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

E-NEWS

EDITORIAL NOTE – August 2018

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, commentary, and relevant images of related professional scenes. Past issues are available at https://cuhma.ca, serving an ongoing role as an information repository.

Neal W. Pollock

NEWS/ANNOUNCEMENTS

Canadian Diploma in Hyperbaric Medicine is Live!

Ken LeDez and Geoff Zbitnew

It has been a long process, but the Diploma in Hyperbaric Medicine from the Royal College of Physicians and Surgeons of Canada (Royal College) is now able to accept applications. The Diploma is part of the Royal College Areas of Focused Competence (AFC) program. Any licensed physician with certification from either the Royal College or the College of Family Physicians of Canada (CFPC) may apply. Specialists awarded the Diploma are referred to as a "Diplomate" of the Royal College and may use "DRCPSC (Hyperbaric" after their name, whereas family doctors are "Diplomate-Affiliate" and may use "D-Affiliate Royal College (Hyperbaric)."

There are two streams for the Diploma, Clinical Hyperbaric Medicine (focused on hyperbaric oxygen treatment of approved medical conditions) and Diving Medicine (focused on the medical aspects of diving). If a candidate meets the requirement for both streams a combined Diploma may be obtained simultaneously from the same application.

There are two routes to physician certification with the Diploma. The first is by successful completion of a training program that is accredited by the Royal College based at a medical school. It is expected that accredited training programs will be available in the near future. The second route is the PER – Practice Eligibility Route for Areas of Focused Competency (PER-AFC). This is for physicians already in hyperbaric practice for at least two years and that meet the detailed eligibility requirements.

The application process involves a sophisticated online system called "eDiploma" which may be accessed once a physician applies. Diploma requirements are publicly accessible on the Royal College website. Navigating the site however is not completely intuitive. There is guidance on finding all the information on the Diploma and using the links below in a more detailed PDF article available on the CUHMA website. Useful links:

www.royalcollege.ca
http://www.royalcollege.ca/rcsite/credentials-exams/exam-eligibility/afc/apply-afc-practicing-e
http://www.royalcollege.ca/rcsite/membership/join-the-royal-college/become-diplomate-e

The current Royal College application fees for the Diploma are $1872 for the PER-AFC route and $925 for the Training Program route. University fees for training programs are not known at this time. Annual dues for both Diplomates and Diplomate Affiliates are $250. Additional details are found in a more comprehensive PDF version of this article available on the CUHMA website along with the Royal College MOC system and requirements.

To complete the application for the Diploma, all required evidence must be uploaded to eDiploma. This evidence requires anonymized case summaries, consultations and other clinical documentation of patients assessed and managed. For a training program the documents would be uploaded contemporaneously. For the PER-AFC applicant, assembling the required documentation will involve some effort but there is greater flexibility in what would be acceptable than seen in the past. It is important to note that the same standard of competency is expected for either route to certification. If the reports from the assessors assigned to review the application are marked as achieved, the candidate will be contacted by the Royal College to confirm the portfolio assessment was successful.

Getting the Diploma to this stage has involved a lot of hard work over a period of years by past and present members of the Royal College Hyperbaric Medicine Committees. The AFC-Diploma in Hyperbaric Medicine is not static. It must be reviewed and updated regularly and the AFC Committee in Hyperbaric Medicine is responsible for this and the oversight of applications and for working with the Royal College and other AFC and Specialties on the issues above and many others.

UPCOMING EVENTS

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. 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. University of California (UC) Berkeley and UC 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, visit: www.aaus.org/annual_symposium.

CUHMA Annual Scientific Meeting 2018

The 2018 CUHMA ASM will be held November 02-04, in Quebec City, hosted by Université Laval and Hôtel-Dieu de Lévis. One day of pre-conference events will be followed by two days of scientific talks. Pre-conference events include:

- 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.

EUROTEK 2018

EUROTEK is Europe's premiere advanced and technical diving conference. The meeting will be held December 01-02, 2018, in Birmingham, England. Lectures and exhibitors will cover the range of current and emerging equipment, concepts, and issues. For more information, visit: http://eurotek.uk.com.

RECENT PUBLICATIONS

Almosnino G, Holm JR, Schwartz SR, Zeitler DM. The role of hyperbaric oxygen as salvage therapy for sudden sensorineural hearing loss. Ann Otol Rhinol Laryngol. 2018 Jul 1:3489418787832. doi: 10.1177/0003489418787832. [Epub ahead of print]

OBJECTIVE: We sought to evaluate hearing outcomes after salvage therapy with hyperbaric oxygen (HBO_2) for the treatment of sudden sensorineural hearing loss (SSNHL). STUDY DESIGN: Matched control retrospective case series. SETTING: Tertiary neurotology referral center. PATIENTS: Thirty-six patients (>18 years) diagnosed with SSNHL. INTERVENTION: Patients received initial therapy with oral and/or intratympanic (IT) steroids with an incomplete response. Eighteen patients underwent salvage therapy with IT steroids and HBO_2 (group 1). Eighteen matched controls underwent salvage therapy with IT steroids alone (group 2). MAIN OUTCOME MEASURES: The main outcome measure was improvement in pure tone average (PTA) and word recognition score (WRS). Complications as a result of therapy were also monitored. RESULTS: There were no significant differences in age, gender, or hearing between the 2 groups ($P>0.05$). There was no significant difference in mean post-treatment PTA between group 1 (60.3 dB) and group 2 (53.2 dB). There were no significant difference in mean post-treatment WRS between group 1 (42%) and group 2 (51%). Serviceable hearing was defined as a minimum WRS of 50%. Thirty-three percent in group 1 and 42% in group 2 went from nonserviceable hearing to serviceable hearing ($P >0.05$). PTA and WRS change scores were not significantly affected by age, gender, form of initial treatment, or pre-treatment PTA and WRS. CONCLUSION: The present study demonstrated no significant difference in hearing outcomes between patients receiving salvage therapy with HBO_2 and IT steroids compared to patients receiving IT steroids alone. Larger, prospective randomized trials are needed to better define the role of HBO_2 as salvage therapy for SSNHL.

Altug HA, Tatli U, Coskun AT, Erdogan Ö, Özkan A, Sencimen M, Kürkçü M. Effects of hyperbaric oxygen treatment on implant osseointegration in experimental diabetes mellitus. J Appl Oral Sci. 2018 Jul 10;26:e20180083. doi: 10.1590/1678-7757-2018-0083.

OBJECTIVE: To evaluate whether hyperbaric oxygen (HBO) treatment has a favorable effect on implant osseointegration in diabetic rabbits. MATERIAL AND METHODS: An experimental diabetes model was induced in 32 New Zealand rabbits through IV injection of alloxan. After the state of diabetes had been confirmed, one dental implant was placed in the metaphysical region of each animal's tibia. After the implants' placements, the animals were divided into two groups. Half of the animals underwent HBO treatment, while the other group did not receive HBO treatment and served as the control group. The animals were euthanized at the 4th and 8th weeks. The osseointegration of the implants were compared by histomorphometry and resonance frequency analysis (RFA). RESULTS: The bone implant contact (BIC) values were significantly higher in the HBO group than in the control group at the 4th week. There was no difference in the BIC values between the groups at the 8th week. There

was no significant difference in the RFA scores between the groups both at the 4th and 8th weeks after the operation. CONCLUSION: Histomorphometry findings suggest that HBO has positive effect on implant osseointegration in the early healing period in diabetic rabbits. However, implant stability is not affected by HBO treatment

Arieli R, Khatib S, Vaya J. Ovine plasma dipalmitoylphosphatidylcholine does not predict decompression bubbling. Respir Physiol Neurobiol. 2018 Jun 30. pii: S1569-9048(18)30138-1. doi: 10.1016/ j.resp.2018.06.013. [Epub ahead of print]

Decompression illness (DCI) is the main risk associated with scuba diving. Some divers ("bubblers") are more sensitive to DCI than others ("non-bubblers"). We found that there are active hydrophobic spots (AHS) on the luminal aspect of ovine blood vessels, which contain the surfactant dipalmitoylphosphatidylcholine (DPPC). DPPC leaks from the lung into the plasma, settling on the blood vessel to create AHS. These are the main source of gas micronuclei from which bubbles develop after decompression. A correlation between bubbling ovine blood vessels and the animal's plasma DPPC might lead to the development of a blood test for vulnerability to DCI. Samples from ovine blood vessels were stretched on microscope slides, placed anaerobically in saline at the bottom of a Pyrex bowl, and exposed to high pressure. Automated photography was used after decompression to reveal AHS by visualising their bubble production. Phospholipids were extracted from the AHS and plasma for determination of DPPC. Bubbling was unrelated to the concentration of DPPC in the plasma (2.15 ± 0.87 μg/ml). Bubble production from the AHS ($n = 130$) as a function of their DPPC content yielded two groups, one unrelated to DPPC and the other which demonstrated increased bubbling with elevation of DPPC. We suggest this may be related to alternate layering with hydrophobic and hydrophilic phospholipids. This study reinforces the connection between DPPC and DCI. However, a blood test for diver vulnerability to decompression stress is not recommended.

Barak OF, Caljkusic K, Hoiland RL, Ainslie PN, Thom SR, Yang M, Jovanov P, Dujic Z. Differential influence of vitamin C on the peripheral and cerebral circulation following diving and exposure to hyperoxia. Am J Physiol Regul Integr Comp Physiol. 2018 Jul 11. doi: 10.1152/ajpregu.00412.2017. [Epub ahead of print]

We examined if the diving-induced vascular changes in the peripheral and cerebral circulation could be prevented by oral antioxidant supplementation. Fourteen divers performed a single scuba dive to 18 msw for 47 min. Twelve of the divers participated in a follow-up study involving breathing 60% oxygen at ambient pressure for 47 min. Prior to both studies, participants ingested vitamin C (2g/day) or a placebo capsule for six days. After two-week washout, the study was repeated with the different condition. Endothelium-dependent vasodilator function of the brachial artery was assessed pre- and post-intervention using the flow mediated dilation (FMD) technique. Transcranial Doppler ultrasound was used to measure intra-cranial blood velocities pre- and for 90 min post-intervention. FMD was reduced by ~32.8% and ~21.2% post-dive in the placebo and vitamin C trial and post-hyperoxic condition in the placebo trial by ~28.2% ($P<0.05$). This reduction in FMD was attenuated by ~10% following vitamin C supplementation in the hyperoxic study ($P>0.05$). Elevations in intra-cranial blood velocities 30 min after surfacing from diving were reduced in the vitamin C study compared to the placebo trial ($P<0.05$). O_2 breathing had no post-intervention effects on intra-cranial velocities ($P>0.05$). Prophylactic ingestion of vitamin C effectively abrogated peripheral vascular dysfunction following exposure to 60% O_2 but did not abolish the post-dive decrease in FMD. Transient elevations of intra-cranial velocities post-dive were reduced by vitamin C. These findings highlight the differential influence of vitamin C on peripheral and cerebral circulations following scuba diving, which are only partly mediated via hyperoxia.

Brett KD, Meintjes W. Incidence of otic barotrauma in Canadian Armed Forces shallow-water diver candidate students 2011-2015. Undersea Hyperb Med. 2018; 45(3):249-55.

INTRODUCTION: While otic barotrauma (OBT) is a common condition experienced by divers, data related to military divers is limited. This study aimed to determine the incidence of OBT in Canadian armed forces (CAF) shallow-water diver (SWD) students trained through the Fleet Dive Unit (Atlantic) (FDU[A]) between 2011-2015. METHODS: A retrospective cohort evaluation was performed. The study group consisted of all SWD candidates who embarked on an SWD course through FDU(A) between 2011-2015. A total of 241 subjects comprised the final data analysis. RESULTS: A total of 56 individuals (23.2%) suffered 60 instances of OBT, yielding an incidence density rate of 8.68 per 1,000 person-days on course. A total of 73 diving days (10.44 per 1,000 planned person-course days, or 4.87 diving days per course) were lost due to OBT. Of the reported OBT cases, 18% resulted in cessation of training, 72% in temporary removal from diving. There was no statistically significant association between sex, history of environmental allergies, previous dive qualification, age or rank and the development of OBT. CONCLUSIONS: This study reveals that OBT is prevalent among CAF SWD candidates, with operational impact due to missed diving days. This study is limited, and further prospective study is recommended.

Falise AM, Griffin I, Fernandez D, Rodriguez X, Moore E, Barrera A, Suarez J, Cutie L, Zhang G. Carbon monoxide poisoning in Miami-Dade County following Hurricane Irma in 2017. Disaster Med Public Health Prep. 2018 Jul 17:1-3. doi: 10.1017/dmp.2018.67. [Epub ahead of print]

OBJECTIVE: The Florida Department of Health in Miami-Dade County (DOH-Miami-Dade) investigated 106 reported carbon monoxide (CO) exposures over a 9-day timeframe after Hurricane Irma. This report evaluates risk factors for CO poisoning and the importance of heightened surveillance following natural disasters. METHODS: Data on CO poisoning cases from September 9 to 18, 2017 were extracted from Merlin, the Florida Department of Health Surveillance System. Medical records were obtained and follow-up interviews were conducted to collect data on the confirmed CO poisoning cases. Data were analyzed using SAS v9.4. RESULTS: Ninety-one of the 106 people exposed to CO met the case definition for CO poisoning: 64 confirmed, 7 probable, and 20 suspect cases. Eighty-eight percent of the affected individuals were evaluated in emergency departments and 11.7% received hyperbaric oxygen treatment. The most frequently reported symptoms included headache (53.3%), dizziness (50.7%), and nausea (46.7%). Three patients expired due to their exposure to CO. CONCLUSIONS: Post Hurricane Irma, the DOH-Miami-Dade investigated numerous cases for CO exposure. By understanding who is most likely to be impacted by CO and the impact of generators' location on people's health, education efforts can be tailored to the population most at risk and further CO exposures and related mortalities following natural disasters can be reduced.

Hedetoft M, Polzik P, Olsen NV, Hyldegaard O. Neuronal nitric oxide inhibition attenuates the protective effect of HBO2 during cyanide poisoning. Undersea Hyperb Med. 2018;45(3):335-50.

PURPOSE: Experiments have shown that hyperbaric oxygen (HBO_2) therapy reduces cyanide-induced cerebral distress. The exact mechanism behind HBO_2's neuroprotective effect is unknown, but has been proposed to be mediated by an increased neuronal nitric oxide (NO) bioavailability, which may compete with cyanide for the active site of cytochrome oxidase in the mitochondrial respiratory chain. We hypothesized that the ameliorating effect of HBO_2 is caused by an increased bioavailability of NO, which can be attenuated by injection of the selective neuronal NO synthase inhibitor, 7-nitroindazole, preceding the HBO2 procedure. METHODS: A total of 41 anesthetized female Sprague-Dawley rats were allocated to four groups: 1) vehicle [1.2 ml isotonic NaCl via intra-arterial administration]; 2) cyanide [5.4 mg/kg potassium CN (KCN) intra-arterial] plus 7-nitroindazole [25 mg/kg 7-nitroindazole via intraperitoneal injection]; 3) cyanide plus 7-nitroindazole plus HBO_2 [284 kPa for 90 minutes]; 4) cyanide plus 7-nitroindazole plus normobaric oxygen [101.3 kPa for 90 minutes]. Cerebral interstitial lactate, glucose, glycerol and pyruvate were evaluated by means of microdialysis. RESULTS: HBO2 during inhibition of nNOS worsened cerebral metabolism compared to both solely CN-intoxicated animals and normobaric oxygen-treated animals. This was indicated by elevated lactate (in mM; 0.85 vs. 0.63 and 0.42, P=0.006 and P ⟨ 0.001, respectively), glycerol (in mM; 46 vs. 17 and 14, both P ⟨ 0.001), glucose (in mM; 0.58 vs. 0.31 and 0.32, both P ⟨ 0.001). CONCLUSIONS: The results indicate that a specific nNOS inhibition offsets the ameliorating effect of HBO_2 during cerebral CN intoxication. However, other factors might contribute to this neuroprotective effect as well.

Hernando A, Pelaez M, Lozano Albalate MT, Aiger M, Izquierdo D, Sanchez A, Lopez-Jurado MI, Moura JI, Fidalgo J, Lazaro J, Gil E. Autonomic nervous system measurement in hyperbaric environments using ECG and PPG signals. IEEE J Biomed Health Inform. 2018 Jan 25. doi: 10.1109/JBHI.2018.2797982. [Epub ahead of print]

The main aim of this work was to characterise the Autonomic Nervous System (ANS) response in hyperbaric environments using electrocardiogram (ECG) and pulse-photoplethysmogram (PPG) signals. To that end, 26 subjects were introduced into a hyperbaric chamber and five stages with different atmospheric pressures (1 atm; descent to 3 and 5 atm; ascent to 3 and 1 atm) were recorded. Respiratory information was extracted from the ECG and PPG signals and a combined respiratory rate was studied. This information was also used to analyse Heart Rate Variability (HRV) and Pulse Rate Variability (PRV). The database was cleaned by eliminating those cases where the respiratory rate dropped into the low frequency band (LF: 0.04-0.15 Hz) and those in which there was a discrepancy between the respiratory rates estimated using the ECG and PPG signals. Classical temporal and frequency indices were calculated in such cases. The ECG results showed a time-related dependency, with the heart rate and sympathetic markers (normalised power in LF and LF/HF ratio) decreasing as more time was spent inside the hyperbaric environment. A dependency between the atmospheric pressure and the parasympathetic response, as reflected in the high frequency band power (HF: 0.15-0.40 Hz), was also found, with power increasing with atmospheric pressure. The combined respiratory rate also reached a maximum in the deepest stage, thus highlighting a significant difference between this stage and the first one. The PPG data gave similar findings and also allowed the oxygen saturation to be computed, therefore we propose the use of this signal for future studies in hyperbaric environments.

Khater A, El-Anwar MW, Nofal AA, Elbahrawy AT. Sudden sensorineural hearing loss: comparative study of different treatment modalities. Int Arch Otorhinolaryngol. 2018;22(3):245-9.

Introduction: Idiopathic sudden sensorineural hearing loss (ISSNHL) is hearing loss of at least 30 dB in at least 3 contiguous frequencies within at least 72 hours. There are many different theories to explain it, and many different modalities are used for its management, such as: systemic steroids (SSs), intratympanic steroid injection (ITSI), hyperbaric oxygen therapy (HOT), antiviral drugs, and vasodilators or vasoactive substances. Objectives: This study aims to evaluate the efficacy of the combination of the most common treatment modalities of ISSNHL and to compare the results if HOT was not one of the treatment modalities administered. Methods: The study was conducted with 22 ISSNHL patients with ages ranging from 34 to 58 years. The patients were divided into 2 groups; group A included 11 patients managed by SSs, ITSI, antiviral therapy, and HOT simultaneously, and group B included 11 patients exposed to the aforementioned modalities, with the exception of HOT. Results: After one month, all of the patients in group A showed total improvement in hearing in all frequencies, with pure tone average (PTA) of 18.1 ± 2.2, while in group B, 5/11 (45.5%) patients showed total improvement, and 6 /11 (54.5%) patients showed partial improvement, with a total mean PTA of 28.1 ± 8.7. Conclusion: The early administration of HOT in combination with other clinically approved modalities (SSs, ITSI, antiviral therapy) provides better results than the administration of the same modalities, with the exception of HOT, in the treatment of ISSNHL.

Krajcovicova Z, Melus V, Zigo R, Matisáková I, Vecera J, Kalíková K. Efficacy of hyperbaric oxygen therapy as a supplementary therapy of sudden sensorineural hearing loss in the Slovak Republic. Undersea Hyperb Med. 2018;45(3):363-70.

We evaluated the efficacy of hyperbaric oxygen (HBO_2) therapy used as a supplement to the first-line medical treatment of sudden sensorineural hearing loss (SSNHL). We tested 68 patients suffering from SSNHL within seven days of hearing loss: 21 patients received the standard treatment protocol of our department (control group) and 47 individuals were treated with an additional application of HBO_2 therapy. Treatment success was assessed using pre- and post-treatment audiograms. Outcomes of our study showed a statistically significant improvement in auditory threshold in all frequency groups for the HBO_2 group ($P<0.001$), whereas in the control group the statistically significant mean auditory gain was observed only for the frequency zone 1,000 to 2,000 Hertz ($P = 0.01$). Furthermore, the rate of hearing gain in the HBO_2 group was more than doubled (61.7%) compared to the control group (28.6%). Complete recovery of the hearing gain in the control group was observed only in the first two frequency groups (14.29%; 4.76%; 0.00%), whereas in the HBO_2 group complete recovery was seen in all the frequency groups (19.15%; 21.13%; 6.38%) as well as in the whole frequency range (6.38%). The efficiency of both treatment protocols was statistically significant ($P<0.001$) in both groups of patients, but supplementation of the therapy with HBO_2 demonstrated a statistically significantly increase in the effect of pharmacotherapy ($P<0.001$) by 11.5 decibels (dB) up to the final hearing gain of 20 dB. HBO_2 is therefore a promising modality of SSNHL treatment, but specific mechanisms of HBO_2 in patients with SSNHL are still unknown. Further investigations are warranted to explore the mechanisms of action.

Liu H, Curet OM. Swimming performance of a bio-inspired robotic vessel with undulating fin propulsion. Bioinspir Biomim. 2018 Jun 18. doi: 10.1088/1748-3190/aacd26. [Epub ahead of print]

Undulatory fin propulsion exhibits high degree of maneuver control -- an ideal for underwater vessels exploring complex environments. In this work, we developed and tested a self-contained, free-swimming robot with a single undulating fin running along the length of the robot, which controls both forward motion and directional maneuvers. We successfully replicated several maneuvers including forward swimming, reversed motion, diving, station-keeping and vertical swimming. For each maneuver, a series of experiments were performed as a function of fin frequency, wavelength and traveling wave direction to measure swimming velocities, orientation angles and mean power consumption. In addition, three-dimensional flow fields were measured during forward swimming and station-keeping using volumetric particle image velocimetry (PIV). The efficiency for forward swimming was compared using three metrics: cost of transport, wave efficiency and Strouhal number. The results indicate that the cost of transport exhibits a V-shape trend with the minimum value at low swimming velocity. The robot can reach optimal wave efficiency and locomotor performance at a range of 0.2 to 0.4 St. Volumetric PIV data reveal the shed of vortex tubes generated by the fin during forward swimming and station keeping. For forward swimming, a series of vortex tubes are shed off the fin edge with a lateral and downward direction with respect to the longitudinal axis of the fin. For station keeping, flow measurements suggest that the vortex tubes are shed at the mid-section of the fin while the posterior and anterior segment of the vortex stay attached to the fin. These results agree with the previous vortex structures based on simulations and 2D PIV. The further development of this vessel with high maneuverability and station keeping performance can be used for oceanography, coastal exploration, defense, oil

industry and other marine industries where operations are unsafe or impractical for divers or human-piloted vessels.

Lu K, Wang H, Ge X, Liu Q, Chen M, Shen Y, Liu X, Pan S. Hyperbaric oxygen protects against cerebral damage in permanent middle cerebral artery occlusion in rats and inhibits autophagy activity. Neurocrit Care. 2018 Jul 9. doi: 10.1007/s12028-018-0577-x. [Epub ahead of print]

BACKGROUND: To investigate the effects of hyperbaric oxygen (HBO) on brain damage and autophagy levels in a rat model of middle cerebral artery occlusion. METHODS: Neurologic injury and infarcted areas were evaluated according to the modified neurological severity score and 2,3,5-triphenyltetrazolium chloride staining. Western blots were used to determine beclin1, caspase-3 and fodrin1 protein expression. Beclin1 protein expression (an autophagy marker), positive terminal dUTP nick-end labeling (TUNEL) staining (an apoptosis marker) and positive propidium iodide (PI) staining (a necrosis marker) were detected by immunofluorescence. RESULTS: Our results indicated that HBO could decrease the infarct volume and speed up the recovery of the neurological deficit scores in ischemic rats. Beclin1 was down-regulated after HBO treatment. HBO treatment inhibited fodrin1 protein expression and decreased the number of PI-positive cells. HBO also down-regulated caspase-3 and decreased the number of TUNEL-positive cells. CONCLUSION: Cerebral ischemia caused early neuronal death due to necrosis, followed by delayed neuronal death due to apoptosis. Consequently, autophagy might be involved in all processes of ischemia. HBO could protect the brain against ischemic injury, and the possible mechanisms might be correlated with decreased autophagy activity and decreased apoptosis and necrosis levels.

Morgan A, Sinclair H, Tan A, Thomas E, Castle R. Can scuba diving offer therapeutic benefit to military veterans experiencing physical and psychological injuries as a result of combat? A service evaluation of Deptherapy UK. Disabil Rehabil. 2018 Jun 29:1-9. doi: 10.1080/09638288.2018.1480667. [Epub ahead of print]

PURPOSE: To explore the effectiveness of scuba diving in providing therapeutic and rehabilitative benefit to ex-service personnel who have experienced traumatic physical and/or psychological injuries resulting from combat. METHODS: This study took the form of a service evaluation of Deptherapy, a UK-based niche charity offering support to military veterans who have experienced life-changing injuries. Deptherapy provides scuba diving qualifications, consisting of theory and practical diving experience, to participants alongside a Peer Support Buddy scheme that provides continuing support to servicemen involved with the charity. A total of 15 male veterans were invited to take part in the study. The methodology comprised retrospective and current quantitative measures of mental well-being and functional ability, utilising the General Health Questionnaire-28, and subsequent semi-structured interviews with participants, their families and health professionals. RESULTS: Participants reported an improvement in levels of anxiety, depression and social functioning, and a reduction in insomnia, following their involvement in organised scuba diving activities. There was a mean average difference of 14.3 points improvement on the General Health Questionnaire-28 scale variants between prior interaction with Deptherapy and current perceptions following engagement with the programme. The positive perceptions, as indicated from the semi-structured interviews, were more pronounced in those whose injuries were predominantly psychological, rather than physical. CONCLUSION: Scuba diving can offer significant therapeutic benefits, particularly for ex-military amputees experiencing co-morbid anxiety and/or chronic psychological adjustment disorders, notably in terms of improvements in social dysfunction and symptomology of depression. Implications for rehabilitation scuba diving as a therapy military combat can result in devastating, chronic physical and/or psychological injury. Current research suggests that a combination of medical and psychological therapy may prove to be the most beneficial for military veterans. Scuba diving has the potential to benefit injured veterans due the requirement of complete focus and the feeling of weightlessness when underwater. This article evaluates whether scuba diving is an effective physical and psychological therapy through GHQ-28 analysis and veteran interviews. Scuba diving benefited injured veterans in terms of chronic pain relief and depression symptoms alleviation.

Morin J, de Maistre S, Druelle A, Le Hot H, Blatteau JÉ. [Is it possible to dive again after decompression sickness?] [French] Rev Infirm. 2018;67(242):25-6.

Decompression sickness in underwater diving exposes the diver to a risk of clinical sequelae which require specific care. In the absence of sequelae or after clinical recovery, the question of diving again may be raised. As part of a secondary prevention approach, the hyperbaric practitioner measures the physical, psychological and social impact of re-exposure to pressure and the immersion of the patient-diver.

Moses KL, Seymour M, Beshish A, Baker KR, Pegelow DF, Lamers LJ, Eldridge MW, Bates ML. Inspiratory and expiratory resistance cause right-to-left bubble passage through the foramen ovale. Physiol Rep. 2018 Jun;6(12):e13719. doi: 10.14814/phy2.13719.

A patent foramen ovale (PFO) is linked to increased risk of decompression illness in divers. One theory is that venous gas emboli crossing the PFO can be minimized by avoiding lifting, straining and Valsalva maneuvers.

Alternatively, we hypothesized that mild increases in external inspiratory and expiratory resistance, similar to that provided by a scuba regulator, recruit the PFO. Nine healthy adults with a Valsalva-proven PFO completed three randomized trials (inspiratory, expiratory, and combined external loading) with six levels of increasing external resistance (2-20 $cmH_2O/L/sec$). An agitated saline contrast echocardiogram was performed at each level to determine foramen ovale patency. Contrary to our hypothesis, there was no relationship between the number of subjects recruiting their PFO and the level of external resistance. In fact, at least 50% of participants recruited their PFO during 14 of 18 trials and there was no difference between the combined inspiratory, expiratory, or combined external resistance trials ($P>0.05$). We further examined the relationship between PFO recruitment and intrathoracic pressure, estimated from esophageal pressure. Esophageal pressure was not different between participants with and without a recruited PFO. Intrasubject variability was the most important predictor of PFO patency, suggesting that some individuals are more likely to recruit their PFO in the face of even mild external resistance. Right-to-left bubble passage through the PFO occurs in conditions that are physiologically relevant to divers. Transthoracic echocardiography with mild external breathing resistance may be a tool to identify divers that are at risk of PFO-related decompression illness.

Shreeves K, Buzzacott P, Hornsby A, Caney M. Violations of safe diving practices among 122 diver fatalities. Int Marit Health. 2018;69(2):94-8.

BACKGROUND: Diving is a popular recreation with an excellent safety record, with an estimated 1.8 deaths per 1 million dives. This study investigated the relationship between intentional deviation from accepted diving practices (violations) and diver fatalities. MATERIALS AND METHODS: The authors examined 119 incidents/122 diver fatalities that did not involve diver training in North America and the Caribbean, and identified the presence of violations of accepted diving safety practices, as well as if the death was associated with an acute medical event such as heart attack. RESULTS: Of the 122 fatalities, 57% (n=70) were associated with a medical event and 43% (n=52) were non-medical. Violations were found in 45% of fatalities (n=55) overall. Violations were recorded for 23% of the 70 medical and 75% of the 52 non-medical fatalities. Divers who died from something other than a medical cause were 7 times as likely to have one or more violations associated with the fatality (OR 7.3, 95% CI 2.3-23.2). The odds of dying from something other than a medical condition increased approximately 60% for each additional 10 metres of depth. The odds of a death being associated with a medical condition increased approximately 9% per year of age, or 2.4 times for every 10 years older a diver was. CONCLUSIONS: Medical events are associated with over half of the non-training related diver fatalities in North America and the Caribbean, with the odds of death being associated with a medical condition doubling each decade of additional age. These data support recommendations that divers stay physically fit and have regular medical checkups, particularly as they get older. They also strongly support the safety benefit of adhering to established safe diving practices.

Myers CM, Kim JS, Florian JP. Effects of repeated long-duration water immersions on skeletal muscle performance in well-trained male divers. Eur J Appl Physiol. 2018 Jul 12. doi: 10.1007/s00421-018-3928-6. [Epub ahead of print]

PURPOSE: The objective of this study was to examine the effects of repeated long-duration water immersions (WI)s at 1.35 atmospheres absolute (ATA) on neuromuscular performance in load bearing and non-load bearing muscle groups. METHODS: During a dive week (DW), 15 well-trained male divers completed five consecutive 6-h resting dives with 18-h surface intervals while breathing compressed air at 1.35 ATA. Skeletal muscle performance assessments occurred immediately before and after each WI, and 24 and 72 h after the final WI. Exercise assessments included maximum voluntary isometric contraction (MVIC), maximal isokinetic (IK) contraction, maximum handgrip strength (MHG). Surface electromyography measured neuromuscular activation of the quadriceps, biceps brachii (BB), and brachioradialis. RESULTS: MVIC torque of knee extensors and BB decreased by 6% ($p = 0.001$) and 2% ($p=0.014$), respectively, by WI 3. Maximal IK torque of knee extensors increased by 11 and 5% post-WI on WIs 3 and 5 ($p<0.001$) with greater neuromuscular activation post-WI than pre-WI ($p<0.001$). Maximum IK elbow flexion torque did not change throughout the DW with BB neuromuscular activation greater post-WI than pre-WI ($p<0.001$). MHG force output was 4% greater post-WI than pre-WI ($p<0.001$) with increased brachioradialis activation through 72-h post-WI ($p<0.001$). All muscle performance metrics returned baseline levels by 72-h post-WI. CONCLUSION: Our findings indicate that repeated WIs caused noticeable decrements in neuromuscular activation and performance of load bearing muscles on WI 3 while full recovery was observed by 72-h post-WI.

Sun Y, Wen Y, Shen C, Zhu Y, You W, Meng Y, Chen L, Feng Y, Yang X, Chen ZB. Hyperbaric oxygen therapy in liver diseases. Int J Med Sci. 2018 May 22;15(8):782-7.

Hyperbaric oxygen therapy (HBOT) is an efficient therapeutic option to improve progress of lots of diseases especially hypoxia-related injuries, and has been clinically established as a wide-used therapy for patients with carbon monoxide poisoning, decompression sickness, arterial gas embolism, problematic wound, and so on. In

the liver, most studies positively evaluated HBOT as a potential therapeutic option for liver transplantation, acute liver injury, nonalcoholic steatohepatitis, fibrosis and cancer, especially for hepatic artery thrombosis. This might mainly attribute to the anti-oxidation and anti-inflammation of HBOT. However, some controversies are existed, possibly due to hyperbaric oxygen toxicity. This review summarizes the current understandings of the role of HBOT in liver diseases and hepatic regeneration. Future understanding of HBOT in clinical trials and its in-depth mechanisms may contribute to the development of this novel adjuvant strategy for clinical therapy of liver diseases.

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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