

E-NEWS

EDITORIAL NOTE – February 2019

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

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NEWS/ANNOUNCEMENTS

Educational Video Clips from CUHMA 2018 ASM

We are extending the educational reach of CUHMA scientific meetings by recording video clips of presentation highlights and workshops. These will be accessible through the CUHMA website, and freely available for educational purposes. There are 8 of 15 clips now available, some English and some French, ranging from 5-13 minutes in duration. To review:

<https://www.youtube.com/playlist?list=PLHJt-7L92RI42TEfb79-lf5b1LPt9aUcm>

Call for Original Research – CUHMA 2019

Both original research and review session abstracts will be considered for oral presentation at the 2019 CUHMA annual scientific meeting in St. John's, NL October 03-06. The submission deadline is June 15, 2019, with decisions returned to corresponding authors by July 15. Submit abstracts to neal.pollock@kin.ulaval.ca.

Abstract Submission Guidelines (Word file)

Line 1 - informative title, bold and block capitals.

Line 2 - author(s) (surname followed by initials for each).

Line 3 - professional affiliations for each author.

Lines 4+ (research abstracts) - maximum 250 words (introduction, methods, results, conclusions, funding acknowledgment), 10 pitch Times New Roman, block format (ie, no indenting), complete data but no references, tables or figures.

Lines 4+ (review session abstracts) - 150-250 words, 10 pitch Times New Roman, block format (ie, no indenting), overview of proposed presentation but no references, tables or figures.

Doctoral Studies in Diving Research

Active recruitment is underway at Université Laval for qualified and motivated students wanting to pursue doctoral studies in environmental physiology related to diving. The research focus is health and safety in extreme environments, with concentration in decompression stress, monitoring technology, and diver safety. Students will also gain experience with a variety of studies in hyperbaric medicine. Contact Dr. Neal Pollock (neal.pollock@kin.ulaval.ca) for more information. Inquiries would best include concise CVs and a description of key interests and goals.

UPCOMING EVENTS

OZTek 2019

OZTek 2019 will be held March 16-17 at the International Convention Centre in Sydney, Australia. For further information, see: www.diveoztek.com.

UHN Introductory Course in Hyperbaric Medicine

The University Health Network-Toronto General Hospital, Hyperbaric Medicine Unit is offering an introductory course in hyperbaric medicine April 01-05. The course is suitable for physicians, physician assistants, respiratory therapists, military medical personnel, paramedic/emergency medical technicians, licensed practical nurses, and nurse practitioners. The program is accredited by the Undersea and Hyperbaric Medical Society (40 CME credits) and the National Board of Diving and Hyperbaric Medical Technology (40 CME credits and as a pre-course for CHT certification). For details and online registration, see: https://www.uhn.ca/Surgery/PatientsFamilies/Clinics_Tests/Hyperbaric_Medicine_Unit/Pages/Continuing_Education.aspx

UMC Level 2 Advanced Diving Medicine Course

Undersea Medicine Canada is offering a CSA Z275 Level 2 'Advanced Course in Diving Medicine: Diagnosis and Treatment'. This 6-day course will be held May 06-11 at the Canadian Museum of Immigration, Pier 21 in Halifax, NS. Augmenting classroom instruction and case-based learning, site visits will allow observation of commercial diver training and diving operations, as well as training at the Hyperbaric Medicine Unit at the QEII Health Sciences Centre in Halifax. A CSA Z275.2-15 Level 1 course or equivalent training is a prerequisite for this 45-h program.

You can register at <https://underseamedicine.ca> or contact Dr. Debbie Pestell at drdeb1@ns.sympatico.ca or 902-225-8214 for more information.

UMC Level 1 Introductory Diving Medicine Course

Undersea Medicine Canada is offering a CSA Z275.2-15 Level 1 'Introductory Course in Diving Medicine - Fitness to Dive' October 28-November 01 in Quebec City, QC. Upon successful completion of the course, physicians will qualify as CSA Z275.2-15 Level 1 Diving Medical Examiners and can have their names listed with the Diver Certification Board of Canada (DCBC) to conduct commercial diver medicals in Canada. This 40-h course has been accredited for 35 MAINPRO+ CME credits by the College of Family Physicians of Canada. Contact Dr. Debbie Pestell (drdeb1@ns.sympatico.ca; 902-225-8214) or visit: <https://underseamedicine.ca> for more information.

RECENT PUBLICATIONS

Ari C, Koutnik AP, DeBlasi J, Landon C, Rogers CQ, Vallas J, Bharwani S, Puchowicz M, Bederman I, Diamond DM, Kindy MS, Dean JB, D Agostino DP. Delaying latency to hyperbaric oxygen-induced CNS oxygen toxicity seizures by combinations of exogenous ketone supplements. *Physiol Rep.* 2019;7(1):e13961.

Central nervous system oxygen toxicity (CNS-OT) manifests as tonic-clonic seizures and is a limitation of hyperbaric oxygen therapy (HBOT), as well as of recreational and technical diving associated with elevated partial pressure of oxygen. A previous study showed that ketone ester (1,3-butanediol acetoacetate diester, KE) administration delayed latency to seizures (LS) in 3-month-old Sprague-Dawley (SD) rats. This study explores the effect of exogenous ketone supplements in additional dosages and formulations on CNS-OT seizures in 18 months old SD rats, an age group correlating to human middle age. Ketogenic agents were given orally 60 min prior to exposure to hyperbaric oxygen and included control (water), KE (10 g/kg), KE/2 (KE 5 g/kg + water 5 g/kg), KE + medium-chain triglycerides (KE 5 g/kg + MCT 5 g/kg), and ketone salt (Na+ /K+ β HB, KS) + MCT (KS 5 g/kg + MCT 5 g/kg). Rats were exposed to 100% oxygen at 5 atmospheres absolute (ATA). Upon seizure presentation (tonic-clonic movements) experiments were immediately terminated and blood was tested for glucose and D-beta-hydroxybutyrate (D- β HB) levels. While blood D- β HB levels were significantly elevated post-dive in all treatment groups, LS was significantly delayed only in KE (P = 0.0003), KE/2 (P = 0.023), and KE + MCT (P = 0.028) groups. In these groups, the severity of seizures appeared to be reduced, although these changes were significant only in KE-treated animals (P = 0.015). Acetoacetate (AcAc) levels were also significantly elevated in KE-treated animals. The LS in 18-month-old

rats was delayed by 179% in KE, 219% in KE + MCT, and 55% in KE/2 groups, while only by 29% in KS + MCT. In conclusion, KE supplementation given alone and in combination with MCT elevated both β HB and AcAc, and delayed CNS-OT seizures.

Bayoumy AB, van der Veen EL, van Ooij PAM, Besseling-Hansen FS, Koch DAA, Stegeman I, de Ru JA. Effect of hyperbaric oxygen therapy and corticosteroid therapy in military personnel with acute acoustic trauma. *J R Army Med Corps.* 2019 Jan 5. pii: jramec-2018-001117. [Epub ahead of print]

INTRODUCTION: Acute acoustic trauma (AAT) is a sensorineural hearing impairment due to exposure to an intense impulse noise which causes cochlear hypoxia. Hyperbaric oxygen therapy (HBO) could provide an adequate oxygen supply. The aim was to investigate the effectiveness of early treatment with combined HBO and corticosteroid therapy in patients with AAT compared with corticosteroid monotherapy. **METHODS:** A retrospective study was performed on military personnel diagnosed with AAT between November 2012 and December 2017. Inclusion criteria for HBO therapy were hearing loss of 30 dB or greater on at least one, 25 dB or more on at least two, or 20 dB or more on three or more frequencies as compared with the contralateral ear. **RESULTS:** Absolute hearing improvements showed significant differences (independent t-test) between patients receiving HBO and the control group at 500 Hz (p=0.014), 3000 Hz (p=0.023), 4000 Hz (p=0.001) and 6000 Hz (p=0.01) and at the mean of all frequencies (p=0.002). Relative hearing improvements were significantly different (independent t-test) at 4000 Hz (p=0.046) and 6000 Hz (p=0.013) and at all frequencies combined (p=0.005). Furthermore, the percentage of patients with recovery to the functional level required by the Dutch Armed Forces (clinical outcome score) was higher in the HBO group. **CONCLUSIONS:** Early-stage combination therapy for patients with AAT was associated with better audiometric results at higher frequencies and better clinical outcome score.

Ennis WJ, Huang ET, Gordon H. Impact of hyperbaric oxygen on more advanced Wagner grades 3 and 4 diabetic foot ulcers: matching therapy to specific wound conditions. *Adv Wound Care (New Rochelle).* 2018; 7(12):397-407.

Objective: The goal of this research was to identify a population of diabetic foot ulcer patients who demonstrate a significant response to hyperbaric oxygen therapy (HBOT) using a large sample size to provide guidance for clinicians when treating these complicated patients. **Approach:** The effect of HBOT on diabetic foot ulcers, Wagner grades 3 and 4, was evaluated using a retrospective observational real-world data set. The study reported on the overall healing rate, (74.2%) at the

population level, for >2 million wounds. Results: When a subgroup of patients of only foot ulcers with a Wagner grade 3 or 4 were considered, the healing rate was only 56.04%. The use of HBOT, without filtering for the number of treatments received, improved the healing rate to 60.01% overall. Healing rates for this same subgroup, however, were improved to 75.24% for patients who completed the prescribed number of hyperbaric treatments. Innovation: This observational study discusses the importance of reporting at the population level, specific wound etiology level, a risk-stratified level, and to then overlay the effect of treatment adherence on those outcomes to provide clinicians with a comprehensive understanding of when to prescribe an advanced modality such as hyperbaric oxygen. Conclusion: The authors provide healing outcomes data from several prior HBOT studies as well as other advanced modalities that have been used in diabetic foot ulcer care for comparison and context

Fujita M, Oda Y, Kaneda K, Kawamura Y, Nakahara T, Todani M, Yagi T, Koga Y, Tsuruta R. Variability in treatment for carbon monoxide poisoning in Japan: a multicenter retrospective survey. Emerg Med Int. 2018 Dec 4;2018:2159147. doi: 10.1155/2018/2159147. eCollection 2018.

BACKGROUND: The aim of this study was to identify practice differences in the treatment of carbon monoxide (CO) poisoning with or without hyperbaric oxygen (HBO₂) therapy in Japan. **MATERIALS AND METHODS:** Using an online survey website (Google form), we created a questionnaire and invited interested institutions to join the COP-J Study, a prospective observational study of CO poisoning in Japan. **RESULTS:** Forty-eight (63%) of 76 institutions replied to the questionnaire. Thirty-three institutions (69%) administered HBO₂ therapy to patients with CO poisoning, and 15 institutions (31%) did not. Consciousness disturbance on arrival, exposure to CO for a long time, and elevation of arterial carboxyhemoglobin (CO-Hb) were the major indications for HBO₂ therapy. The maximum therapeutic pressures were 2.0, 2.5, and 2.8 atmospheres absolute (ATA) at 19 (58%), 6 (18%), and 8 (24%) institutions, respectively. The number of HBO₂ sessions on the first day was 1-3, and 1-7 sessions were administered on days 2-7. Seventeen (35%) institutions treated patients with delayed neurological sequelae (DNS) and 15 of them used HBO₂ therapy for DNS. **CONCLUSIONS:** This survey indicates that HBO₂ therapy for CO poisoning was varied in both the indications and practice regimens used in Japan

Lippmann J. Fatal shark attacks on divers in Australia, 1960-2017. Diving Hyperb Med. 2018;48(4):224-8.

AIM: The aim of this study was to identify the number, location and characteristics associated with fatal shark attacks on divers in Australian waters from 1960 to 2017,

inclusive. **METHODS:** Searches were made of the Divers Alert Network Asia-Pacific Diving Mortality Database; the International Shark Attack File website; the Australian Shark Attack File and the Global Shark Attack File to identify cases of fatal shark attacks on divers in Australia. In addition, a systematic search of published medical and sporting literature was conducted to identify relevant reports. The data collected were scrutinised for relevance and duplication. **RESULTS:** There were 187 recorded attacks on divers, comprising 112 snorkellers, 62 scuba divers and 13 on divers using surface-supplied breathing apparatus. These included 28 verified deaths: 13 involving snorkellers, eight involving scuba divers, and seven divers using surface-supply. The victims' ages ranged from 13-50 years (mean 31 years). All but three were males. The vast majority of attacks were by *Carcharodon carcharias* (Great White Shark). **CONCLUSION:** Spearfishing and other seafood collection, as well as diving near fishing activities and/or seals, were identified as major risk factors. However, shark attacks on divers are relatively rare and represent only 3% of diving-related fatalities in Australia over this 57-year period.

Park KM, Hu KS, Choi H, Oh SE, Kim HI, Park W, Kim S. Synergistic effect of hyperbaric oxygen therapy with PTH [1-34] on calvarial bone graft in irradiated rat. Oral Dis. 2019 Jan 11. doi: 10.1111/odi.13037. [Epub ahead of print]

OBJECTIVE: To determine the synergistic effect of parathyroid hormone (PTH) [1-34] in combination with hyperbaric oxygen (HBO) on bone graft in a rat calvarial bone defect model under impaired osteogenic conditions. **MATERIALS AND METHODS:** Twenty-four rats were divided into 3 groups. Localized radiation with a single 12 Gy dose was administered to the calvaria. Four weeks after radiation, calvarial circular defects were created in the parietal bones. All defects were filled with biphasic calcium phosphate. After the bone graft, PTH [1-34] was injected subcutaneously, and HBO was administered. At 6 weeks after the bone graft, the rats were sacrificed, and specimens were harvested. **RESULTS:** Histomorphometric evaluation showed that the percentage of new bone area was higher in the PTH and PTH/HBO groups than in the control group. The percent residual material area was decreased in the PTH/HBO group compared with the control group. The percentage blood vessel number was highest in the PTH group. Micro-CT evaluation showed that the new bone volume was highest in the PTH/HBO group. The residual material volume was lowest in the PTH/HBO group. **CONCLUSION:** Within the limitations of this study, our data indicate that PTH combined with HBO may reverse radiation-induced impairment of bone healing.

Simonsen C, Thorsteinsson K, Mortensen RN, Torp-Pedersen C, Kjærgaard B, Andreasen JJ. Carbon

monoxide poisoning in Denmark with focus on mortality and factors contributing to mortality. PLoS One. 2019;14(1):e0210767.

INTRODUCTION: Carbon monoxide (CO) poisoning is frequent worldwide but knowledge regarding the epidemiology is insufficient. The aim of this study was to clarify the extent of this intoxication, its mortality and factors associated with mortality. **MATERIALS AND METHODS:** National databases from Statistics Denmark were used to identify individuals who suffered from CO-poisoning during 1995-2015, as well as information regarding co-morbidities, mortality and manner of death. **RESULTS:** During the period from 1995 to 2015, 22,930 patients suffered from CO-poisoning in Denmark, and 21,138 of these patients (92%) were hospitalized. A total of 2,102 patients died within the first 30 days after poisoning (9.2%). Among these, 1,792 (85% of 2,102) were declared dead at the scene and 310 (15% of 2,102) died during hospitalization. Deaths due to CO-poisoning from smoke were intentional in 6.3% of cases, whereas deaths due to CO containing gases were intentional in 98.0% of cases. Among patients who survived >30 days, there was no significant difference in survival when comparing hyperbaric oxygen therapy (HBO) treatment with no HBO treatment after adjustment for age and co-morbidities such as drug abuse, psychiatric disease, stroke, alcohol abuse, arterial embolism, chronic obstructive pulmonary disease, cerebrovascular disease and atrial fibrillation. Several co-morbidities predicted poorer outcomes for patients who survived the initial 30 days. **CONCLUSIONS:** Poisoning from smoke and/or CO is a frequent incident in Denmark accounting for numerous contacts with hospitals and deaths. Both intoxication and mortality are highly associated with co-morbidities interfering with cognitive and physical function. Treatment with HBO was not seen to have an effect on survival.

Zhang Y, Brewer AL, Nelson JT, Smith PT, Shirachi DY, Quock RM. Hyperbaric oxygen produces a nitric oxide synthase-regulated anti-allodynic effect in rats with paclitaxel-induced neuropathic pain. Brain Res. 2019 Jan 7. pii: S0006-8993(19)30015-0. doi: 10.1016/j.brainres.2019.01.009. [Epub ahead of print]

Research has demonstrated that hyperbaric oxygen (HBO₂) treatment produced relief of both acute and chronic pain in patients and animal models. However, the mechanism of HBO₂ antinociceptive effect is still illusive. Based on our earlier findings that implicate NO in the acute antinociceptive effect of HBO₂, the purpose of this study was to ascertain whether HBO₂-induced antinociception in a chronic neuropathic pain model is likewise dependent on NO. Neuropathic pain was induced in male Sprague Dawley rats by four injections of paclitaxel (1.0 mg/kg, ip). Twenty-four hours after the last paclitaxel injection, rats were treated for one day or four

consecutive days with 60-min HBO₂ at 3.5 atmospheres absolute (ATA). Two days before HBO₂ treatment, some groups of rats were implanted with Alzet® osmotic minipumps that continuously infused a selective inhibitor of neuronal NO synthase (nNOS) into the lateral cerebral ventricle for 7 days. Mechanical and cold allodynia were assessed every other day, using electronic von Frey and acetone assays, respectively. Rats in the paclitaxel control group exhibited a mechanical or cold allodynia that was significantly reversed by one HBO₂ treatment for mechanical allodynia and four HBO₂ treatments for cold allodynia. In rats treated with the nNOS inhibitor, the effects of HBO₂ were nullified in the mechanical allodynia test but unaffected in the cold allodynia test. In summary, these results demonstrate that the antiallodynic effect of HBO₂ in two different pain tests is dependent on NO in the CNS.

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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