

E-NEWS

EDITORIAL NOTE – March 2018

The E-News is the monthly newsletter of CUHMA used to share news items and links. We invite your comments and content. We welcome new publication abstracts, news, announcements, job postings, and images of underwater work. Please submit items by the 25th of each month for inclusion in the next release. Past issues of E-News will be available online at <https://cuhma.ca>, serving an ongoing role as an information repository.

Neal W. Pollock

NEWS/ANNOUNCEMENTS

Working Diver Knowledge Survey Health and Safety of Cold Water Diving Santé et sécurité en plongée dans les eaux froides

We are conducting a survey to evaluate the knowledge, knowledge gaps, and concerns of working divers as part of an effort to increase the availability of appropriate educational materials and opportunities to divers. The information gained through the survey will be used to help develop a continuing education workshop and to develop enduring materials available to be made freely available for diver education. We ask for your help through completion of the survey. The survey is available in both French and English through the following link:

<http://m.sgizmoca.com/s3/Language-Preference>

There is no cost or obligation to participate; input will remain anonymous. This effort was funded by Réseau Québec Maritime and approved by the institutional review board of Hôtel-Dieu de Lévis,

Call for Abstracts – CUHMA 2018

Both research and review session abstracts will be considered for the 2018 CUHMA annual scientific meeting. The submission deadline is June 15, 2018. Decisions will be returned to corresponding authors by July 15. Proposals and abstracts can be brief, with appropriate titles and 100-150-word descriptions.

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, Réseau Québec 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.

UPCOMING EVENTS

Health and Safety of Cold Water Diving Workshop

This workshop will be held March 13-14, 2018 (0800-1700), at the Institut Maritime in Rimouski, QC. Presentations will be provided in a mixture of French and English. Registration is \$75, including lunch (\$40 for a single day), payable by cheque to Université Laval. Contact Payal Razdan (payal.razdan.1@ulaval.ca) for more information or to register for the meeting.

Spring Symposium - 21st Century Decompression Theory and DCI Treatment: from Haldane to BVM, Endothelium Response, and Heliox

This one-day symposium will be held Saturday, March 17, 2018 at the Academic Medical Centre, University of Amsterdam, Netherlands. Contact: n.a.schellart@amc.uva.nl. Website: www.capitaselectaduikgeneeskunde.nl.

TEKDiveUSA

TekDiveUSA will be held April 27-28, 2018 in Orlando, FL. This is a biennial advanced and technical diving conference that will draw over 35 USA and overseas specialist companies and offer a wide range of talks and workshops focused on advanced and technical diving, including operational diving, physiology, safety and imaging. For more details, visit: <https://tekdiveusa.com>.

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 and Lévis, 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 from the College of Family Physicians of Canada. For more information, contact Debbie Pestell (drdeb1@ns.sympatico.ca; 902-225-8214) or visit: <https://underseamedicine.ca>. A block of rooms has been reserved 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 Undersea and Hyperbaric Medical Society (UHMS) annual scientific meeting will be held June 28-30, 2018 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.

CUHMA Annual Scientific Meeting 2018

The 2018 CUHMA ASM will be held in Quebec, QC November 01-04, 2018, hosted by Université Laval and Hôtel-Dieu de Lévis. Two days of workshops will be followed by two days of science talks. Additional events include board and business meetings, and networking sessions. Tentatively planned workshops include:

- Hyperbaric emergency training simulation (HETS)
- 2D ultrasound for decompression research

- Transcutaneous oxygen monitoring (TCOM)
- Problem wound management

An evening reception will be held on November 02 and a banquet on November 03. Visit our website for updates and future registration: <https://cuhma.ca>.

RECENT PUBLICATIONS

Bosco G, Rizzato A, Moon RE, Camporesi EM. Environmental Physiology and Diving Medicine. Front Psychol. 2018 Feb 2;9:72. doi: 10.3389/fpsyg.2018.00072. eCollection 2018.

Man's experience and exploration of the underwater environment has been recorded from ancient times and today encompasses large sections of the population for sport enjoyment, recreational and commercial purpose, as well as military strategic goals. Knowledge, respect and maintenance of the underwater world is an essential development for our future and the knowledge acquired over the last few dozen years will change rapidly in the near future with plans to establish secure habitats with specific long-term goals of exploration, maintenance and survival. This summary will illustrate briefly the physiological changes induced by immersion, swimming, breath-hold diving and exploring while using special equipment in the water. Cardiac, circulatory and pulmonary vascular adaptation and the pathophysiology of novel syndromes have been demonstrated, which will allow selection of individual characteristics in order to succeed in various environments. Training and treatment for these new microenvironments will be suggested with description of successful pioneers in this field. This is a summary of the physiology and the present status of pathology and therapy for the field.

Casadesús JM, Aguirre F, Carrera A, Boadas-Vaello P, Serrando MT, Reina F. Diagnosis of arterial gas embolism in scuba diving: modification suggestion of autopsy techniques and experience in eight cases. Forensic Sci Med Pathol. 2018 Feb 19. doi: 10.1007/s12024-018-9951-4.

The purpose of this study was to suggest modifications of autopsy techniques in order to improve post-mortem diagnosis of arterial gas embolism (AGE) based on multidisciplinary investigation of scuba diving fatalities. Five adult human cadavers from the voluntary donation program of the Human Anatomy Laboratory, and eight judicial autopsied bodies of scuba divers from the Forensic Pathology Service were assessed. Before performing any autopsies, we accessed the diving plan and the divers' profiles for each case. We then introduced a new dissection procedure that included identification, isolation, and manipulation of carotid, vertebral and thoracic arterial systems. The dissected vascular structures that allowed optimal isolation of the systemic arterial circulation were identified and ligated. In three of the eight judicial cases,

we had a strongly suggestive history of arterial gas embolism following pulmonary barotrauma (PBt/AGE). In these cases, the additional arterial dissection allowed us to clearly diagnose AGE in one of them. The autopsy of the rest of the cases showed other causes of death such as asphyxia by drowning and heart attack. In all cases we were able to reject decompression sickness, and in some of them we showed the presence of artefacts secondary to decomposition and resuscitation maneuvers. These results allow us to suggest a specific autopsy technique divided into four steps, aimed at confirming or excluding some evidence of dysbaric disorders according to a re-enactment of the incident. We have demonstrated the presence of large volumes of intravascular air, which is typical of PBt/AGE.

Curi MM, Condezo AFB, Ribeiro KDCB, Cardoso CL. Long-term success of dental implants in patients with head and neck cancer after radiation therapy. *Int J Oral Maxillofac Surg.* 2018 Feb 6. pii: S0901-5027(18)30028-6. doi: 10.1016/j.ijom.2018.01.012. [Epub ahead of print]

The purpose of this study was to analyze the long-term success and factors potentially influencing the success of dental implants placed in patients with head and neck cancer who underwent radiation therapy with a minimum total dose of 50Gy during the years 1995-2010. Thirty-five patients (169 dental implants) were included in this study. Data on demographic characteristics, tumour type, radiation therapy, implant sites, implant dimensions, and hyperbaric oxygen therapy (HBOT) were obtained from the medical records and analyzed. Implant survival was estimated using Kaplan-Meier survival curves. Seventy-nine dental implants were placed in the maxilla and 90 in the mandible. The mean follow-up after implant installation was 7.4 (range 0.3-14.7) years. The overall 5-year survival rate for all implants was 92.9%. Sex ($P < 0.001$) and the mode of radiation therapy delivery ($P = 0.005$) had a statistically significant influence on implant survival. Age, time of implantation after irradiation, implant brand and dimensions, and HBOT had no statistically significant influence on implant survival. Osseointegrated dental implants can be used successfully in the oral rehabilitation of patients with head and neck cancer with a history of radiation therapy. Risk factors such as sex and the mode of radiation therapy delivery can affect implant survival.

Jang DH, Khatri UG, Shortal BP, Kelly M, Hardy K, Lambert DS, Eckmann DM. Alterations in mitochondrial respiration and reactive oxygen species in patients poisoned with carbon monoxide treated with hyperbaric oxygen. *Intensive Care Med Exp.* 2018 Jan 30;6(1):4. doi: 10.1186/s40635-018-0169-2.

BACKGROUND: Carbon monoxide (CO) poisoning is the leading cause of poisoning mortality and morbidity in the USA. Carboxyhemoglobin (COHb) levels are not

predictive of severity or prognosis. At this time, the measurement of mitochondrial respiration may serve as a biomarker in CO poisoning. The primary objective of this study was to assess changes in mitochondrial function consisting of respiration and generation of reactive oxygen species (ROS) in peripheral blood mononuclear cells (PBMCs) obtained from patients with CO poisoning. **METHODS:** PBMCs from patients having confirmed CO exposure treated with hyperbaric oxygen or HBO (CO group) and healthy controls (control group) were analyzed with high-resolution respirometry. PBMCs were placed in a 2-ml chamber at a final concentration of $3-4 \times 10^6$ cells/ml to simultaneously obtain both respiration and hydrogen peroxide (H₂O₂) production. In the CO group, we performed measurements before and after patients underwent their first HBO treatment. **RESULTS:** We enrolled a total of 17 subjects, including 7 subjects with confirmed CO poisoning and 10 subjects in the control group. The CO group included five (71.4%) men and two (28.6%) women having a median COHb of 28%. There was a significant decrease in respiration as measured in pmol O₂ × s⁻¹ × 10⁻⁶ PBMCs in the CO group (pre-HBO) when compared to the control group: maximal respiration (18.4 ± 2.4 versus 35.4 ± 2.8 , $P < 0.001$); uncoupled Complex I respiration (19.8 ± 1.8 versus 41.1 ± 3.8 , $P < 0.001$); uncoupled Complex I+II respiration (32.3 ± 3.2 versus 58.3 ± 3.1 , $P < 0.001$); Complex IV respiration (43.5 ± 2.9 versus 63.6 ± 6.31 , $P < 0.05$). There were also similar differences measured in the CO group before and after HBO treatment with an overall increase in respiration present after treatment. We also determined the rate of H₂O₂ production simultaneously with the measurement of respiration. There was an overall significant increase in the H₂O₂ production in the CO group after HBO treatment when compared to prior HBO treatment and the control group. **CONCLUSIONS:** In this study, PBMCs obtained from subjects with CO poisoning have an overall decrease in respiration (similar H₂O₂ production) when compared to controls. The inhibition of Complex IV respiration is from CO binding leading to a downstream decrease in respiration at other complexes. PBMCs obtained from CO-poisoned individuals immediately following initial HBO therapy displayed an overall increase in both respiration and H₂O₂ production. The study findings demonstrate that treatment with HBO resulted in improved cellular respiration but a higher H₂O₂ production. It is unclear if the increased production of H₂O₂ in HBO treatment is detrimental.

Korzeniewski K, Krzyżak J. Travel medicine for divers. *Int Marit Health.* 2017;68(4):215-228. doi: 10.5603/IMH.2017.0040.

Recreational diving is increasing in popularity globally, also among European travellers. Since a majority of popular diving sites are located in tropical or subtropical destinations commonly characterised by harsh climate and

poor sanitation, travellers planning to engage in recreational diving are recommended to take certain health prevention measures to reduce travel-associated health risks. They need to be aware of the fact that diving can threaten their lives or even be fatal; however, if they are well prepared physically and mentally and follow all the recommended safety rules while underwater, diving is an unforgettable experience that cannot be compared to any other sports activity performed on land. Before going on a diving trip, it is important to make the necessary arrangements, bearing in mind they should not only concentrate on diving-related activities (the marine environment) but also on other aspects, e.g. contact with terrestrial flora and fauna. Therefore, the health prevention measures (a pre-travel consultation, vaccinations, antimalarial chemoprophylaxis, a properly prepared travel health kit and travel insurance) are to keep a traveller healthy during the entire travel and not just the moments of going underwater. The most important of the pre-travel arrangements include pre-travel medical evaluation, selecting and preparing medications for chronic conditions and assembling the first aid kit for personal use. Travellers are recommended to have a pre-travel consultation in medical facilities whose personnel have an appropriate level of knowledge and expertise on hyperbaric, tropical and travel medicine.

Lechner M, Sutton L, Fishman JM, Kaylie DM, Moon RE, Masterson L, Klingmann C, Birchall MA, Lund VJ, Rubin JS. Otorhinolaryngology and Diving-Part 1: Otorhinolaryngological hazards related to compressed gas scuba diving; a review. JAMA Otolaryngol Head Neck Surg. 2018 Feb 15. doi: 10.1001/jamaoto.2017.2617. [Epub ahead of print]

IMPORTANCE: Scuba diving is becoming increasingly popular. However, scuba diving is associated with specific risks; 80% of adults and 85% of juvenile divers (aged 6-17 years) have been reputed to have an ear, nose, or throat complaint related to diving at some point during their diving career. Divers frequently seek advice from primary care physicians, diving physicians, and otorhinolaryngologists, not only in the acute setting, but also related to the long-term effects of diving. **OBSERVATIONS:** The principles underpinning diving-related injuries that may present to the otorhinolaryngologist rely on gas volume and gas saturation laws, and the prevention of these injuries requires both that the diver is skilled and that their anatomy allows for pressure equalization between the various anatomical compartments. The overlapping symptoms of middle ear barotrauma, inner ear barotrauma, and inner ear decompression sickness can cause a diagnostic conundrum, and a thorough history of both the diver's symptoms and the dive itself are required to elucidate the diagnosis. Correct diagnosis and appropriate treatment result in a more timely return to safe diving. **CONCLUSIONS AND**

RELEVANCE: The aim of this review is to provide a comprehensive overview of otorhinolaryngological complications during diving. With the increasing popularity of diving and the frequency of ear, nose, or throat-related injuries, it could be expected that these injuries will become more common and this review provides a resource for otorhinolaryngologists to diagnose and treat these conditions.

Lechner M, Sutton L, Fishman JM, Kaylie DM, Moon RE, Masterson L, Klingmann C, Birchall MA, Lund VJ, Rubin JS. Otorhinolaryngology and Diving-Part 2: Otorhinolaryngological Fitness for Compressed Gas Scuba Diving: A Review. JAMA Otolaryngol Head Neck Surg. 2018 Feb 15. doi: 10.1001/jamaoto.2017.2616. [Epub ahead of print]

IMPORTANCE: Self-contained underwater breathing apparatus (scuba) diving has become increasingly popular with millions of people diving each year. Otorhinolaryngologists are often consulted either by patients or diving physicians regarding fitness to dive, and at present, the guidelines do not provide comprehensive information regarding the evaluation of this patient cohort. The aim of this review is to provide a comprehensive overview of existing otorhinolaryngological guidelines for fitness to dive recreationally. **OBSERVATIONS:** There is a paucity of guidelines for assessing otorhinolaryngological fitness to dive in the recreational diver. Comprehensive guidelines exist from US, European, and UK regulatory bodies regarding fitness for commercial diving; however, not all of these can be directly extrapolated to the recreational diver. There are also a variety of conditions that are not covered either by the existing fitness for recreational diving guidelines or the commercial regulatory bodies. **CONCLUSIONS AND RELEVANCE:** With the paucity of recreational fitness to dive guidelines we must draw on information from the commercial diving regulatory bodies. We have provided our own recommendations on the conditions that are not covered by either of the above, to provide otorhinolaryngologists with the information they require to assess fitness for recreational diving.

Ng PCY, Long B, Koefman A. Clinical chameleons: an emergency medicine focused review of carbon monoxide poisoning. Intern Emerg Med. 2018 Feb 12. doi: 10.1007/s11739-018-1798-x. [Epub ahead of print]

Carbon monoxide (CO) is a colorless, odorless gas that is found in the environment, in the home, and in the human body as a normal part of mammalian metabolism. Poisoning from CO, a common exposure, is associated with significant morbidity and mortality if not recognized and treated in a timely manner. This review evaluates the signs and symptoms of CO poisoning, conditions that present similar to CO poisoning, and an approach to the recognition and management for CO poisoning. CO poisoning accounts for thousands of emergency department

visits annually. If not promptly recognized and treated, it leads to significant morbidity and mortality. CO poisoning poses a challenge to the emergency physician because it classically presents with non-specific symptoms such as headache, dizziness, nausea, and vomiting. Due to nonspecific presentations, it is easily mistaken for other, more benign diagnoses such as viral infection. The use of specific historical clues such as exposure to non-conventional heat sources or suicide attempts in garages, as well as the use of targeted diagnostic testing with CO-oximetry, can confirm the diagnosis of CO poisoning. Once diagnosed, treatment options range from observation to the use of hyperbaric oxygen. CO poisoning is an elusive diagnosis. This review evaluates the signs and symptoms CO poisoning, common chameleons or mimics, and an approach to management of CO poisoning.

Olex-Zarychta D. Successful treatment of sudden sensorineural hearing loss by means of pharmacotherapy combined with early hyperbaric oxygen therapy: Case report. Medicine (Baltimore). 2017 Dec;96(51):e9397. doi: 10.1097/MD.0000000000009397.

RATIONALE: According to the World Health Organization reports, adult-onset hearing loss is the 15th leading cause of burden of disease, and is projected to move up to 7th by the year 2030, especially in high-income countries. Sudden sensorineural hearing loss is considered by otologists as a true otologic emergency. The current standard treatment for sudden hearing loss is a tapered course of oral high-dose corticosteroids. The described clinical case points to the validity of undertaking early hyperbaric oxygenation (HBO) therapy together with corticosteroids for full recovery of adult onset idiopathic sudden sensorineural hearing loss. **PATIENT CONCERNS:** A 44-year-old woman complained of an abrupt hearing deterioration in the left ear with the sensation of aural fullness and loud tinnitus presented for 48 hours. The patient was admitted to the Department of Otolaryngology of Public Hospital for diagnosis and treatment. **DIAGNOSES:** The patient was diagnosed with unilateral sudden idiopathic sensorineural hearing loss, assessed by measuring the tonal audiograms. **INTERVENTIONS:** The patient received treatment including oral high-dose corticosteroids combined with HBO protocol including 15 daily 1-hour exposures to 100% oxygen at 2.5 atmosphere absolute. **OUTCOMES:** A pharmacotherapy combined with early HBO resulted in full recovery of hearing. **LESSONS:** Early implementation of HBO to the pharmacotherapy in sudden sensorineural hearing loss may lead to full recovery of hearing. There is a need for systematic research to establish guidelines for optimal number of HBO sessions in relation to the timeframe from hearing loss symptoms onset to implementation of HBO therapy.

Otria L, Tettamanti L, Gargari M, Valente G, Pacini V, Costanzo C. Hyperbaric oxygen therapy (HBOT) and periodontal health. J Biol Regul Homeost Agents. 2018 Jan-Feb;32(2 Suppl. 1):217-21.

This study has tested the effects of hyperbaric oxygen in periodontal structures in agreement with the theories supported by literature research. Eight patients, from 30 to 50 years-of-age, were tested with pure oxygen inhalation, at the 2.5 ATA absolute pressure. Main approved tests of periodontal health were evaluated before and after HBOT cycles. The results in all patients treated with HBOT, have founded clear improvement of clinical and instrumental parameters.

Oyaizu T, Enomoto M, Yamamoto N, Tsuji K, Horie M, Muneta T, Sekiya I, Okawa A, Yagishita K. Hyperbaric oxygen reduces inflammation, oxygenates injured muscle, and regenerates skeletal muscle via macrophage and satellite cell activation. Sci Rep. 2018 Jan 22;8(1):1288. doi: 10.1038/s41598-018-19670-x.

Hyperbaric oxygen treatment (HBO) promotes rapid recovery from soft tissue injuries. However, the healing mechanism is unclear. Here we assessed the effects of HBO on contused calf muscles in a rat skeletal muscle injury model. An experimental HBO chamber was developed and rats were treated with 100% oxygen, 2.5 atmospheres absolute for 2 h/day after injury. HBO reduced early lower limb volume and muscle wet weight in contused muscles, and promoted muscle isometric strength 7 days after injury. HBO suppressed the elevation of circulating macrophages in the acute phase and then accelerated macrophage invasion into the contused muscle. This environment also increased the number of proliferating and differentiating satellite cells and the amount of regenerated muscle fibers. In the early phase after injury, HBO stimulated the IL-6/STAT3 pathway in contused muscles. Our results demonstrate that HBO has a dual role in decreasing inflammation and accelerating myogenesis in muscle contusion injuries.

Seo HI, Lee HJ, Han KH. Hyperbaric oxygen therapy for pyoderma gangrenosum associated with ulcerative colitis. Intest Res. 2018 Jan;16(1):155-157. doi: 10.5217/ir.2018.16.1.155. Epub 2018 Jan 18.

Pyoderma gangrenosum (PG), an ulcerating skin condition, is rare in patients with ulcerative colitis (UC). We report a case of successful treatment of PG in a patient with UC using hyperbaric oxygen therapy (HBOT). The patient had UC that was in remission following treatment with mesalazine and azathioprine therapy. After visiting an orthopedic clinic, the patient opted for treatment with antibiotics and daily dressing of the ulcerative skin lesions, while azathioprine was discontinued. However, the lesions did not improve. Two months later, the patient visited a dermatologist who diagnosed the lesions as PG, and he was admitted to our unit. Surgical debridement and HBOT

were performed by a plastic surgeon in the emergency department. After 3 months of HBOT and topical treatment, the patient's PG completely resolved. His UC was still in remission with mesalazine alone. HBOT may be an effective and safe alternative treatment for PG associated with UC, particularly in patients in whom anti-tumor necrosis factor agents are unnecessary.

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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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