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

E-NEWS

EDITOR'S NOTE – November 2020

The E-News is the monthly newsletter of CUHMA, the primary outlet to share news and information. It was developed to deliver a range of relevant content, including news/announcements, upcoming events, new publication abstracts, job postings, professional perspectives, incident reports, and images of relevant professional scenes. This is my last issue as editor. It has been a pleasure bringing you the bulletin. Past issues are available at https://cuhma.ca.

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NEWS/ANNOUNCEMENTS

CUHMA BOD 2020 ELECTION

The 2020 board of directors election cycle is now complete. Votes were cast by 58% (n=101; 57 regular and 44 associate) of eligible members (n=175; 93 regular and 82 associate). The results have been accepted by the current board. The 8 individuals elected (see below with province and membership status) will add to the standing positions of President and Past-President. The complete roster appears on the last page of this issue. Thanks to all who participated.

Geoff Zbitnew (NL - regular)	President-Elect
Ken LeDez (NL - regular)	Vice-President
Julie Malone (NS - associate)	Treasurer
Sherri Ferguson (BC - associate)	Secretary
Caroline Bain (AB - regular)	Director-at-Large
George Harpur (ON - regular)	Director-at-Large
Ray Janisse (ON - associate)	Director-at-Large
Anton Marinov (ON - regular)	Director-at-Large

UPCOMING EVENTS

Canadian Association of Wilderness Medicine

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 first (virtual) conference will be held November 14-15, with 15.5 hours of presentations (including 2.5 hours of diving material). CME credits are available in multiple forms. Details and registration: https://canadianwildmed.ca.

UHN Introductory Hyperbaric Medicine Course

The University Health Network, Toronto General Hospital, course runs November 24-28. The program is suitable for physicians and other health professionals looking to become CHT certified or obtain Level 1 certification. It is accredited by the Undersea and Hyperbaric Medical Society for 40 CME credits, and by the National Board of Diving and Hyperbaric Medical Technology for 40 CME credits. For more information and registration: https://www.uhn.ca/Surgery/Treatments_Procedures/Hyperbaric_Medicine_Unit#tab4

RECENT PUBLICATIONS

Fischer HG, Schmidtbauer C, Seiffart A, Bucher M, Plontke SK, Rahne T. Contribution of ambient noise and hyperbaric atmosphere to olfactory and gustatory function. PLoS One. 2020;15(10):e0240537.

Introduction: Taste and smell are important for occupational performance and quality of life. Previous studies suggested that the function of these senses might be influenced by ambient pressure and noise. This knowledge would be helpful for divers, submarine crews, or mine workers. The present study aimed to investigate the effects of noise and hyperbaric pressure on olfactory and gustatory functions. Methods: This prospective controlled study included 16 healthy male divers. Inside a hyperbaric chamber, participants performed olfactory and gustatory function tests at sea level pressure and at 2 bar pressure. The olfaction threshold, and the discrimination and identification of odorants were measured with validated 'Sniffin sticks.' Taste identification and the gustation threshold scores were examined with validated filter paper strips. Tests were performed under two conditions: noise reduction (silence) and white noise stimulation presented at 70 dB sound pressure level. Results: The results showed that normobaric and hyperbaric ambient pressures did not significantly affect olfactory or gustatory function. Moreover, noise had no relevant impact on taste or odor sensation. The odor identification score was not influenced in hyperbaric conditions, and the odor threshold score was not influenced by ambient noise or both barometric conditions. The only taste modality affected by hyperbaric conditions was the sensitivity to salty taste, but it was not significant. Conclusion: We concluded that hyperbaric and noisy environments have no influence on gustatory and

olfactory function. From a practical point of view, the influence of pressure in moderate hyperbaric occupations should be negligible

Kumar A, Shukla U, Prabhakar T, Srivastava D. Hyperbaric oxygen therapy as an adjuvant to standard therapy in the treatment of diabetic foot ulcers. J Anaesthesiol Clin Pharmacol. 2020;36(2):213-8.

Background and aims: Chronic diabetic foot ulcers pose a major problem because of associated limb threatening complications. The aim of the present study was to evaluate the efficacy of hyperbaric oxygen therapy (HBOT) as an adjuvant to standard therapy for treatment of diabetic foot ulcers. Material and methods: A total of 54 patients with diabetic foot ulcer of Wagner grade II-IV were recruited in this prospective, randomized, double blind study. Patients were randomized to receive HBOT along with standard therapy (group H; n=28) or standard therapy alone (group S; n=26). Patients were given 6 sessions per week for 6 weeks and followed up for 1 year. Outcomes were measured in terms of healing, and need for amputation, grafting or debridement. Parametric continuous variables were analyzed using Student unpaired t-test and categorical variables were analyzed using Chi square test. Results: The diabetic ulcers in 78% patients in Group H completely healed without any surgical intervention while no patient in group S healed without surgical intervention (P=0.001). 2 patients in group H required distal amputation while in Group S, three patients underwent proximal amputation. Conclusion: The present study shows that hyperbaric oxygen therapy is a useful adjuvant to standard therapy and is a better treatment modality if combined with standard treatment rather than standard treatment alone for management of diabetic foot ulcer.

Lippmann J, Taylor MD. Scuba diving fatalities in Australia 2001 to 2013: chain of events. Diving Hyperb Med. 2020;50(3):220-9.

Introduction: We aimed to identify the possible chain of events leading to fatal scuba diving incidents in Australia from 2001-2013 to inform appropriate countermeasures. Methods: The National Coronial Information System was searched to identify scuba diving-related deaths from 2001-2013, inclusive. Coronial findings, witness and police reports, medical histories and autopsies, toxicology and equipment reports were scrutinised. These were analysed for predisposing factors, triggers, disabling agents, disabling injuries and causes of death using a validated template. Results: There were 126 known scuba diving fatalities and 189 predisposing factors were identified, the major being health conditions (59; 47%), organisational/training/experience/skills issues (46; 37%), planning shortcomings (29; 23%) and equipment inadequacies (24; 19%). The 138 suspected triggers included environmental (68; 54%), exertion (23; 18%) and gas supply problems (15; 12%) among others. The 121 identified disabling agents included medical-related (48; 38%), ascent-related (21; 17%), poor buoyancy control (18; 14%), gas supply (17; 13%), environmental (13; 10%) and equipment (4; 3%). The main disabling injuries were asphyxia (37%), cardiac (25%) and cerebral arterial gas embolism/pulmonary barotrauma (15%). Conclusions: Chronic medical conditions, predominantly cardiac-related, are a major contributor to diving incidents. Divers with such conditions and/or older divers should undergo thorough fitness-to-dive assessments. Appropriate local knowledge, planning and monitoring are important to minimise the potential for incidents triggered by adverse environmental conditions, most of which involve inexperienced divers. Chain of events analysis should increase understanding of diving incidents and has the potential to reduce morbidity and mortality in divers.

Ozgok-Kangal K, Canarslan-Demır K, Zaman T, Sımsek K. The changes in pulmonary functions in occupational divers: smoking, diving experience, occupational group effects. Int Marit Health. 2020;71(3):201-6.

Background: Diving challenges the respiratory system because of the pressure changes, breathing gases, and cardiovascular effects. We aimed to analyse the long term effect of occupational diving on pulmonary functions in terms of diving experience (year), smoking history, and occupational groups (commercial divers and scuba instructors). Materials and methods: We retrospectively analysed respiratory system examination results of the experienced occupational divers who were admitted to the Undersea and Hyperbaric Medicine Department for periodic medical examination between January 1, 2013 and February 28, 2019. Results: Sixty-four divers applied to our department. Candidate divers were not included in our study. The mean diving experience (year) was 13.6±7.3. None of the divers complained of pulmonary symptoms. Pulmonary auscultation and chest radiography were normal in all cases. In divers with 20 years or more experience, the FEV_1/FVC ratio and FEF_{25-75}(%) was significantly lower ($p<0.001$, $p<0.05$, respectively). In addition, there was a statistically significant negative correlation between FEV_1/FVC ratio and FEF_{25-75}(%) and diving experience (year) ($p<0.05$, $r = -0.444$, $p<0.05$, $r=-0.300$, respectively). As the diving experience increase per 1 year, the FEF_{25-75}(%) value decreases by 1.04% according to linear regression analyses. However, smoking and occupational groups did not show any significant influence on pulmonary function test parameters. Conclusions: Occupational diving seems to create clinically asymptomatic pulmonary function test changes related to small airway obstruction after long years of exposure.

Rosén A, Gennser M, Oscarsson N, Kvarnström A, Sandström G, Blennow K, Seeman-Lodding H,

Zetterberg H. Biomarkers of neuronal damage in saturation diving-a controlled observational study. Eur J Appl Physiol. 2020 Sep 25. doi: 10.1007/s00421-020-04499-y. Online ahead of print.

Purpose: A prospective and controlled observational study was performed to determine if the central nervous system injury markers glial fibrillary acidic protein (GFAp), neurofilament light (NfL) and tau concentrations changed in response to a saturation dive. Methods: The intervention group consisted of 14 submariners compressed to 401 kPa in a dry hyperbaric chamber. They remained pressurized for 36 h and were then decompressed over 70 h. A control group of 12 individuals was used. Blood samples were obtained from both groups before, during and after hyperbaric exposure, and from the intervention group after a further 25-26 h. Results: There were no statistically significant changes in the concentrations of GFAp, NfL and tau in the intervention group. During hyperbaric exposure, GFAp decreased in the control group (mean/median -15.1/-8.9 $pg \cdot mL^{-1}$, $p<0.01$) and there was a significant difference in absolute change of GFAp and NfL between the groups (17.7 $pg \cdot mL^{-1}$, p=0.02 and 2.34 $pg \cdot mL^{-1}$, p=0.02, respectively). Albumin decreased in the control group (mean/median -2.74 g/L/-0.95 g/L, p=0.02), but there was no statistically significant difference in albumin levels between the groups. In the intervention group, haematocrit and mean haemoglobin values were slightly increased after hyperbaric exposure (mean/median 2.3%/1.5%, p=0.02 and 4.9 g/L, p=0.06, respectively). Conclusion: Hyperbaric exposure to 401 kPa for 36 h was not associated with significant increases in GFAp, NfL or tau concentrations. Albumin levels, changes in hydration or diurnal variation were unlikely to have confounded the results. Saturation exposure to 401 kPa seems to be a procedure not harmful to the central nervous system.

Spruijt NE, van den Berg R. The effect of hyperbaric oxygen treatment on late radiation tissue injury after breast cancer: A case-series of 67 patients. Diving Hyperb Med. 2020;50(3):206-13.

Introduction: Late radiation tissue injury (LRTI) after breast cancer may benefit from hyperbaric oxygen treatment (HBOT). This study aimed to report the LRTI symptom scores up to 12 months after HBOT and identify risk factors for poor scores. Methods: A case-series of 67 patients who underwent a mean of 44 sessions of HBOT was analysed. LRTI symptoms were scored at four time points using the LENT-SOMA scale (late effects in normal tissues - subjective, objective, management, and analytic), a visual analog scale for pain, and the range of shoulder motion. Results: Between starting HBOT and 12 months after HBOT 57 patients (85%) reported at least one point improvement in their LENT-SOMA score. Median pain and fibrosis scores improved significantly between the start and end of HBOT (P<0.001), and remained stable three and 12 months after HBOT. The median breast oedema score improved significantly 12 months after HBOT (P=0.003). Median shoulder abduction increased significantly from 90 to 165 degrees (P=0.001) and median shoulder anteflexion increased significantly from 115 to 150 degrees (P=0.004). Various risk factors were identified for poor scores despite HBOT; the most common risk factor was a poor score at start of HBOT. Conclusions: In this case-series, patients who underwent HBOT for LRTI after breast cancer reported significant improvement in pain, fibrosis, oedema, and shoulder movement. The improvement persisted up to 12 months after HBOT. A poor score at the start of HBOT was predictive for a poor score 12 months after HBOT

Wilkinson D, Szekely S, Gue B, Tam CS, Chapman I, Heilbronn LK. Assessment of insulin sensitivity during hyperbaric oxygen treatment. Diving Hyperb Med. 2020;50(3):238-43.

Introduction: Previous studies using a hyperinsulinaemic, euglycaemic glucose clamp have demonstrated an increase in peripheral insulin sensitivity in men with and without Type-2 diabetes mellitus on the third and thirtieth hyperbaric oxygen treatment (HBOT) session. In two studies using different techniques for assessment of insulin sensitivity, we investigated the onset and duration of this insulin-sensitising effect of HBOT. Methods: Men who were obese or overweight but without diabetes were recruited. One study performed a hyperinsulinaemic euglycaemic glucose clamp (80 $mU \cdot m^{-2} \cdot min^{-1}$) at baseline and during the first HBOT exposure (n=9) at a pressure of 203 kPa. Data were analysed by paired t-test. The other study assessed insulin sensitivity by a frequently sampled intravenous glucose tolerance test (FSIGT) at three time points: baseline, during the third HBOT and 24-hours post-HBOT (n=9). Results were analysed by repeated-measures ANOVA. Results: There was a significant 23% increase in insulin sensitivity by clamp measured during the first HBOT exposure. The FSIGT showed no significant changes in insulin sensitivity. Conclusions: The hyperinsulinaemic, euglycaemic glucose clamp demonstrated a significant increase in peripheral insulin sensitivity during a single, 2-hour HBOT session in a group of men who were obese or overweight but without diabetes. As an alternate technique for assessing insulin sensitivity during HBOT, the FSIGT failed to show any changes during the third HBOT and 24-hours later, however modification of the study protocol should be considered.

Woo J, Min JH, Lee YH, Roh HT. Effects of hyperbaric oxygen therapy on inflammation, oxidative/antioxidant balance, and muscle damage after acute exercise in normobaric, normoxic and hypobaric, hypoxic environments: a pilot study. Int J Environ Res Public Health. 2020;17(20):E7377.

The purpose of this study was to investigate the effects of hyperbaric oxygen therapy (HBOT) on inflammation, the oxidative/antioxidant balance, and muscle damage after acute exercise in normobaric, normoxic (NN) and hypobaric, hypoxic (HH) environments. Eighteen healthy males were selected and randomly assigned to three groups: exercise in NN conditions (NN group, n=6), HBOT treatment after exercise in NN conditions (HNN group, n=6), and HBOT treatment after exercise in HH conditions (HHH group, n=6). All subjects performed treadmill running for 60 min at 75-80% maximum heart rate (HR_{max}) exercise intensity under each condition. The HBOT treatments consisted of breathing 100% oxygen at 2.5 atmosphere absolute (ATA) for 60 min. Blood samples were collected before exercise (BE), after exercise (AE), and after HBOT (AH) to examine inflammation (fibrinogen, interleukin-6 [IL-6], and tumor necrosis factor-α (TNF-α)), the oxidative/antioxidant balance (derivatives of reactive oxygen metabolites (d-ROMs) and the biological antioxidant potential (BAP)), and muscle damage (creatine kinase (CK) and lactate dehydrogenase (LDH)). Plasma fibrinogen, serum IL-6, CK, and LDH levels were significantly increased AE compared to BE in all groups ($p<0.05$). Plasma fibrinogen levels were significantly decreased AH compared to AE in all groups ($p<0.05$), and the HNN group had a significantly lower AH compared to BE ($p<0.05$). Serum IL-6 levels were significantly decreased AH compared to AE in the HNN and HHH groups ($p<0.05$). Serum CK levels were significantly decreased AH compared to AE in the HHH group ($p<0.05$). Serum LDH levels were significantly decreased AH compared to AE in the HNN and HHH groups ($p<0.05$), and the NN and HNN groups had significantly higher AH serum LDH levels compared to BE ($p<0.05$). These results suggest that acute exercise in both the NN and HH environments could induce temporary inflammatory responses and muscle damage, whereas HBOT treatment may be effective in alleviating exercise-induced inflammatory responses and muscle damage.

Zaman T, Celebi A, Mirasoglu B, Toklu AS. The evaluation of in-chamber sound levels during hyperbaric oxygen applications: results of 41 centres. Diving Hyperb Med. 2020;50(3):244-9.

Introduction: Noise has physical and psychological effects on humans. Recommended exposure limits are exceeded in many hospital settings; however, information about sound levels in hyperbaric oxygen treatment chambers is lacking. This study measured in-chamber sound levels during treatments in Turkish hyperbaric centres. Methods: Sound levels were measured using a sound level meter (decibel meter). All chambers were multiplace with similar dimensions and shapes. Eight measurements were performed in each of 41 chambers; three during compression, three during decompression, and two at treatment pressure, one during chamber ventilation (flushing) and one without ventilation. At each measurement a sound sample was collected for 25 seconds and A-weighted equivalent (LA_{eq}) and C-weighted peak (LC_{peak}) levels were obtained. Recorded values were evaluated in relation to sound level limits in regulations. Results: The highest sound level measured in the study was 100.4 dB(A) at treatment pressure while ventilation was underway and the lowest was 40.5 dB(A) at treatment pressure without ventilation. Most centres had sound levels between 70 dB and 85 dB throughout the treatment. Ventilation caused significant augmentation of noise. Conclusions: The chambers were generally safe in terms of noise exposure. Nevertheless, hyperbaric chambers can be very noisy environments so could pose a risk for noise-related health problems. Therefore, they should be equipped with appropriate noise control systems. Silencers are effective in reducing noise in chambers. Thus far, hyperbaric noise research has focused on chambers used for commercial diving. To our knowledge, this is the first study to investigate noise in hospital-based chambers during medical treatments.

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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