

E-NEWS

EDITOR'S NOTE – October 2024

The E-News is the monthly newsletter of CUHMA, the primary outlet to share news/announcements, upcoming events, abstracts of recent publications, job postings, professional perspectives, and images of relevant professional scenes. Submission of applicable content is welcome. New issues are released on the last business day of each month. Past issues are available at <https://cuhma.ca>. Direct correspondence to info@cuhma.ca.

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NEWS/ANNOUNCEMENTS

CUHMA Board of Directors Elections

The nomination period for the board of directors election is open through December 11 (0800 Eastern time). Please send nominations (of other or self) to info@cuhma.ca. Voting in the online election will run from December 27 (0800 Eastern time) through December 29 (2359 Eastern time). Open positions include President-Elect, Vice-President, Secretary, Treasurer, and Director-at-Large. Further details will be shared in a separate communication and in upcoming issues of the E-News.

Rebreather Forum 4 Proceedings Now Available

The proceedings of the Rebreather Forum 4 are now available electronically at no cost. The document includes individual papers and the discussion following them, general discussion to develop consensus statements, the final consensus statements, and a list of participants. The effort of all involved will benefit the broader community. A print-on-demand option is available for those wanting hard copies. To download pdf: <https://indepthmag.com/wp-content/uploads/2024/09/Rebreather-Forum-4-Proceedings-2024.pdf>

Options for print-on-demand ordering will be announced in the coming weeks for those wanting hard copies.

WDHOF Scholarships and Training Grants

The Women Divers Hall of Fame administers a range of scholarships and training grants related to diving, up to a maximum of \$5000^{US}. Some are restricted to women and some are open to all applicants. The submission period for

the 2025 cycle is September 01 through October 31. Visit: <https://www.wdhof.org/scholarships/scholarship-descriptions>.

UPCOMING EVENTS

Divescapes Scuba Conference 2024

The Divescapes scuba conference and exhibition will be held October 18-19 at the Deerfoot Inn and Casino in Calgary, AB. The Alberta Underwater Council program includes international speakers, workshops, and trade show booths. Visit: <https://www.divescapes.ca>.

Canadian Association of Wilderness Medicine 2024

CAWM was founded in 2020 as a non-profit organization with the goal of connecting Canadian practitioners and researchers with an interest in wilderness medicine, and in promoting the field as an area of focus and specialization. The fifth annual conference will be held in hybrid form November 01-03 in Halifax, NS, with pre-conference courses October 30-31. Visit: <https://cawm.ca/cawm2024>.

DEMA Show 2024

The Diving Equipment & Marketing Association (DEMA) show will be held November 19-22 at the Las Vegas Convention Center in Las Vegas, NV. The long-standing industry event promises 500 exhibitor booths, educational seminars, and a variety of evening events. Visit: <https://www.demashow.com>.

RECENT PUBLICATIONS

Canarslan Demir K, Yücel Z. Maxillary sinus barotrauma with infraorbital nerve paraesthesia after breath-hold diving. Diving Hyperb Med. 2024 Sep 30;54(3):230-232. doi: 10.28920/dhm54.3.230-232.

Barosinusitis, or sinus barotrauma, is a sinonasal injury and/or inflammation that results when the aerated spaces of the nose and sinuses are exposed to an uncompensated change in ambient pressure. We describe a 19-year-old male diver who presented to our clinic on the fourth day following a breath-hold diving session. During descent on a constant weight monofin dive at the South Cyprus World Championship he began to experience symptoms due to the inability to equalise the pressure, particularly in the Eustachian tubes and middle ear cavities. He felt pain and

pressure in the upper left half of his face, left upper molars, and under his left eye at 60 metres, and he continued diving down to 74 metres. At presentation to our clinic, he still had ecchymosis under his right eye and pain in his upper right teeth, half of his face, and ear. He also described tingling in the lower left half of his nose and the left half of his upper lip. He received decongestants, B vitamins, and underwent endoscopic sinus drainage which alleviated his symptoms alleviated over time. The diver reported complete resolution of tingling, numbness, and pain after three months. It should not be forgotten that if appropriate treatment is delayed, permanent changes may occur as a result of long-term compression of the nerve, and therefore patients should be monitored closely.

Druelle A, Mouhat B, Zbitou O, Castagna O. Static immersion and negative static lung load-induced right ventricle systolic function adaptation: a risk factor for immersion pulmonary edema. Chest. 2024 Sep;166(3):532-543. doi: 10.1016/j.chest.2024.03.042. Epub 2024 May 15.

Background: Immersion pulmonary edema (IPE) is a form of hemodynamic edema likely involving individual susceptibility. Research question: Can assessing right ventricle (RV) systolic adaptation during immersion be a marker for IPE susceptibility? Study design and methods: Twenty-eight divers participated: 15 study participants with a history of IPE (IPE group; mean \pm SD age, 40.2 \pm 8.2 years; two women) and 13 control participants (no IPE group; mean \pm SD age, 43.1 \pm 8.5 years; two women) underwent three transthoracic echocardiography studies under three different conditions: dry (participants were in the supine position on an examination table without immersion), surface immersion (participants were floating prone on the water's surface and breathing through a snorkel), and immersion and negative static lung load (divers were submerged 20 cm below the water's surface in the prone position using a specific snorkel connected to the surface for breathing). Echocardiographic measurements included tricuspid annular plane systolic excursion (TAPSE), tissue S' wave, and right ventricle global strain (RVGLS). Results: For all divers, immersion increased RV preload. In the no IPE group, the increase in RV preload induced by immersion was accompanied by an improvement in the contractility of the RV, as evidenced by increases in TAPSE (17.08 \pm 1.15 mm vs 20.89 \pm 1.32 mm), S' wave (14.58 \pm 2.91 cm/s vs. 16.26 \pm 2.77 cm/s), and RVGLS (25.37 \pm 2.79% vs. 27.09 \pm 2.89%). Negative SLL amplified these RV adaptations. In contrast, among divers with IPE, the increase in RV preload did not coincide with an improvement in RV contractility, indicating altered adaptive responses. In the IPE group, the TAPSE values changed from 17.19 \pm 1.28 mm to 21.69 \pm 1.67 mm and then to 23.55 \pm 0.78 mm, respectively, in the dry, surface immersion, and immersion and negative SLL conditions. The S' wave values changed from 13.42 \pm 2.94 cm/s to

13.26 \pm 2.96 cm/s and then to 12.49 \pm 0.77 cm/s, respectively, and the RVGLS values changed from -24.09 \pm 2.91% to -23.99 \pm 3.38% and then to -21.96 \pm 0.55%, respectively. Interpretation: Changes in RV systolic function induced by immersion (especially with the addition of negative static lung load) vary among divers based on the history of IPE. Analyzing ventricular contractility during immersion, particularly RVGLS, could help to identify individual susceptibility in divers. These findings provide insights for the development of preventive strategies. Trial registry: Comité de Protection des Personnes; No.: 21.05.05.35821; Recherche Impliquant la Personne Humaine de type 1 (RIPH1) HPS; No.: 2021-A01225-36.

Hájek M, Chmelař D, Tlapák J, Klugar M. The effectiveness of hyperbaric oxygen treatment in patients with complex regional pain syndrome: a retrospective case series. Int J Med Sci. 2024 Aug 1;21(11):2021-2030. doi: 10.7150/ijms.97513. eCollection 2024.

Background: Complex regional pain syndrome (CRPS) presents as persistent regional pain, both spontaneous and triggered. The demand persists for innovative treatments that patients can endure with minimal adverse effects. Hyperbaric oxygen therapy (HBOT) emerges as a possible intervention in this regard. Methods: The main objective of this work is to retrospectively analyse a case series of patients diagnosed with CRPS treated in the Centre of Hyperbaric Medicine Ostrava over two years (period 2018-2019). The HBOT was applied at 2.0-2.4 absolute atmosphere (ATA) once a day. Results: A total of 83 patients with CRPS were treated with HBOT. 98% of cases reported pain, 92% reported limitation of movement of the affected limb, 87% had swelling of the limb, 41% had lividity and 70% had sensory problems. The mean number of HBOT exposures was 22.0 \pm 7.1. At the end of HBOT treatment, 86% of cases had symptoms relief. The mean VAS value of pain at rest before the start of HBOT was 3.2 \pm 3.0, after treatment it was 1.6 \pm 1.9 (p <0.001). In a pain at activity it was 6.1 \pm 2.4 and 3.7 \pm 2.4 (p <0.001), respectively, at the end of HBOT. The value of the functional assessment of the limb was 7.0 \pm 2.0 and 4.3 \pm 2.4 (p <0.001), respectively, at the end of treatment. 79 cases were included in the end-of-treatment assessment. 23 cases (29%) were evaluated as large clinically significant response, 48 cases (61%) were evaluated as partial response with minimally important difference. The results showed larger clinical HBOT effect in cases of disease duration up to 3 and 6 months (p =0.029). Conclusions: The majority of patients improved pain and functional state of the affected limb. Our data also suggests the sooner after diagnosis of CRPS is HBOT started, the treatment has larger clinical effect. There was no serious HBOT-related complication or injury.

Nagrai S, Palaiodimos L. Patent foramen ovale and decompression illness: the present and future. *Cardiol Clin.* 2024 Nov;42(4):525-536. doi: 10.1016/j.ccl.2024.01.010. Epub 2024 Feb 28.

Presence of patent foramen ovale (PFO), particularly if high-grade, increases the risk of decompression illness (DCI) and its severe forms. In unprovoked or recurrent DCI, neurologic, cutaneous, or cardiopulmonary DCI, testing for PFO is indicated with bubble contrast echocardiography or transcranial Doppler using provocative maneuvers. In patients with PFO and history of DCI, evaluation by a cardiologist with expertise in diving medicine is recommended. Consideration should be given to PFO closure if cessation of diving or conservative diving cannot be achieved. Prospective studies evaluating long-term outcomes in patients who continue to dive after PFO closure are required.

Pollock NW, Lippmann J, Pearn J, Hayman J. Arterial dissection in scuba divers: a potential adverse manifestation of the physiological effects of immersion. *Diving Hyperb Med.* 2024 Sep 30;54(3):188-195. doi: 10.28920/dhm54.3.188-195.

Introduction: Aortic dissections and dissections of cervical, cerebral, and coronary arteries have been previously reported in scuba divers. These incidents may be the consequence of a variety of physiological effects. We review the reported cases of arterial dissection in scuba divers and discuss potential contributing factors related to immersion and diving. Methods: Medline, CINAHL Plus, and SPORTDiscus were searched for published reports of arterial dissection and the Australasian Diving Safety Foundation fatality database was searched for additional cases from Australia. Identified cases were recorded and scrutinised for possible contributing factors. Results: Nineteen cases of arterial dissection, both fatal and non-fatal, were identified. These included cervical or intracranial artery dissection (n=14), aortic dissection (n=4), and coronary artery dissection (n=1). There were 14 male and five female victims; mean age 44 years (SD 14, range 18-65). Contributing factors may include a combination of vasoconstriction and blood redistribution, untreated hypertension, increased pulse pressure, abnormal neck movement or positioning, constrictive and burdensome equipment, exercise, increased gas density and circuit resistance with concomitant elevated work of breathing, atheroma, and possibly the mammalian dive response. Conclusions: Dissecting aneurysms of the aorta or cervical, cerebral, and coronary arteries should be considered as a potential complication of scuba diving. The development of aneurysms associated with scuba diving is likely multifactorial in pathogenesis. Detailed reporting is important in the evaluation of cases. The potential role of the mammalian dive response as a contributing factor requires further evaluation.

Reus I, van de Sande E, Rienks R, Wingelaar T. Retrospective analysis of challenging cases for medical examiners of diving. *Diving Hyperb Med.* 2024 Sep 30;54(3):184-187. doi: 10.28920/dhm54.3.184-187.

Introduction: Assessing a diver's fitness to dive enhances diving safety, with medical examiners of diving (MED) being entrusted with this responsibility. However, the effectiveness of MED training in preparing physicians for this task remains underexplored. In the Netherlands, where any physician can pursue MED qualification, challenging cases can be presented to a board of experts. Methods: This retrospective analysis included all cases presented to a board of experts in the period 2013-2023. Aside from baseline information, cases were coded using the International Classification of Diseases 11th Revision (ICD-11). Additionally, the type of advice given by the board was also recorded. Results: A total of 291 cases could be included, 62.5% were male divers with a median age of 47 years old (interquartile range 29-55). Circulatory (20.9%), respiratory (16.2%), neurologic (14.4%), psychiatric (9.6%) and endocrine (6.5%) disease comprised more than two-thirds of all presented cases. Problems for the MED included multimorbidity, knowledge of guidelines and interpretation of diagnostic data. Conclusions: These results could be used to improve MED courses or serve as a topic for continuing medical education for MEDs, however, further research into generalisability is required.

Risberg J, Midtgaard H. Decompression sickness in surface decompression breathing air instead of oxygen. *Diving Hyperb Med.* 2024 Sep 30;54(3):242-248. doi: 10.28920/dhm54.3.242-248.

We report an unusual decompression sickness (DCS) incident in a commercial diving project. Eleven divers completed 91 dives to 23.5-36.2 m with bottom times ranging 23-67 min. The divers were breathing compressed air while immersed. Decompression was planned as surface decompression in a deck decompression chamber breathing oxygen typically for 15-30 min. Due to a technical error the divers breathed air rather than oxygen during the surface decompression procedure. Two divers suffered DCS. Both were recompressed on site with the same error resulting in them breathing compressed air rather than oxygen. One of them experienced a severe relapse with cardiovascular decompensation following recompression treatment. While DCS was expected due to the erroneous decompression procedures, it is noteworthy that only two incidents occurred during 91 dives with surface decompression breathing air instead of oxygen. Accounting for this error, the median omitted decompression time was 17 min (range 0-26 min) according to the Bühlmann ZHL-16C algorithm. These observations suggest that moderate omission of decompression time has a relatively small effect on DCS incidence rate. The other nine divers were interviewed in

the weeks following completion of the project. None of them reported symptoms at the time, but five divers reported having experienced minor symptoms compatible with mild DCS during the project which was not reported until later.

Sadler C, Lussier A, Grover I, Van Hoesen K, Lindholm P. Medical examination of divers after COVID-19 infection: a prospective, observational study using published (original and revised) guidelines for evaluation. *Diving Hyperb Med.* 2024 Sep 30;54(3):176-183. doi: 10.28920/dhm54.3.176-183.

Introduction: The COVID-19 pandemic raised significant concerns about fitness to dive due to potential damage to the pulmonary and cardiovascular systems. Our group previously published guidelines (original and revised) for assessment of these divers. Here, we report a prospective, observational study to evaluate the utility of these guidelines. **Methods:** Recreational, commercial, and scientific divers with a history of COVID-19 were consented and enrolled. Subjects were evaluated according to the aforementioned guidelines and followed for any additional complications or diving related injuries. **Results:** One-hundred and twelve divers (56 male, 56 female, ages 19-68) were enrolled: 59 commercial, 30 scientific, 20 recreational, two unknown (not documented), one military. Cases were categorised according to two previous guidelines ('original' n=23 and 'revised' n=89): category 0 (n=6), category 0.5 (n=64), category 1 (n=38), category 2 (n=2), category 3 (n=1), uncategorisable due to persistent symptoms (n=1). One hundred divers (89.3%) were cleared to return to diving, four (3.6%) were unable to return to diving, four (3.6%) were able to return to diving with restrictions, and four (3.6%) did not complete testing. Regarding diving related complications, one diver had an episode of immersion pulmonary oedema one year later and one diver presented with decompression sickness and tested positive for COVID-19. **Conclusions:** Most divers who presented for evaluation were able to return to diving safely. Abnormalities were detected in a small percentage of divers that precluded them from being cleared to dive. Guidelines were easily implemented by a variety of clinicians.

Wang C, Yu O, Liu Y, Ren Z, Liu Y, Xue L. Evaluation of a new hyperbaric oxygen ventilator during pressure-controlled ventilation. *Diving Hyperb Med.* 2024 Sep 30;54(3):212-216. doi: 10.28920/dhm54.3.212-216.

Introduction: The stability of a new hyperbaric ventilator (Shangrila590, Beijing Aeonmed Company, Beijing, China) at different clinically relevant pressures in a hyperbaric chamber during pressure-controlled ventilation (PCV) was investigated. **Methods:** The ventilator was connected to a test lung in the multiplace hyperbaric chamber. The inspiratory pressure (P_i) of the ventilator was set to 1.0, 1.5, 2.0, 2.5 and 3.0 kPa (approximately 10, 15,

20, 25 and 30 cmH₂O). The compliance and resistance of the test lung were set to 200 mL·kPa⁻¹ and 2 kPa·L⁻¹·s⁻¹, respectively. Experiments were conducted at 101, 203 and 284 kPa ambient pressure (1.0, 2.0 and 2.8 atmospheres absolute respectively). At each of the 5 P_i values, the tidal volume (V_T), peak inspiratory pressure (P_{peak}) and peak inspiratory flow (F_{peak}) displayed by the ventilator and the test lung were recorded for 20 cycles. Test lung data were considered the actual ventilation values. The ventilation data were compared among the three groups to evaluate the stability of the ventilator. **Results:** At every P_i , the P_{peak} detected by the ventilator decreased slightly with increasing ambient pressure. The F_{peak} values measured by the test lung decreased substantially as the ambient pressure increased. Nevertheless, the reduction in V_T at 284 kPa and P_i 30 cmH₂O (compared to performance at 101 kPa) was comparatively small (approximately 60 mL). **Conclusions:** In PCV mode this ventilator provided relatively stable V_T across clinically relevant P_i values to ambient pressures as high as 284 kPa. However, because F_{peak} decreases at higher ambient pressure, some user adjustment might be necessary for precise V_T maintenance during clinical use at higher P_i s and ambient pressures.

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.

Canadian Undersea and Hyperbaric Medical Association

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