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

E-NEWS

EDITORIAL NOTE – May 2018

The E-News is the monthly newsletter of CUHMA used to share news items and links. We invite comments and content, including new publication abstracts, news, announcements, job postings, and relevant underwater images. Items should be submitted by the 25th of each month for inclusion in the next release. Past issues are available at https://cuhma.ca, serving an ongoing role as an information repository.

Neal W. Pollock

NEWS/ANNOUNCEMENTS

Call for Abstracts – CUHMA 2018

The program for the November annual scientific meeting is approaching completion. Abstracts (100-150 words) can still be submitted for a poster session. Posters may present original research or material presented elsewhere within that last year. The submission deadline is June 15, 2018.

UPCOMING EVENTS

UMC Diving and Hyperbaric Medicine Course

The 3rd Undersea Medicine Canada Introductory Course in Diving Medicine - Fitness to Dive program will be held May 07-11, 2018 in Quebec City. 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 from the College of Family Physicians of Canada. Contact Debbie Pestell (drdeb1@ns.sympatico.ca; 902-225-8214) or visit: https://underseamedicine.ca. A block of rooms has been reserved for the group at the Sepia Hotel ($130 single / $145 double [plus taxes] including breakfast, parking and wifi; http://www.hotelsepia.ca).

Hyperbaric Medicine Technologist Course

The Environmental Medicine and Physiology Unit at Simon Fraser University is offering a HMT course May 14-26, 2018. Visit: http://www.sfu.ca/science/faculty-support/facilities-services/empu/courses/hyperbaric-medical-technologist.html.

UHMS Annual Scientific Meeting

The 2018 Undersea and Hyperbaric Medical Society annual scientific meeting will be held June 28-30 in Orlando, FL. Visit: https://www.uhms.org. Note: CUHMA members are eligible to receive a 50% discount on UHMS annual membership dues.

Second Tricontinental Scientific Conference on Diving and Hyperbaric Medicine

The second Tricontinental Scientific Conference will be held in Durban, KwaZulu Natal, South Africa, September 23-29, 2018. The week will combine scientific meetings, diving workshops, and social events. The joint organizing committee includes EUBS, SPUMS, SAUHMA and the Scott Haldane Foundation, working with local Durban Hyperbaric Centre staff and a South Africa event management bureau. The weather in September is ideal with temperatures in the low 20s for both land and sea and little chance of rain. For more information, visit: www.tricon2018.org.

AAUS Diving for Science Symposium 2018

The 2018 American Academy of Underwater Sciences Diving for Science Symposium will be held October 09-13 in Tahoe City, CA. The University of California Berkeley and the University of California Davis will serve as hosts. This meeting is relevant to diving scientists, students, diving safety officers, and anyone with an interest in diving science. For more information: www.aaus.org/annual_symposium.

CUHMA Annual Scientific Meeting 2018

The 2018 CUHMA ASM will be held in Quebec, QC November 01-04, hosted by Université Laval and Hôtel-Dieu de Lévis. Two days of pre-conference workshops, courses and exams will be followed by two days of scientific talks.

Pre-conference events include:

- Transcutaneous oximetry (TCOM) workshop
- Problem wound management workshop
- CHT exam offered by the National Board of Diving and Hyperbaric Medical Technology (NBDHMT)
- Hyperbaric emergency team simulation (HETS) course to be held at the hyperbaric chamber at Hôtel-Dieu de Lévis
- Board of Directors meeting

A welcome reception with be held on Friday evening, and the awards banquet on Saturday evening. Visit our website for updates and future registration: https://cuhma.ca.

STUDENT OPPORTUNITIES

Doctoral Studies in Diving Research

Active recruitment is underway at Université Laval for qualified students wanting to pursue doctoral studies in environmental physiology. 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. Current efforts are funded by the Canadian Institutes of Health Research, Reseau Quebec Maritime, and the Canadian Space Agency. This opportunity is open to highly motivated individuals wanting to dedicate their educational efforts to environmental physiology. 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.

RECENT PUBLICATIONS

Bennett MH, Feldmeier J, Smee R, Milross C. Hyperbaric oxygenation for tumour sensitisation to radiotherapy. Cochrane Database Syst Rev. 2018 Apr 11;4:CD005007. doi: 10.1002/14651858.CD005007.pub4.

BACKGROUND: Cancer is a common disease and radiotherapy is one well-established treatment for some solid tumours. Hyperbaric oxygenation therapy (HBOT) may improve the ability of radiotherapy to kill hypoxic cancer cells, so the administration of radiotherapy while breathing hyperbaric oxygen may result in a reduction in mortality and recurrence. OBJECTIVES: To assess the benefits and harms of administering radiotherapy for the treatment of malignant tumours while breathing HBO. SEARCH METHODS: In September 2017 we searched the Cochrane Central Register of Controlled Trials (CENTRAL), the Cochrane Library Issue 8, 2017, MEDLINE, Embase, and the Database of Randomised Trials in Hyperbaric Medicine using the same strategies used in 2011 and 2015, and examined the reference lists of included articles. SELECTION CRITERIA: Randomised and quasi-randomised studies comparing the outcome of malignant tumours following radiation therapy while breathing HBO versus air or an alternative sensitising agent. DATA COLLECTION AND ANALYSIS: Three review authors independently evaluated the quality of and extracted data from the included trials. MAIN RESULTS: We included 19 trials in this review (2286 participants: 1103 allocated to HBOT and 1153 to control). For head and neck cancer, there was an overall reduction in the risk of dying at both one year and five years after therapy (risk ratio (RR) 0.83, 95% confidence interval (CI) 0.70 to 0.98, number needed to treat for an additional beneficial outcome (NNTB) = 11 and RR 0.82, 95% CI 0.69 to 0.98, high-quality evidence), and some evidence of improved local tumour control immediately following irradiation (RR with HBOT 0.58, 95% CI 0.39 to 0.85, moderate-quality evidence due to imprecision). There was a lower incidence of local recurrence of tumour when using HBOT at both one and five years (RR at one year 0.66, 95% CI 0.56 to 0.78, high-quality evidence; RR at five years 0.77, 95% CI 0.62 to 0.95, moderate-quality evidence due to inconsistency between trials). There was also some evidence with regard to the chance of metastasis at five years (RR with HBOT 0.45 95% CI 0.09 to 2.30, single trial moderate quality evidence imprecision). No trials reported a quality of life assessment. Any benefits come at the cost of an increased risk of severe local radiation reactions with HBOT (severe radiation reaction RR 2.64, 95% CI 1.65 to 4.23, high-quality evidence). However, the available evidence failed to clearly demonstrate an increased risk of seizures from acute oxygen toxicity (RR 4.3, 95% CI 0.47 to 39.6, moderate-quality evidence). For carcinoma of the uterine cervix, there was no clear benefit in terms of mortality at either one year or five years (RR with HBOT at one year 0.88, 95% CI 0.69 to 1.11, high-quality evidence; RR at five years 0.95, 95% CI 0.80 to 1.14, moderate-quality evidence due to inconsistency between trials). Similarly, there was no clear evidence of a benefit of HBOT in the reported rate of local recurrence (RR with HBOT at one year 0.82, 95% CI 0.63 to 1.06, high-quality evidence; RR at five years 0.85, 95% CI 0.65 to 1.13, moderate-quality evidence due to inconsistency between trials). We also found no clear evidence for any effect of HBOT on the rate of development of metastases at both two years and five years (two years RR with HBOT 1.05, 95% CI 0.84 to 1.31, high quality evidence; five years RR 0.79, 95% CI 0.50 to 1.26, moderate-quality evidence due to inconsistency). There were, however, increased adverse effects with HBOT. The risk of a severe radiation injury at the time of treatment with HBOT was 2.05, 95% CI 1.22 to 3.46, high-quality evidence. No trials reported any failure of local tumour control, quality of life assessments, or the risk of seizures during treatment. With regard to the treatment of urinary bladder cancer, there was no clear evidence of a benefit in terms of mortality from HBOT at one year (RR 0.97, 95% CI 0.74 to 1.27, high-quality evidence), nor any benefit in the risk of developing metastases at two years (RR 2.0, 95% CI 0.58 to 6.91, moderate-quality evidence due to imprecision). No trial reported on failure of local control, local recurrence, quality of life, or adverse effects. When all cancer types were combined, there was evidence for an increased risk of severe radiation tissue injury during the course of radiotherapy with HBOT (RR 2.35, 95% CI 1.66 to 3.33, high-quality evidence) and of oxygen toxic seizures during

treatment (RR with HBOT 6.76, 96% CI 1.16 to 39.31, moderate-quality evidence due to imprecision). AUTHORS' CONCLUSIONS: We found evidence that HBOT improves local tumour control, mortality, and local tumour recurrence for cancers of the head and neck. These benefits may only occur with unusual fractionation schemes. Hyperbaric oxygenation therapy is associated with severe tissue radiation injury. Given the methodological and reporting inadequacies of the included studies, our results demand a cautious interpretation. More research is needed for head and neck cancer, but is probably not justified for uterine cervical or bladder cancer. There is little evidence available concerning malignancies at other anatomical sites.

Fitz-Clarke JR. Breath-hold diving. Compr Physiol. 2018; 8(2):585-630.

Breath-hold diving is practiced by recreational divers, seafood divers, military divers, and competitive athletes. It involves highly integrated physiology and extreme responses. This article reviews human breath-hold diving physiology beginning with an historical overview followed by a summary of foundational research and a survey of some contemporary issues. Immersion and cardiovascular adjustments promote a blood shift into the heart and chest vasculature. Autonomic responses include diving bradycardia, peripheral vasoconstriction, and splenic contraction, which help conserve oxygen. Competitive divers use a technique of lung hyperinflation that raises initial volume and airway pressure to facilitate longer apnea times and greater depths. Gas compression at depth leads to sequential alveolar collapse. Airway pressure decreases with depth and becomes negative relative to ambient due to limited chest compliance at low lung volumes, raising the risk of pulmonary injury called "squeeze," characterized by postdive coughing, wheezing, and hemoptysis. Hypoxia and hypercapnia influence the terminal breakpoint beyond which voluntary apnea cannot be sustained. Ascent blackout due to hypoxia is a danger during long breath-holds, and has become common amongst high-level competitors who can suppress their urge to breathe. Decompression sickness due to nitrogen accumulation causing bubble formation can occur after multiple repetitive dives, or after single deep dives during depth record attempts. Humans experience responses similar to those seen in diving mammals, but to a lesser degree. The deepest sled-assisted breath-hold dive was to 214 m. Factors that might determine ultimate human depth capabilities are discussed.

Kozakiewicz M, Kedziora-Kornatowska K, Kaczerska D, Siermontowski P, Olszanski R, Krefft K. Influence of exposure in hyperbaric chambers on selected parametersof oxidative stress in professional divers. Undersea Hyperb Med. 2018;45(1):49-54.

PURPOSE: This study evaluated the influence of hyperbaric exposure chambers on selected parameters of oxidative stress in divers' blood. METHODS: 25 healthy men (non-smoking experienced divers) ages 18-40 took part in the experiment. Subjects were exposed to hyperbaric conditions similar to those at 30 meters of depth while diving. A control group consisted of 20 healthy men who have never dived or been exposed to hyperbaric conditions. Blood was drawn from the cubital vein after overnight fasting. Superoxide dismutase (SOD-1) activity and malondialdehyde (MDA) concentration were marked in red blood cells (RBCs), carbonyl group concentration marked in serum proteins, and nitrate/nitrite concentrations were estimated in plasma. RESULTS: Statistically significant differences were found between the divers and the control group in MDA concentration in erythrocytes and carbonyl group concentration in serum proteins. Nitrite/nitrate concentrations in plasma plus SOD-1 activity in RBCs decreased significantly in the diver group compared with the control group. After hyperbaric exposure MDA concentration in erythrocytes increased considerably in the test group and a significant increase in SOD-1 activity was observed. A significant increase of nitrite/nitrate concentration was noted in plasma as well as an increase in the carbonyl group in serum proteins. CONCLUSION: Considerably weak enzymatic antioxidative defense was observed in the RBCs of individuals exposed to hyperbaric pressures versus those in normobary. This issue indicates that a diver's system has a larger susceptibility for negative effects from oxidative stress. The results also indicate that hyperbaric conditions can intensify reactions via free radicals.

Kulkarni AC. Compressed air working in Chennai during metro tunnel construction: occupational health problems. Indian J Occ Environ Med. 2017; 21(3):105-8.

Chennai metropolis has been growing rapidly. Need was felt of a metro rail system. Two corridors were planned. Corridor 1, of 23 km starting from Washermanpet to Airport. 14.3 km of this would be underground. Corridor 2, of 22 km starting from Chennai Central Railway station to St. Thomas Mount. 9.7 km of this would be underground. Occupational health centre's role involved selection of miners and assessing their fitness to work under compressed air. Planning and execution of compression and decompression, health monitoring and treatment of compression related illnesses. More than thirty five thousand man hours of work was carried out under compressed air pressure ranged from 1.2 to 1.9 bar absolute. There were only three cases of pain only (Type I) decompression sickness which were treated with recompression. Vigilant medical supervision, experienced lock operators and reduced working hours under pressure because of inclement environmental conditions viz. high temperature and humidity, has helped achieve this low incident. Tunnelling activity will increase in India as more

cities will soon opt for underground metro railway. Indian standard IS 4138 - 1977 "Safety code for working in compressed air" needs to be updated urgently keeping pace with modern working methods.

Leung JK, Lam RP. Hyperbaric oxygen therapy: its use in medical emergencies and its development in Hong Kong. Hong Kong Med J. 2018; 24(2):191-9.

Hyperbaric oxygen therapy is widely accepted as life-saving treatment for decompression illness. Yet its use in acute carbon monoxide poisoning has remained controversial because of inconsistent findings in clinical trials. Hyperbaric oxygen therapy has an adjunctive role in managing gas gangrene, necrotising soft-tissue infection, and crush injury, as supported by case series. Several cases have been reported in the literature detailing the use of hyperbaric oxygen therapy in patients with severe anaemia in whom blood transfusion is not possible. Today, use of hyperbaric oxygen therapy in Hong Kong is limited by low awareness among physicians and patients, a lack of service access, and inadequate hospital and critical care support for the existing non-hospital facility. The recent introduction of a hospital-based facility is expected to benefit more patients for whom hyperbaric oxygen therapy is appropriate. This article reviews the mechanistic basis of and emerging scientific evidence to support the use of hyperbaric oxygen therapy in a number of acute medical emergencies, as well as the past and future development of hyperbaric oxygen therapy in Hong Kong.

Lucrezi S, Egi SM, Pieri M, Burman F, Ozyigit T, Cialoni D, Thomas G, Marroni A, Saayman M. Safety priorities and underestimations in recreational scuba diving operations: a European study supporting the implementation of new risk management programmes. Front Psychol. 2018 Mar 23;9:383.

Introduction: Scuba diving is an important marine tourism sector, but requires proper safety standards to reduce the risks and increase accessibility to its market. To achieve safety goals, safety awareness and positive safety attitudes in recreational scuba diving operations are essential. However, there is no published research exclusively focusing on scuba divers' and dive centres' perceptions toward safety. This study assessed safety perceptions in recreational scuba diving operations, with the aim to inform and enhance safety and risk management programmes within the scuba diving tourism industry. Materials and Methods: Two structured questionnaire surveys were prepared by the organisation Divers Alert Network and administered online to scuba diving operators in Italy and scuba divers in Europe, using a mixture of convenience and snowball sampling. Questions in the survey included experience and safety offered at the dive centre; the buddy system; equipment and accessories for safe diving activities; safety issues in the certification of new scuba divers; incidents/accidents; and attitudes toward safety. Results: 91 scuba diving centres and 3,766 scuba divers participated in the study. Scuba divers gave importance to safety and the responsiveness of service providers, here represented by the dive centres. However, they underestimated the importance of a personal emergency action/assistance plan and, partly, of the buddy system alongside other safety procedures. Scuba divers agreed that some risks, such as those associated with running out of gas, deserve attention. Dive centres gave importance to aspects such as training and emergency action/assistance plans. However, they were limitedly involved in safety campaigning. Dive centres' perceptions of safety in part aligned with those of scuba divers, with some exceptions. Conclusion: Greater responsibility is required in raising awareness and educating scuba divers, through participation in prevention campaigns and training. The study supports the introduction of programmes aiming to create a culture of safety among dive centres and scuba divers. Two examples, which are described in this paper, include the Hazard Identification and Risk Assessment protocol for dive centres and scuba divers, and the Diving Safety Officer programme to create awareness, improve risk management, and mitigate health and safety risks.

Papadopoulou V, Germonpré P, Cosgrove D, Eckersley RJ, Dayton PA, Obeid G, Boutros A, Tang MX, Theunissen S, Balestra C. Variability in circulating gas emboli after a same scuba diving exposure. Eur J Appl Physiol. 2018 Apr 3. doi: 10.1007/s00421-018-3854-7.

PURPOSE: A reduction in ambient pressure or decompression from scuba diving can result in ultrasound-detectable venous gas emboli (VGE). These environmental exposures carry a risk of decompression sickness (DCS) which is mitigated by adherence to decompression schedules; however, bubbles are routinely observed for dives well within these limits and significant inter-personal variability in DCS risk exists. Here, we assess the variability and evolution of VGE for 2 h post-dive using echocardiography, following a standardized pool dive in calm warm conditions. METHODS: 14 divers performed either one or two (with a 24 h interval) standardized scuba dives to 33 mfw (400 kPa) for 20 min of immersion time at NEMO 33 in Brussels, Belgium. Measurements were performed at 21, 56, 91 and 126 min post-dive: bubbles were counted for all 68 echocardiography recordings and the average over ten consecutive cardiac cycles taken as the bubble score. RESULTS: Significant inter-personal variability was demonstrated despite all divers following the same protocol in controlled pool conditions: in the detection or not of VGE, in the peak VGE score, as well as time to VGE peak. In addition, intra-personal differences in 2/3 of the consecutive day dives were seen (lower VGE counts or faster clearance). CONCLUSIONS: Since VGE evolution post-dive varies between people, more work is clearly needed to isolate contributing factors. In this respect, going toward a more continuous evaluation, or

developing new means to detect decompression stress markers, may offer the ability to better assess dynamic correlations to other physiological parameters.

Pougnet R, Pougnet L, Lucas D, Henckes A, Loddé B, Dewitte JD. Health effects of hyperbaric exposure on chamber attendants: a literature review. Int Marit Health. 2018;69(1):58-62. doi: 10.5603/IMH.2018.0009.

BACKGROUND: Inside attendants working in hyperbaric chambers are exposed to risks related to the hyperbaric environment, handling and care. The aim of this study is to review the literature focusing on the impact of this activity on health. METHODS: This is a literature review using the Medline database. RESULTS: Eight articles studied decompression illness (DCI). The incidence of DCI ranged from 0 to 37 per 100,000 sessions in hyperbaric chambers (SHC). The incidence of injuries ranged from 0 to 412 per 100,000 SHC. The most prevalent cause of accidental death was fire: 77 deaths (patients and attendants) between 1923 and 1996. Dysbaric osteonecrosis has been reported in one study only. CONCLUSIONS: Inside attendants face risks in the chamber, even if serious health effects seems rare compared to the total number of SHC.

Ranapurwala SI, Kucera KL, Denoble PJ. The healthy diver: A cross-sectional survey to evaluate the health status of recreational scuba diver members of Divers Alert Network (DAN). PLoS One. 2018 Mar 22;13(3):e0194380. doi: 10.1371/journal.pone.0194380. eCollection 2018.

BACKGROUND: Scuba diver fitness is paramount to confront environmental stressors of diving. However, the diving population is aging and the increasing prevalence of diseases may be a concern for diver fitness. PURPOSE: The purpose of this study is to assess the demographics, lifestyle factors, disease prevalence, and healthcare access and utilization of Divers Alert Network (DAN) members and compare them with those from the general population. METHODS: DAN membership health survey (DMHS) was administered online in 2011 to DAN members in the United States (US). Health status of DMHS respondents was compared with the general US population data from the Center for Disease Control and Prevention's Behavioral Risk Factor Surveillance System using two-sided student's t-tests and Mantel-Haenszel chi-square tests. Univariate and multivariate logistic regression analyses were conducted to identify factors associated with healthcare utilization among the DMHS participants. RESULTS: Compared to the general US population, the DMHS population had lower prevalence of asthma, heart attack, angina, stroke, diabetes, hypertension, hypercholesterolemia, and disabilities ($p<0.01$); more heavy alcohol drinkers, and fewer smokers ($p<0.01$); and greater access and utilization (routine checkup) of healthcare ($p<0.01$). Healthcare utilization in males was lower than among females. Increasing age and increase in the number of chronic illnesses were associated with increased healthcare utilization. CONCLUSIONS: DAN members are healthier than the general US population. DAN members also have better access to healthcare and utilize healthcare for preventive purposes more often than the general population. DAN members appear to have a better fitness level than their non-diving peers.

Rose JJ, Nouraie M, Gauthier MC, Pizon AF, Saul MI, Donahoe MP, Gladwin MT. Clinical outcomes and mortality impact of hyperbaric oxygen therapy in patients with carbon monoxide poisoning. Crit Care Med. 2018 Apr 6. doi: 10.1097/CCM.0000000000003135.

OBJECTIVES: Carbon monoxide poisoning affects 50,000 per year in the United States alone. Mortality is approximately 3%, and up to 40% of survivors suffer from permanent neurocognitive and affective deficits. Hyperbaric oxygen therapy has shown benefit on reducing the long-term neurologic sequelae of carbon monoxide poisoning but has not demonstrated improved survival. The objective of this study is to assess the efficacy of hyperbaric oxygen for acute and long-term mortality in carbon monoxide poisoning using a large clinical databank. DESIGN: Retrospective analysis. SETTING: University of Pittsburgh Medical Center healthcare system (Pittsburgh, PA). PATIENTS: One-thousand ninety-nine unique encounters of adult patients with carbon monoxide poisoning. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: Baseline demographics, laboratory values, hospital charge transactions, discharge disposition, and clinical information from charting were obtained from the electronic medical record. In propensity-adjusted analysis, hyperbaric oxygen therapy was associated with a reduction in inpatient mortality (absolute risk reduction, 2.1% [3.7-0.9%]; $p = 0.001$) and a reduction in 1-year mortality (absolute risk reduction, 2.1% [3.8-0.4%]; $p = 0.013$). CONCLUSIONS: These data demonstrate that hyperbaric oxygen is associated with reduced acute and reduced 1-year mortality. Further studies are needed on the mortality effects of hyperbaric oxygen therapy in carbon monoxide poisoning.

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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