndrome. MRI showed diffuse encephalopathy with vasogenic edema. Analysis of the radiological sequences did not suggest an ischemic or embolic mechanism. This finding is likely to be associated with the diagnosis of posterior reversible encephalopathy syndrome. The rapid ascent speeds associated with underwater scooter use could potentially result in the formation of nitrogen micro-bubbles in the capillaries of brain tissue. The emergence of scooters in freediving can be a hazard because of their ability to facilitate very rapid ascents. It is therefore essential to take preventive measures to ensure the safety of users of these devices.

Kageyama N, Sawamura T. Effect of hyperbaric exposure on cognitive performance: an investigation conducting numerical Stroop tasks during a simulated 440 m sea water saturation diving. J Physiol Anthropol. 2024 Oct 7;43(1):24. doi: 10.1186/s40101-024-00366-3.

Background: Saturation diving (SD) is useful and safe in deep diving for long durations. Japan Maritime Self-Defense Force (JMSDF) Undersea Medical Center (UMC) maintained safely deep 45 ATA SD. However, cognitive performance was reportedly impaired by hyperbaric

exposure in over 31 atmosphere absolute (ATA) SD. This study investigated the effects of hyperbaric exposure during 45 ATA deep SD on expert divers' cognitive function using Stroop tasks, a useful method to examine cognitive function, especially in narrow spaces such as SD chambers. Methods: Two numerical Stroop tasks were utilized to create two magnitude comparisons of a pair of single-digit numerical and physical tasks. Both numerical Stroop tasks were examined twice, at 1 and 45 ATAs, during a simulated 440 m of sea water depth for SD. Participants were 18 male expert JMSDF SD divers (age 36.58 ± 4.89 years). Results: In the numerical task, reaction time (RT) was significantly delayed at 45 ATA compared with 1 ATA in the incongruent condition. In the physical task, RT at 45 ATA was significantly delayed under all the conditions (congruent, incongruent, and neutral). The correct rates (CR) in both numerical Stroop tasks significantly decreased at 45 ATA compared with 1 ATA in the incongruent condition. Conclusions: Our findings suggest that divers' cognition is impaired during 45 ATA deep SD. These results emphasize the importance of monitoring cognition in deep sea SD and highlight the need to educate and train for SD. Further examination combining Stroop tasks with other analyses such as event-related potential (ERP) is expected.

Kim BM, Wang KY, Xu TT, Hooshmand SJ, Toups GN, Millman MP, Steinkraus LW, Tooley AA, Barkmeier AJ, Chen JJ. Outcomes of hyperbaric oxygen treatment for central retinal artery occlusion: a single center experience. Am J Ophthalmol. 2024 Oct 3:S0002-9394(24)00455-0. doi: 10.1016/j.ajo.2024.09.027.

Purpose: To describe the outcomes of hyperbaric oxygen therapy (HBOT) for patients with central retinal artery occlusion (CRAO) at a single tertiary care center. Design: Retrospective clinical cohort study. Methods: Medical records of all patients diagnosed with CRAO who received HBOT at Mayo Clinic in Rochester, Minnesota from 1/1/2009 to 12/31/2020 were reviewed to confirm diagnosis, time from onset to presentation, exam findings, treatments, and follow-up data. Main outcome measures included final visual acuity (VA) and number of lines of improvement. Results: There were 41 patients diagnosed with CRAO who received HBOT during the 12 year study period. Median time from symptom onset to HBOT treatment was 9.5 hours (interquartile range [IQR] 6.5, 14.0 hours), and patients received a median of 4 HBOT sessions (IQR 2.5, 6.0 sessions). There were 20 patients who received HBOT within 9 hours, 14 (70%) of which had clinically meaningful improvement in VA of ≥0.3 logMAR. In comparison, of the 21 patients treated after 9 hours, 6 (28.6%) had VA improvement of ≥0.3 logMAR (p=0.008). For all patients, the median logMAR VA at presentation was 2.00 (IQR 1.70, 2.30) and the median logMAR VA at follow-up was 1.94 (IQR 1.00, 2.00) (p<0.001), with median lines of improvement of 3.0 (IQR 0.0, 7.0). For patients treated within 9 hours, the median logMAR VA at presentation was 2.00 (IQR 1.93, 2.30) and the median logMAR VA at follow-up was 1.70 (IQR 0.54, 2.00). Patients treated within 9 hours had statistically significant greater median lines of VA improvement than cases that were treated after >9 hours from symptom onset at 5.9 (IQR 3.0, 10.0) and 0.0 (IQR 0.0, 3.0), respectively (p<0.001). There was no difference in VA recovery associated with specific retinal exam findings such as cherry-red spot (p=0.22) and cilioretinal artery perfusion (p=0.36) compared to patients without those findings. Conclusion: There was a statistically significant improvement in VA after HBOT treatment in CRAO patients among patients that received early HBOT, with patients receiving the most benefit when receiving treatment within 9 hours. Randomized control trials in patients with CRAO are required to confirm the efficacy of HBOT.

Van Meter KW. Hyperbaric oxygen therapy in the ATLS/ACLS resuscitative management of acutely ill or severely injured patients with severe anemia: a review. Front Med (Lausanne). 2024 Oct 8:11:1408816. doi: 10.3389/fmed.2024.1408816. eCollection 2024.

For short periods, even without the presence of red blood cells, hyperbaric oxygen can safely allow plasma to meet the oxygen delivery requirements of a human at rest. By this means, hyperbaric oxygen, in special instances, may be used as a bridge to lessen blood transfusion requirements. Hyperbaric oxygen, applied intermittently, can readily avert oxygen toxicity while meeting the body's oxygen requirements. In acute injury or illness, accumulated oxygen debt is shadowed by adenosine triphosphate debt. Hyperbaric oxygen efficiently provides superior diffusion distances of oxygen in tissue compared to those provided by breathing normobaric oxygen. Intermittent application of hyperbaric oxygen can resupply adenosine triphosphate for energy for gene expression and reparative and anti-inflammatory cellular function. This advantageous effect is termed the hyperbaric oxygen paradox. Similarly, the normobaric oxygen paradox has been used to elicit erythropoietin expression. Referfusion injury after an ischemic insult can be ameliorated by hyperbaric oxygen administration. Oxygen toxicity can be averted by short hyperbaric oxygen exposure times with air breaks during treatments and also by lengthening the time between hyperbaric oxygen sessions as the treatment advances. Hyperbaric chambers can be assembled to provide everything available to a patient in modern-day intensive care units. The complication rate of hyperbaric oxygen therapy is very low. Accordingly, hyperbaric oxygen, when safely available in hospital settings, should be considered as an adjunct for the management of critically injured or ill patients with disabling anemia.

Weaver LK. Carbon monoxide poisoning (reprinted from the 2023 Hyperbaric Indications Manual 15th edition). Undersea Hyperb Med. 2024 Third Quarter; 51(3): 253-76. PMID: 39348519.

Despite established exposure limits and safety standards, and the availability of carbon monoxide (CO) alarms, each year an estimated 50,000 people in the United States visit emergency departments for CO poisoning. Carbon monoxide poisoning can occur from brief exposures to high levels of CO or from longer exposures to lower levels. If the CO exposure is sufficiently high, unconsciousness and death occur quickly, and without symptoms. With non-lethal exposures to CO, common symptoms include headaches, nausea and vomiting, dizziness, general malaise, and altered mental status. Some patients may have chest pain, shortness of breath, and myocardial ischemia, and may require mechanical ventilation and treatment of shock. Individuals poisoned by CO often develop brain injury. As with brain injury from non-CO causes such as traumatic brain injury, the clinical expression of brain injury caused by CO poisoning includes the domains of cognition, affect, neurological, and somatic. Common problems are neurological: imbalance, motor weakness, neuropathies, hearing loss, tinnitus, Parkinson's-like syndrome, vestibular, gaze, auditory processing, cognitive, anxiety and depression, posttraumatic stress, personality change, persistent headaches, dizziness, sleep problems, and others. In addition, some will have cardiac or other problems. While breathing oxygen hastens the removal of carboxyhemoglobin (COHb), hyperbaric oxygen (HBO_2) hastens COHb elimination and favorably modulates inflammatory processes instigated by CO poisoning, an effect not observed with breathing normobaric oxygen. Hyperbaric oxygen improves mitochondrial function, inhibits lipid peroxidation transiently, impairs leukocyte adhesion to injured microvasculature, and reduces brain inflammation caused by CO-induced adduct formation of myelin basic protein. Based upon supportive randomized clinical trials in humans and considerable evidence from animal studies, HBO_2 should be considered for all cases of acute symptomatic CO poisoning. Hyperbaric oxygen is indicated for CO poisoning complicated by cyanide poisoning, often concomitantly with smoke inhalation.

Wei NC, Mingn KW. Complications after Covid-19 infection in Singapore military divers: a retrospective cohort study. Undersea Hyperb Med. 2024 Third Quarter; 51(3): 221-9. PMID: 39348514.

Studies suggest that COVID-19 infections may have longer-term and more significant complications, even with mild or absent symptoms. This may predispose divers to pulmonary barotrauma, arterial gas embolisms, and reduced exercise tolerance, and impact physical and cognitive performance during diving. Military diving is physically, physiologically, and psychologically taxing on the individual. This study aims to assess the incidence of complications after COVID-19 infections in a cohort of active military divers and the incidence of diving-related injuries such as decompression sickness and barotrauma following recovery from acute COVID-19 infections. A single-center, retrospective cohort study of complications after COVID-19 infections was done in a cohort of the Republic of Singapore Navy (RSN) Naval Diving Unit (NDU) Divers and involved the collection of retrospective data for 329 military divers who were diagnosed with COVID-19 infection from 25 Mar 2020 and 13 Feb 2023. We found no clinical or subclinical complications after COVID-19 infection in our fully vaccinated, low-risk population of NDU divers after asymptomatic or mild COVID-19 infection. There were also no incidences of diving-related injuries related to COVID-19 after recovery from the acute illness. Based on the study results, it is recommended that all military divers with asymptomatic or mild COVID-19 infections return to military diving activities immediately after recovery from acute COVID-19 infection with resolution of symptoms. As existing guidelines recommend, divers with moderate to critical COVID-19 infection should be reviewed by a diving physician and undergo necessary investigations before returning to military diving.

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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