

E-NEWS

EDITOR'S NOTE – December 2019

The E-News is the monthly newsletter of CUHMA used to share news and information. We invite relevant content, including news/announcements, upcoming events, new publication abstracts, job postings, professional perspectives, incident reports, and relevant images of related professional scenes. Please share with interested colleagues. Past issues are available at <https://cuhma.ca>.

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NEWS/ANNOUNCEMENTS

Dive Community Passings in 2019

Robert F. Marx (82) - 07/04/19
 Glen H. Egstrom, PhD (90) - 10/07/19
 Alfred A. Bove, MD, PhD (81) - 10/17/19
 Fiona Sharp, MBBS (55) - 10/17/19
 Carl W. Edmonds, MB (83) - 11/01/19

Call for Presentations – CUHMA ASM 2020

Both thematic lecture and original research abstracts will be considered for oral presentation at the October 2020 CUHMA annual scientific meeting. Submission deadlines: **February 15** for thematic lectures, and **June 15** for original research. Submit abstracts to neal.pollock@kin.ulaval.ca. Abstract Submission Guidelines (Word file; all text 10 pitch New Times Roman).

Line 1 - informative title, bold and block capitals.

Line 2 - author(s) (surname followed by initials for each; affiliation numbers superscripted after initials).

Line 3 - professional affiliations that capture all author(s); department and institution; each starting with a superscripted number and separated by a semi-colon.

Lines 4+ (thematic lecture abstracts) - 150-250 words, block format (ie, no indenting), overview of proposed presentation; no references, tables or figures. No line breaks between sections.

Lines 4+ (research abstracts) - maximum 250 words (introduction, methods, results, conclusions, funding acknowledgment [optional]), block format (ie, no indenting), complete data but no references, tables or figures. No line breaks between sections but section headers bold. Funding acknowledgment limited to one line.

COMMUNITY IMAGES



Students (with some faculty), attending the recent UMC Level 1 'Fitness to Dive, Introductory Course in Diving Medicine' held in Quebec in October 2019. Picture taken outside the Hôtel-Dieu de Lévis multi-lock hyperbaric chamber following a tour and demonstration of transfer under pressure conducted with the assistance of the Quebec police dive team.

UPCOMING EVENTS

Hyperbaric Technician Training Course 2020

Simon Fraser University is offering a hyperbaric technician course February 02-07 in Burnaby, BC. It will cover skills and knowledge to maintain a hyperbaric facility including: operating principles of the main control equipment; air filtration systems; hyperbaric electric systems; and maintenance and inspection of acrylic windows. Hands-on components include: valve & regulator service, Swagelok fittings and tube bending; HP Bauer compressor servicing; oxygen cleaning; and HP cylinder inspection. Visit: <https://www.sfu.ca/science/faculty-support/facilities-services/empu/courses/hyperbaric-technician.html>.

Hyperbaric Safety Director Course 2020

Simon Fraser University, in Burnaby, BC, is offering this 3-day program in collaboration with International ATMO February 07-09. It will provide necessary tools and resources to fulfill the responsibilities of the Hyperbaric Safety Director (as defined by CSA Z275.1). Both classroom instruction and practical exercises are provided. Visit: https://www.sfu.ca/science/faculty-support/facilities-services/empu/courses/hyperbaric_safety_director.html.

Hyperbaric Medical Emergency Simulation 2020

Simon Fraser University, in Burnaby, BC, is offering this HMES course on February 10. It is an interactive team simulation program aimed at improving team dynamics to optimize patient outcomes in a crisis. It is intended for both physicians and non-physicians. Participants will gain hands-on experience with simulated monoplace and multiplace emergencies. The program is approved for 6.75 h of AMA PRA Category 1 credits. For more information, visit: <https://www.sfu.ca/science/faculty-support/facilities-services/empu/courses/hyperbaric-medical-emergency-simulation.html>.

CUHMA Annual Scientific Meeting 2020

The 2020 CUHMA ASM will be held October 22-25 in Niagara Falls, ON. McMaster University CPD will provide accreditation and meeting support. Two days of pre-conference events will be followed by two days of scientific talks. A welcome reception will be held on Friday evening, and the awards banquet on Saturday evening. Visit our website for updates and registration: <https://cuhma.ca>.

International Congress on Hyperbaric Medicine

The 20th ICHM will be held November 11-15, 2020 at the Rio Othon Palace Hotel, in Copacabana, Rio de Janeiro, Brazil. The conference is held every three years, and is unusual in not being linked to any single institution. The scientific program will include oral and poster research presentations and invited lectures by renowned national and international speakers. CUHMA members are being offered 10% off the registration price. Visit www.ichm2020.rio.br.

RECENT PUBLICATIONS

Castagna O, Bergmann C, Blatteau JE. Is a 12-h nitrox dive hazardous for pulmonary function? Eur J Appl Physiol. 2019 Nov 1. doi: 10.1007/s00421-019-04248-w. [Epub ahead of print]

PURPOSE: Prolonged exposure to a high partial pressure of oxygen leads to inflammation of pulmonary tissue [pulmonary oxygen toxicity (POT)], which is associated with tracheobronchial irritation, retrosternal pain and coughing, and decreases in vital capacity (VC). The nitric oxide (NO) concentration in exhaled gas (FeNO) has been used as an indicator of POT, but the effect of SCUBA diving on FeNO has rarely been studied. The study presented here aimed to assess alterations to pulmonary function and FeNO following a 12-h dive using breathing apparatus with a relatively high partial pressure of oxygen. **METHODS:** Six healthy, male, non-smoking military scuba divers were recruited (age 31.8±2.7 years, height 179±0.09 cm, and body weight 84.6±14 kg). Each diver completed a 12-h dive using a demand-controlled semi-closed-circuit rebreather. During the 12 h of immersion,

divers were subjected to 672 oxygen toxicity units (OTU). A complete pulmonary function test (PFT) was completed the day before and immediately after immersion. FeNO was measured using a Nobreath™ Quark (COSMED™, Rome, Italy), three times for each diver. The first datapoint was collected before the dive to establish the "basal state," a second was collected immediately after divers emerged from the water, and the final measurement was taken 24 h after the dive. **RESULT:** Despite prolonged inhalation of a hyperoxic hyperbaric gas mixture, no clinical pulmonary symptoms were observed, and no major changes in pulmonary function were detected. However, a major decrease in FeNO values was observed immediately after emersion [0-12 ppb (median, 3.8 ppb)], with a return to baseline [2-60 ppb (median, 26 ppb) 24 h later (3-73 ppb (median, 24.7 ppb)]. **CONCLUSION:** These results suggest that if the OTU remain below the recommended limit values, but does alter FeNO, this type of dive does not persistently impair lung function

Coco M, Buscemi A, Perciavalle V, Maci T, Galvano G, Scavone AMF, Perciavalle V, Di Corrado D. Cognitive deficits and white matter alterations in highly trained scuba divers. Front Psychol. 2019 Oct 22;10:2376. doi: 10.3389/fpsyg.2019.02376. eCollection 2019.

Nitrogen gas (N₂), present in the normal atmospheric air, is a potential source of risk for scuba divers. It seems probable that myelin can represent, in hyperbaric conditions, a preferential site for the accumulation of N₂ in central nervous system (CNS). The purpose of this study is to verify whether the practice of the scuba diving is capable to determine a damage of the brain white matter (WM) in a dose dependent manner and, consequently, possible deficiency of their cognitive abilities. For this purpose, 54 professional scuba divers (35 men and 19 women), with at least 2,000 dives in their careers, were studied. Possible alterations of brain WM were evaluated in terms of Fractional anisotropy (FA) by using Diffusion Tensor Imaging, whereas possible cognitive impairments were verified by means of neuropsychological testing, by studying: (1) General mental capability (2) Executive functioning; (3) Visuospatial construction such as Rey Complex Figure; (4) Attention and orientation; (5) Selective attention capacity and processing speed ability; (6) Memory. The results showed alteration of the WM in terms of changes in FA; these alterations, statistically significant but quantitatively quite modest, were mainly observed in the WM of the anterior part of the brain, whereas no differences were observed between left and right hemisphere. The alterations of the WM were associated with changes, also in this case statistically significant but quantitatively quite modest, of the cognitive functions, in particular of those dependent on the prefrontal cortex, such as attention and memory function. The present study leads to the conclusion that repeated

dives, even performed in compliance with the current decompression tables, can progressively lead in the CNS to the formation of micro-lesions in the myelin sheet capable of altering the functioning of the neuron.

Edmonds C, Lippmann J, Bove A. Immersion pulmonary edema: an analysis of 31 cases from Oceania. Undersea Hyperb Med. 2019;46(5):603-10.

AIM: To review incidents of immersion pulmonary edema (IPE) from Oceania, to determine the demographics, diving parameters, and comorbidities that may be related to this disorder. **METHOD:** Incidents of IPE, most of which were documented by Divers Alert Network Asia-Pacific (DAN AP) or reported in our medical literature, were analyzed. They included interviews with the survivors and a review of available medical records. Only incidents diagnosed as IPE by specialist diving physicians or pathologists with experience in the investigation of diving accidents were included. **RESULTS:** Thirty-one IPE incidents in divers from Oceania were documented. There were two surface snorkelers, 22 scuba air divers and seven nitrox divers, which included three closed-circuit rebreathers (CCR). The mean (SD) age was 53 (12) years, 58% of victims were females, and the average dive profile was to a maximum depth of 19 msw for 25 minutes. Six victims (19%) had previous episodes of IPE. There were nine recorded fatalities in this cohort. Medical comorbidities were recorded in 68%, with 42% being cardiac. The latter included valvular disease in 29%, transient cardiomyopathies in 26% and dysrhythmias in 16%. **CONCLUSION:** IPE was more likely in middle-aged females, in experienced divers, and during ascent or after surfacing. Commonly reported associations such as exertion, stress, cold exposure, negative inspiratory pressure, hypertension, overhydration, tight wetsuit, aspiration and certain medications were identified. This series supports the hypothesis that the elderly IPE subjects are likely to have comorbidities and be susceptible to IPE recurrences and fatalities unless the contributing factors can be identified and addressed

Edmonds C, Lippmann J, Fock A. Immersion pulmonary edema: case reports from Oceania. Undersea Hyperb Med. 2019;46(5):581-601.

INTRODUCTION: We aimed to document identified cases of immersion pulmonary edema (IPE) in divers from Oceania (the Indo-Pacific region) from January 2002 to May 2018, inclusive. **METHOD:** Cases were identified using various sources, including searches of the Divers Alert Network Asia-Pacific (DAN AP) Fatality Database, published case reports, and interviews with survivors who had reported their incident to DAN AP. Where available, investigations, pathology and autopsy results were obtained. Only incidents diagnosed as IPE by diving physicians or pathologists with experience in the investigation of diving accidents were included. Individual

case histories and outcomes, together with brief individual summaries of the associations and possible contributing factors were recorded. **RESULTS:** Thirty-one IPE incidents in divers from Oceania were documented. There were two surface snorkelers, 22 scuba air divers and seven nitrox divers which included three closed-circuit rebreathers (CCR). The mean (SD) age was 53 (12) years, 58% of victims were females, and the average dive profile was to a maximum depth of 19 meters of seawater for 25 minutes. Six victims (19%) had previous episodes of IPE. There were nine recorded fatalities. Cardiac anomalies dominated the associated or possible contributing factors. These included valvular disease in 29%, transient cardiomyopathies in 26% and dysrhythmias in 16%. **CONCLUSIONS:** Previously reported associations of IPE such as exertion, stress, cold exposure, negative inspiratory pressure, hypertension, overhydration, ascent or surfacing, tight wetsuit, aspiration and certain medications were identified. Cardiac conditions were frequent and included chronic disorders (valvular pathology, coronary artery disease) and transient disorders (dysrhythmias, transient myocardial dysfunction, takotsubo or stress cardiomyopathy). It is likely that the chronic cardiac disorders may have contributed to the IPE, whereas the transient cases could be either sequelae, contributors or coincidental to the IPE

El-Rabbany M, Duchnay M, Raziee HR, Zych M, Tenenbaum H, Shah PS, Azarpazhooh A. Interventions for preventing osteoradionecrosis of the jaws in adults receiving head and neck radiotherapy. Cochrane Database Syst Rev. 2019;2019(11).

BACKGROUND: Osteoradionecrosis (ORN) of the jaws is among the most serious oral complications of head and neck cancer radiotherapy, arising from radiation-induced fibro-atrophic tissue injury, manifested by necrosis of osseous tissues and failure to heal, often secondary to operative interventions in the oral cavity. It is associated with considerable morbidity and has important quality of life ramifications. Since ORN is very difficult to treat effectively, preventive measures to limit the onset of this disease are needed; however, the effects of various preventive interventions has not been adequately quantified. **OBJECTIVES:** To assess the effects of interventions for preventing ORN of the jaws in adult patients with head and neck cancer undergoing curative or adjuvant (i.e. non-palliative) radiotherapy. **SEARCH METHODS:** Cochrane Oral Health's Information Specialist searched the following databases: Cochrane Oral Health's Trials Register (to 5 November 2019), the Cochrane Central Register of Controlled Trials (CENTRAL; 2019, Issue 10) in the Cochrane Library (searched 5 November 2019), MEDLINE Ovid (1946 to 5 November 2019), Embase Ovid (1980 to 5 November 2019), Allied and Complementary Medicine (AMED) Ovid (1985 to 5 November 2019), Scopus (1966 to 5

November 2019), Proquest Dissertations and Theses International (1861 to 5 November 2019) and Web of Science Conference Proceedings (1990 to 5 November 2019). The US National Institutes of Health Ongoing Trials Register (ClinicalTrials.gov) and the World Health Organization International Clinical Trials Registry Platform were searched for ongoing trials. No restrictions were placed on the language or date of publication when searching the electronic databases. **SELECTION CRITERIA:** We selected randomised controlled trials (RCTs) or quasi-RCTs of adult patients 18 years or older with head and neck cancer who had undergone curative or adjuvant radiotherapy to the head and neck, who had received an intervention to prevent the onset of ORN. Eligible patients were those subjected to pre- or post-irradiation dental evaluation. Management of these patients was to be with interventions independent of their cancer therapy, including but not limited to local, systemic, or behavioural interventions. **DATA COLLECTION AND ANALYSIS:** Two review authors independently selected trials from search results, assessed risk of bias, and extracted relevant data for inclusion in the review. Authors of included studies were contacted to request missing data. We used standard methodological procedures expected by Cochrane. **MAIN RESULTS:** Four studies were identified that met pre-determined eligibility criteria, evaluating a total of 342 adults. From the four studies, all assessed as at high risk of bias, three broad interventions were identified that may potentially reduce the risk of ORN development: one study showed no reduction in ORN when using platelet-rich plasma placed in the extraction sockets of prophylactically removed healthy mandibular molar teeth prior to radiotherapy (odds ratio (OR) 3.32, 95% confidence interval (CI) 0.58 to 19.09; one trial, 44 participants; very low-certainty evidence). Another study involved comparing fluoride gel and high-content fluoride toothpaste (1350 parts per million (ppm)) in prevention of post-radiation caries, and found no difference between their use as no cases of ORN were reported (one trial, 220 participants; very low-certainty evidence). The other two studies involved the use of perioperative hyperbaric oxygen (HBO) therapy and antibiotics. One study showed that treatment with HBO caused a reduction in the development of ORN in comparison to patients treated with antibiotics following dental extractions (risk ratio (RR) 0.18, 95% CI 0.43 to 0.76; one trial, 74 participants; very low-certainty evidence). Another study found no difference between combined HBO and antibiotics compared to antibiotics alone prior to dental implant placement (RR 3.00, 95% CI 0.14 to 65.16; one trial, 26 participants; very low-certainty evidence). Adverse effects of the different interventions were not reported clearly or were not important. **AUTHORS' CONCLUSIONS:** Given the suboptimal reporting and inadequate sample sizes of the included studies, evidence regarding the interventions

evaluated by the trials included in this review is uncertain. More well-designed RCTs with larger samples are required to make conclusive statements regarding the efficacy of these interventions.

Estrada EJ, Decima JL, Bortman G, Roberti J, Romero EB, Samaja G, Saavedra AR, Martínez G, Gutiérrez S. Combination treatment of autologous bone marrow stem cell transplantation and hyperbaric oxygen therapy for type 2 diabetes mellitus: a randomized controlled trial. Cell Transplant. 2019 Oct 30:963689719883813. doi: 10.1177/0963689719883813. [Epub ahead of print]

The objective of this study was to compare standard treatment versus the combination of intrapancreatic autologous stem cell (ASC) infusion and hyperbaric oxygen treatment (HBOT) before and after ASC in the metabolic control of patients with type 2 diabetes mellitus (T2DM). This study was a prospective, randomized controlled trial. The combined intervention consisted of 10 sessions of HBOT before the intrapancreatic infusion of ASC and 10 sessions afterwards. ASCs were infused into the main arterial supply of the pancreas to maximize the presence of the stem cells where the therapeutic effect is most desired. A total of 23 patients were included (control group = 10, intervention group = 13). Age, gender, diabetes duration, number of medications taken, body weight and height, and insulin requirements were recorded at baseline and every three months. Also, body mass index, fasting plasma glucose, C-peptide, and HbA1c, C-peptide/glucose ratio (CPGR) were measured every three months for one year. HbA1c was significantly lower in the intervention group compared with control throughout follow-up. Overall, 77% of patients in the intervention group and 30% of patients in the control group demonstrated a decrease of HbA1c at 180 days (compared with baseline) of at least 1 unit. Glucose levels were significantly lower in the intervention group at all timepoints during follow-up. C-peptide levels were significantly higher in the intervention group during follow-up and at one year: 1.9 ± 1.0 ng/mL versus 0.7 ± 0.4 ng/mL in intervention versus control groups, respectively, $p=0.0021$. CPGR was higher in the intervention group at all controls during follow-up. The requirement for insulin was significantly lower in the intervention group at 90, 180, 270, and 365 days. Combined therapy of intrapancreatic ASC infusion and HBOT showed increased metabolic control and reduced insulin requirements in patients with T2DM compared with standard treatment.

Garrido MA, Parra M, Díaz J, Medel J, Nowak D, Radon K. Occupational safety and health in a community of shellfish divers: a community-based participatory approach. J Community Health. 2019 Nov 14. doi: 10.1007/s10900-019-00777-9. [Epub ahead of print]

In artisanal fishing communities in Chile, the access to occupational safety and health (OSH) is limited by factors such as the informality of employment. Our objective was to analyze the working and health conditions of workers in a coastal town in Southern Chile, under a community-based participatory approach. We carried out two independent social dialogue workshops within the community. The first one (N of participants=25) was aimed to identify the strengths, weaknesses and challenges for preventing decompression sickness among divers. The second workshop (N of participants=10) was set to identify the work processes and to map the occupational risks during seafood harvesting and processing in the community. Community members' training for handling and preventing decompression sickness among divers, and the collaboration between a local health representative, stakeholders and authorities, were identified as contributing factors in reducing fatalities and sequels among divers in the past. Technology and safety on board the vessels, training of healthcare personnel in OSH, and access to health programs, were identified as remaining challenges. Through risk mapping, the participants identified the relationship between working and health conditions in the community, reinforcing the necessity of improving access to health and social security. The community participation in identifying and analyzing working and health conditions could be the first step for a strategy to address OSH through primary health care in rural communities. Community empowerment and involvement in action plans, training on basic OSH for health care workers, and public policies are required

Ghumman A, St Denis-Katz H, Ashton R, Wherrett C, Malic C. Treatment of frostbite with hyperbaric oxygen therapy: a single center's experience of 22 cases. Wounds. 2019 Sep 30. pii: WNDS20190930-1. [Epub ahead of print]

INTRODUCTION: Frostbite is well documented in the military and countries with extreme temperatures, and it is most likely due to increased exposure to cold temperatures and/or risk-taking behavior. Severity of injury depends on absolute temperature, wind chill, duration of exposure, wet or dry cold, immersion, clothing quality, and substance use. Hyperbaric oxygen therapy (HBOT) has been described as a treatment option but only in small case series. **OBJECTIVE:** The aim of this retrospective study is to describe the usage patterns, side effects, and outcomes of HBOT used as an adjunct to wound care at a single major Canadian university hospital. **MATERIALS AND METHODS:** A retrospective review of patients with

frostbite injury admitted and treated with HBOT between January 2000 and March 2015 was performed. A total of 22 patients were studied. Available data included patient demographics, duration of exposure to cold temperature, severity of injury, time to HBOT, duration of therapy, side effects of therapy, concurrent therapies (dressing, anticoagulation, antibiotics), bone scan results, and consequent level of amputation. **RESULTS:** The cohort consisted mostly of men (18, 81.8%) and patient mean age of 40 years (range, 13-70 years). Ten patients (45.5%) were intoxicated at the time of injury, and psychiatric illness was implicated in 9 (40.9%) patients. Of the presented injuries, 17 (77.3%) had frostbite to the upper extremity. Bone scans were performed on 16 (72.7%) patients. In 4 patients, the absence of radiotracer activity correlated with a protective effect on subsequent amputation levels. All patients received anticoagulant therapy. Of the 22 patients, 16 (72.7%) experienced at least 1 side effect of HBOT, including otologic barotrauma, nausea, vomiting, anxiety, oxygen toxicity seizure, and myopic changes. All study patients recovered without permanent sequelae; it is unclear whether HBOT reduced soft-tissue damage or amputation rates. **CONCLUSIONS:** This is the largest cohort reported in the literature of patients with frostbite injuries treated with HBOT. Hyperbaric oxygen therapy may show positive impact on the demarcation level of frostbite and, despite the common side effects, it generally causes no long-term sequelae.

Henckes A, Cochard G, Gatineau F, Louge P, Gempp E, Demaistre S, Nowak E, Ozier Y. Risk factors for immersion pulmonary edema in recreational scuba divers: a case-control study. Undersea Hyperb Med. 2019;46(5):611-8.

BACKGROUND: Immersion can cause immersion pulmonary edema (IPE) in previously healthy subjects. We performed a case-control study to better identify IPE risk factors. **METHODS:** We prospectively included recreational scuba divers who had presented signs of IPE and control divers who were randomly chosen among diving members of the French Underwater Federation. We sent an anonymous questionnaire to each diver, with questions on individual characteristics, as well as the conditions of the most recent dive (controls) or the dive during which IPE occurred. Univariate logistic regressions were performed for each relevant factor. Then, multivariate logistic regression was performed. **RESULTS:** Of the 882 questionnaires sent, 480 (54%) were returned from 88 cases (90%) and 392 control divers (50%). Multivariate analysis identified the following independent risk factors associated with IPE: being aged over 50 years ((OR) 3.30, (95%CI) 1.76-6.19); female sex (OR 2.20, 95%CI 1.19-4.08); non-steroidal anti-inflammatory drug (NSAID) intake before diving (OR 24.32, 95%CI 2.86-206.91); depth of dive over 20 m (OR

2.00, 95%CI 1.07-3.74); physical exertion prior to or during the dive (OR 5.51, 95%CI 2.69-11.28); training dive type (OR 5.34, 95%CI 2.62-10.86); and daily medication intake (OR 2.79, 95%CI 1.50-5.21); this latter factor appeared to be associated with hypertension in the univariate analysis. **CONCLUSION:** To reduce the risk of experiencing IPE, divers over 50 years of age or with hypertension, especially women, should avoid extensive physical effort, psychological stress, deep dives and NSAID intake before diving

Huang CC, Ho CH, Chen YC, Hsu CC, Lin HJ, Wang JJ, Su SB, Guo HR. Effects of hyperbaric oxygen therapy on acute myocardial infarction following carbon monoxide poisoning. *Cardiovasc Toxicol.* 2019 Nov 15. doi: 10.1007/s12012-019-09552-7. [Epub ahead of print]

Carbon monoxide poisoning (COP) may increase the risk of myocardial infarction. We conducted a study to investigate the effects of hyperbaric oxygen therapy (HBOT) on the risk. We used the Nationwide Poisoning Database in Taiwan to identify COP patients diagnosed between 1999 and 2012. We compared the risk for myocardial infarction between patients with and without HBOT by following up through 2013 and identified the independent predictors of myocardial infarction. The risk of myocardial infarction in the 7278 patients with HBOT was lower than in the 18,459 patients without HBOT, but this difference did not reach statistical significance [adjusted hazard ratio (AHR): 0.69; 95% confidence interval (CI) 0.45-1.07]. Stratified analyses showed that the reductions in the risk associated with HBOT for myocardial infarction reached statistical significance in male patients (AHR: 0.45; 95% CI 0.24-0.83) and during the first 2 weeks of follow-up (AHR: 0.22; 95% CI 0.05-0.96). In patients without HBOT, independent predictors of myocardial infarction were old age, male sex, and the underlying comorbidities of hypertension, diabetes, coronary artery disease, and congestive heart failure. In patients with HBOT, however, old age, male sex, and the underlying comorbidities of diabetes, coronary artery disease, and congestive heart failure were not independent predictors. HBOT was associated with a reduced risk of myocardial infarction in male patients and within 2 weeks following COP. These results may provide important reference for using HBOT in treating COP.

Moon RE. Hyperbaric treatment of air or gas embolism: current recommendations. *Undersea Hyperb Med.* 2019;46(5):673-83.

Gas can enter arteries (arterial gas embolism, AGE) due to alveolar-capillary disruption (caused by pulmonary over-pressurization, e.g., breath-hold ascent by divers) or veins (venous gas embolism, VGE) as a result of tissue bubble formation due to decompression (diving, altitude exposure) or during certain surgical procedures where capillary hydrostatic pressure at the incision site is

subatmospheric. Both AGE and VGE can be caused by iatrogenic gas injection. AGE usually produces stroke-like manifestations, such as impaired consciousness, confusion, seizures and focal neurological deficits. Small amounts of VGE are often tolerated due to filtration by pulmonary capillaries; however VGE can cause pulmonary edema, cardiac "vapor lock" and AGE due to transpulmonary passage or right-to-left shunt through a patent foramen ovale. Intravascular gas can cause arterial obstruction or endothelial damage and secondary vasospasm and capillary leak. Vascular gas is frequently not visible with radiographic imaging, which should not be used to exclude the diagnosis of AGE. Isolated VGE usually requires no treatment; AGE treatment is similar to decompression sickness (DCS), with first aid oxygen then hyperbaric oxygen. Although cerebral AGE (CAGE) often causes intracranial hypertension, animal studies have failed to demonstrate a benefit of induced hypocapnia. An evidence based review of adjunctive therapies is presented.

Vanden Eede M, Van Berendoncks A, De Wolfe D, De Maeyer C, Vanden Eede H, Germonpré P. Percutaneous closure of patent foramen ovale for the secondary prevention of decompression illness in sports divers: mind the gap. *Undersea Hyperb Med.* 2019;46(5):625-32.

OBJECTIVE: To evaluate the efficiency of percutaneous patent foramen ovale (PFO) closure on the recurrence of decompression illness (DCI). **DESIGN:** Retrospective, observational study with interview and questionnaire. **SETTING:** Tertiary referral center. **POPULATION:** 59 scuba divers with a history of DCI who received a percutaneous PFO closure. **MAIN OUTCOME MEASUREMENTS:** Questionnaire about health status, dive habits and recurrence of DCI after PFO closure. **RESULTS:** A total of 59 divers with DCI were included. The most common manifestations of DCI were cutaneous or vestibular DCI. Procedural complications occurred in four patients but none with long-term consequences. Four patients had recurrence of DCI after closure during a 10-year follow-up. In three of these cases there was residual shunting, all of which were initially considered closed. The fourth patient had aggravating factors for his recurrent DCI. A quarter of the patients stated to have changed their diving habits. Four patients quit diving. **CONCLUSION:** Percutaneous PFO closure for secondary prevention of DCI is associated with few, but not negligible, complications. As a large portion of our cohort changed their diving habit after closure it is difficult to ascertain the efficiency of PFO closure for secondary prevention of DCI. However, the study shows that PFO closure does not fully protect against DCI, emphasizing that the relationship between PFO and DCI is but an association. As such it is imperative that divers be counseled to ensure

they understand the risks as well as the benefits of percutaneous PFO closure in their specific case.

Weitgasser L, Ihra G, Schäfer B, Markstaller K, Radtke C. Update on hyperbaric oxygen therapy in burn treatment. Wien Klin Wochenschr. 2019 Nov 7. doi: 10.1007/s00508-019-01569-w. [Epub ahead of print]

Hyperbaric oxygen therapy (HBOT) has been shown to improve tissue hypoxia, neovascularization and ischemia reperfusion injury and reduce pathologic inflammation in various clinical settings and was proposed to be a game changer in treatment of burns. Improved and faster wound healing as well as a reduction of morbidity and mortality after thermal and concomitant carbon monoxide poisoning are expected. In defiance of the observed benefits for burn wounds and carbon monoxide poisoning in animal models and few randomized controlled trials there is an ongoing controversy regarding its use, indications and cost effectiveness. Furthermore, the use of HBOT, its indications and the evidence behind its efficiency are still widely unknown to most physicians involved in the treatment of burn patients. Therefore, a review of the up to date evidence-based literature was performed with a focus on available data of HBOT in burn care, to elaborate its use in acute thermal injury and carbon monoxide intoxication. Although beneficial effects of HBOT seem very likely insufficient evidence to support or disprove the routine use of HBOT in the treatment of burn care was found. Although difficult to carry out because of the high interindividual variability of burns and chronic wounds, the need for larger high-quality prospective randomized double-blinded controlled multicenter trials are necessary to be able to evaluate useful applications, expense and cost-efficiency of HBOT for burn care.

Yuan Y, Zhao G, Ji H, Peng B, Huang Z, Jin W, Chen X, Guan H, Tang G, Zhang H, Jiang Z. Changes in the gut microbiota during and after commercial helium-oxygen saturation diving in China. Occup Environ Med. 2019;76(11):801-7.

OBJECTIVES: The influence of commercial helium-oxygen saturation diving on divers' gut microbiotas was assessed to provide dietary suggestion. **METHODS:** Faecal samples of 47 divers working offshore were collected before (T1), during (T2) and after (T3) saturation diving. Their living and excursion depths were 55-134 metres underwater with a saturation duration of 12-31 days and P_{aO_2} of 38-65 kPa. The faecal samples were examined through 16S ribosomal DNA amplicon sequencing based on the Illumina sequencing platform to analyse changes in the bacteria composition in the divers' guts. **RESULTS:** Although the α and β diversity of the gut microbiota did not change significantly, we found that living in a hyperbaric environment of helium-oxygen saturation decreased the abundance of the genus *Bifidobacterium*, an obligate anaerobe, from $2.43 \pm 3.83\%$

at T1 to $0.79 \pm 1.23\%$ at T2 and $0.59 \pm 0.79\%$ at T3. Additionally, the abundance of some short-chain fatty acid (SCFA)-producing bacteria, such as *Fusicatenibacter*, *Faecalibacterium*, rectale group and *Anaerostipes*, showed a decreased trend in the order of before, during and after diving. On the contrary, the abundance of species, such as *Lactococcus garvieae*, *Actinomyces odontolyticus*, *Peptoclostridium difficile*, *Butyricimonas virosa*, *Streptococcus mutans*, *Porphyromonas asaccharolytica* and *A. graevenitzii*, showed an increasing trend, but most of them were pathogens. **CONCLUSIONS:** Occupational exposure to high pressure in a helium-oxygen saturation environment decreased the abundance of *Bifidobacterium* and some SCFA-producing bacteria, and increased the risk of pathogenic bacterial infection. Supplementation of the diver diet with probiotics or prebiotics during saturation diving might prevent these undesirable changes

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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