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

E-NEWS

EDITOR'S NOTE – June 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

UMC Level 2 Dive Medicine Course Completion

Physicians came from across Canada in May to complete an Undersea Medicine Canada Level 2 course (Advanced Course in Diving Medicine - Diagnosis and Treatment). The event was hosted by the Atlantic Commercial Diving Centre (https://atlanticcommercialdivingcentre.com) in the city of Summerside, PEI. The six-day program included a wide array of lecture topics, case studies, simulations, and close observation of commercial diving equipment and activities.

UPCOMING EVENTS

UHMS Annual Scientific Meeting 2024

The annual scientific meeting of the Undersea and Hyperbaric Medical Association will be held June 12-15, 2024 in French Quarter of New Orleans. Visit: https://www.uhms.org/education/annual-scientific-meeting/asm-registration.html#read-bio.

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

RECENT PUBLICATIONS

Di Paolo M, Mezzetti E, Leoni M, Scatena A, Passino C. Sudden cardiac death during scuba diving: a case report of a patient with unknown hypertrophic cardiomyopathy. Eur Heart J Case Rep. 2024 May 14;8(5):ytae217. doi: 10.1093/ehjcr/ytae217. eCollection 2024 May.

Background: Scuba diving is a recreational activity usually considered at low impact on cardiovascular system. However, when diving, increased ambient pressure exerts several effects on the cardiovascular and pulmonary systems, mainly due to redistribution of peripheral blood into the central circulation. This phenomenon, also known as blood shift, may produce a significant overload on a non-healthy heart. Case summary: We present the case of a female patient who experienced sudden cardiac death during scuba diving: post-mortem cardiac magnetic resonance and autopsy revealed that the patient was affected by previously unknown hypertrophic cardiomyopathy. Discussion: Diving exposes the body to

significant physiological changes that may overstress a diseased heart. This case suggests the need for some cardiovascular exams, such as an echocardiogram or, at least, an electrocardiogram, for screening cardiovascular abnormalities in subjects who wish to practice scuba diving.

Druelle A, Blatteau JE, Duchadeuil LK, Morin J, Roffi R, Dufresne PL, Lehot H, Castagna O. Case report: reassessing guidelines for safe resumption of diving after spinal decompression sickness: insights from a challenging case. Front Med (Lausanne). 2024 May 9:11:1347465. doi: 10.3389/fmed.2024.1347465. eCollection 2024.

Background: Recreational divers who have experienced spinal decompression sickness (DCS) often aspire to return to their diving activities. Traditionally, it is recommended to observe a waiting period of several months before contemplating a return to unrestricted diving, particularly when clinical symptoms are absent, spinal cord magnetic resonance imaging shows no anomalies, and the evaluation for patent foramen ovale (PFO) returns negative results. Methods: This article presents a compelling case study involving a 51-year-old recreational scuba diver who encountered two episodes of spinal decompression illness within a two-year timeframe. Notably, the search for a PFO produced negative results. The primary objective of this article is to underscore the critical importance of a meticulously planned approach to resuming diving after DCS incidents, emphasizing the potential for recurrence and the essential preventive measures. Conclusion: We delve into the intricate decision-making process for returning to diving, emphasizing the significance of clinical evaluations, PFO assessments, spinal cord Magnetic Resonance Imaging, and the absence of clinical symptoms. By recognizing the risk of recurrence and the need for proactive prevention measures, we provide recommendations for both medical professionals and divers, with the ultimate goal of enhancing safety and informed decision-making within the diving community.

Druelle A, Mouhat B, Zbitou O, Castagna O. Static immersion and negative static lung load (SLL) induced right ventricle systolic function adaptation. A novel risk factor fori immersion pulmonary edema (IPE). Chest. 2024 May 15:S0012-3692(24)00558-0. doi: 10.1016/j.chest.2024.03.042. Online ahead of print.

Background: Immersion pulmonary edema (IPE) is a form of hemodynamic edema, likely involves individual susceptibility. Research question: Can assessing right ventricular systolic adaptation during immersion be a marker for IPE susceptibility? Study design and methods: Twenty-eight experimented divers participated: fifteen study subject with history of IPE ('IPE' group) (40.2±8.2 years old, two females) and thirteen controls subjects ('no-IPE' group) (mean age, 43.1±8.5 years old, two females) underwent three transthoracic echocardiogram under three different conditions: 'dry' (subjects supine on an examination table without immersion), 'surface immersion' (participants floating prone on the water's surface, breathing through a snorkel), and 'immersion & negative static lung load (SLL)' (divers submerged 20 cm below the water's surface in a prone position, using a specific snorkel connected to the surface). Echocardiographic measurements included tricuspid annular plane systolic excursion (TAPSE), tissue S' wave, and right ventricle global strain (RVGLS). Results: For all divers, immersion increased right ventricular preload. In the 'no-IPE' group, the increase in right ventricular preload induced by immersion is accompanied by an improvement in the contractility of the right ventricle, as evidenced by increases in TAPSE (17.08±1.15 vs. 20.89±1.32), S' wave (14.58±2.91 vs. 16.26±2.77), and RVGLS (25.37±2.79 vs. 27.09±2.89). Negative SLL amplified these right ventricular adaptations. In contrast, among 'IPE' divers, the increase in right ventricular preload does not coincide with an improvement in right ventricular contractility, indicating altered adaptive responses. In the IPE group, the TAPSE values changed from 17.19±1.28 to 21.69±1.67 and then to 23.55±0.78, respectively, in the 'dry', 'surface immersion', and 'immersion & negative static lung load (SLL)' conditions. The S'wave values changed from 13.42±2.94 to 13.26±2.96 and then to 12.49±0.77, and the RVGLS values changed from -24.09±2.91 to -23.99±3.38 and then to -21.96±0.55. Interpretation: Changes in right ventricular systolic function induced by immersion (especially with the addition of negative SLL) vary among divers based on their history of IPE. Analyzing ventricular contractility during immersion, particularly RVGLS, could help identify individual susceptibility in divers. These findings provide insights for the development of preventive strategies.

Gamarra E, Careddu G, Fazi A, Turra V, Morelli A, Camponovo C, Trimboli P. Continuous glucose monitoring and recreational scuba diving in type 1 diabetes: head-to-head comparison between Free Style Libre 3 and Dexcom G7 performance. Diabetes Technol Ther. 2024 May 20. doi: 10.1089/dia.2024.0126. Online ahead of print.

Background Scuba diving was previously excluded because of hypoglycemic risks for type 1 diabetic patients (T1DM). Specific eligibility criteria and a safety protocol have been defined, while continuous glucose monitoring (CGM) systems have enhanced diabetes management. This study aims to assess the feasibility and accuracy of CGM Dexcom G7 (DG7) and Free Style Libre 3 (FSL3) in a setting of repetitive scuba diving in T1DM, exploring the possibility of non-adjunctive use. Material and methods The study was conducted during an event of Diabete Sommerso® association in November 2023. Participants followed a safety protocol, with capillary glucose as

reference standard (Beurer GL50Evo). Sensors accuracy was evaluated through Median and Mean Absolute Relative Difference (MeARD and MARD) and Surveillance Error Grid (SEG) Analysis. Sub-analyses were performed by glycemic range, timing, gender. Data distribution and correlation was estimated by Spearman test and Bland-Altman plots. The ability of sensors to identify hypoglycaemia was assessed by contingency tables. Participants completed a satisfation questionnaire. Results Data from 202 dives of 13 patients were collected. The overall MARD was 31% for DG7 and 14.2% for FSL3, MeARD 19.7% and 11.6% respectively. FSL3 exhibited better accuracy in normoglycemic and hyperglycemic ranges. SEG analysis showed 82.1% (DG7) and 97.4% (FSL3) data on no-risk zone. FSL3 better performed on hypoglycemia identification (diagnostic odds ratio of 254.10 vs 58.95). Neither of sensors reached the MARD for non-adjunctive use. Patient satisfaction favored FSL3 for size and minimal bulk, while DG7 received positive feedback for versatility. Conclusions The study reveals FSL3 superior accuracy compared to DG7 in a setting of repetitive scuba diving in T1DM, except for hypoglycemic range. Both sensors fails to achieve accuracy for non-adjunctive use. Capillary tests remain crucial for safe dive planning, and sensor data should be interpreted cautiously. We suggest exploring additional factors potentially influencing sensor performance.

Kjeld T, Krag TO, Brenøe A, Møller AM, Arendrup HC, Højberg J, Fuglø D, Hancke S, Tolbod LP, Gormsen LC, Vissing J, Hansen EG. Hemoglobin concentration and blood shift during dry static apnea in elite breath hold divers. Front Physiol. 2024 Apr 30:15:1305171. doi: 10.3389/fphys.2024.1305171. eCollection 2024.

Introduction: Elite breath-hold divers (BHD) enduring apneas of more than 5 min are characterized by tolerance to arterial blood oxygen levels of 4.3 kPa and low oxygen-consumption in their hearts and skeletal muscles, similar to adult seals. Adult seals possess an adaptive higher hemoglobin-concentration and Bohr effect than pups, and when sedated, adult seals demonstrate a blood shift from the spleen towards the brain, lungs, and heart during apnea. We hypothesized these observations to be similar in human BHD. Therefore, we measured hemoglobin- and 2,3-biphosphoglycerate-concentrations in BHD (n=11) and matched controls (n=11) at rest, while myocardial mass, spleen and lower extremity volumes were assessed at rest and during apnea in BHD. Methods and results: After 4 min of apnea, left ventricular myocardial mass (LVMM) determined by 15O-H2O-PET/CT (n = 6) and cardiac MRI (n = 6), was unaltered compared to rest. During maximum apnea (∼6 min), lower extremity volume assessed by DXA-scan revealed a ∼268 mL decrease, and spleen volume, assessed by ultrasonography, decreased ∼102 mL. Compared to age, BMI and VO2max matched controls (n = 11), BHD had similar spleen sizes and 2,3-biphosphoglycerate-concentrations, but higher total hemoglobin-concentrations. Conclusion: Our results indicate: 1) Apnea training in BHD may increase hemoglobin concentration as an oxygen conserving adaptation similar to adult diving mammals. 2) The blood shift during dry apnea in BHD is 162% more from the lower extremities than from the spleen. 3) In contrast to the previous theory of the blood shift demonstrated in sedated adult seals, blood shift is not towards the heart during dry apnea in humans.

Mielecki D, Godlewski J, Salinska E. Hyperbaric oxygen therapy for the treatment of hypoxic/ischemic injury upon perinatal asphyxia-are we there yet? Front Neurol. 2024 Apr 15:15:1386695. doi: 10.3389/fneur.2024.1386695. eCollection 2024.

Birth asphyxia and its main sequel, hypoxic-ischemic encephalopathy, are one of the leading causes of children's deaths worldwide and can potentially worsen the quality of life in subsequent years. Despite extensive research efforts, efficient therapy against the consequences of hypoxia-ischemia occurring in the perinatal period of life is still lacking. The use of hyperbaric oxygen, improving such vital consequences of birth asphyxia as lowered partial oxygen pressure in tissue, apoptosis of neuronal cells, and impaired angiogenesis, is a promising approach. This review focused on the selected aspects of mainly experimental hyperbaric oxygen therapy. The therapeutic window for the treatment of perinatal asphyxia is very narrow, but administering hyperbaric oxygen within those days improves outcomes. Several miRNAs (e.g., mir-107) mediate the therapeutic effect of hyperbaric oxygen by modulating the Wnt pathway, inhibiting apoptosis, increasing angiogenesis, or inducing neural stem cells. Combining hyperbaric oxygen therapy with drugs, such as memantine or ephedrine, produced promising results. A separate aspect is the use of preconditioning with hyperbaric oxygen. Overall, preliminary clinical trials with hyperbaric oxygen therapy used in perinatal asphyxia give auspicious results.

Mitchell SJ. Decompression illness: a comprehensive overview. Diving Hyperb Med. 2024 Mar 31;54(1Suppl):1-53. doi: 10.28920/dhm54.1.suppl.1-53.

Decompression illness is a collective term for two maladies (decompression sickness [DCS] and arterial gas embolism [AGE]) that may arise during or after surfacing from compressed gas diving. Bubbles are the presumed primary vector of injury in both disorders, but the respective sources of bubbles are distinct. In DCS bubbles form primarily from inert gas that becomes dissolved in tissues over the course of a compressed gas dive. During and after ascent ('decompression'), if the pressure of this dissolved gas exceeds ambient pressure small bubbles may form in the extravascular space or in tissue blood vessels,

thereafter passing into the venous circulation. In AGE, if compressed gas is trapped in the lungs during ascent, pulmonary barotrauma may introduce bubbles directly into the pulmonary veins and thence to the systemic arterial circulation. In both settings, bubbles may provoke ischaemic, inflammatory, and mechanical injury to tissues and their associated microcirculation. While AGE typically presents with stroke-like manifestations referrable to cerebral involvement, DCS can affect many organs including the brain, spinal cord, inner ear, musculoskeletal tissue, cardiopulmonary system and skin, and potential symptoms are protean in both nature and severity. This comprehensive overview addresses the pathophysiology, manifestations, prevention and treatment of both disorders.

Shimbo K, Kawamoto H, Koshima I. Role of hyperbaric oxygen therapy in maximizing flap survival in compromised free flaps: a case report. Eplasty. 2024 Mar 14:24:e14. eCollection 2024.

Background: Hyperbaric oxygen therapy (HBOT) has shown potential in salvaging compromised flaps, although its application has primarily been focused on local flaps rather than free flaps. Case: In this case report, we present the successful use of HBOT in a 76-year-old man who underwent free flap reconstruction for calcaneal osteomyelitis. Despite undergoing 2 reoperations on the second and third days post reconstruction, no thrombosis was observed at the anastomotic site. Following the second reoperation, HBOT was promptly initiated and continued for a total of 9 sessions. Notably, after the sixth HBOT session, fresh bleeding occurred upon flap puncture. Eventually, the flap developed epidermal necrosis, which was conservatively treated. Discussion: It is crucial to first rule out mechanical causes of compromised free flaps through surgical exploration, with HBOT serving as an adjunctive rather than a primary treatment option--even considered as the last resort. Nevertheless, in cases where mechanical causes have been ruled out, HBOT may significantly enhance flap survival rates in compromised free flaps.

Yu E, Valdivia-Valdivia JM, Silva F, Lindholm P. Breath-hold diving injuries - a primer for medical providers. Curr Sports Med Rep. 2024 May 1;23(5):199-206. doi: 10.1249/JSR.0000000000001168.

Breath-hold divers, also known as freedivers, are at risk of specific injuries that are unique from those of surface swimmers and compressed air divers. Using peer-reviewed scientific research and expert opinion, we created a guide for medical providers managing breath-hold diving injuries in the field. Hypoxia induced by prolonged apnea and increased oxygen uptake can result in an impaired mental state that can manifest as involuntary movements or full loss of consciousness. Negative pressure barotrauma secondary to airspace collapse can lead to edema and/or hemorrhage. Positive pressure barotrauma secondary to overexpansion of airspaces can result in gas embolism or air entry into tissues and organs. Inert gas loading into tissues from prolonged deep dives or repetitive shallow dives with short surface intervals can lead to decompression sickness. Inert gas narcosis at depth is commonly described as an altered state similar to that experienced by compressed air divers. Asymptomatic cardiac arrhythmias are common during apnea, normally reversing shortly after normal ventilation resumes. The methods of glossopharyngeal breathing (insufflation and exsufflation) can add to the risk of pulmonary overinflation barotrauma or loss of consciousness from decreased cardiac preload. This guide also includes information for medical providers who are tasked with providing medical support at an organized breath-hold diving event with a list of suggested equipment to facilitate diagnosis and treatment outside of the hospital setting.

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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