

## E-NEWS

### EDITOR'S NOTE – September 2020

The E-News is the monthly newsletter of CUHMA, our primary outlet to share news and information. We invite relevant content, including news/announcements, upcoming events, new publication abstracts, job postings, professional perspectives, incident reports, and images of relevant professional scenes. Please feel free to share the publication with interested colleagues. Past issues are available at <https://cuhma.ca>.

Neal W. Pollock, PhD  
Université Laval

### NEWS/ANNOUNCEMENTS

#### CUHMA Board of Directors Nominations

The call for nominations for the CUHMA board of directors is now open, and will close on September 24. Nominations should be submitted to the CUHMA secretary ([neal.pollock@kin.ulaval.ca](mailto:neal.pollock@kin.ulaval.ca)). Electronic polling will open on October 07 and close on October 23 at 2200 EDT. Additional details will be provided in the next issue of the E-News.

Candidates must submit campaign materials to the editor by September 28 for it to be included in the October E-News. Allowable content includes: a head and shoulders photo, a 300-word biosketch, and a 250-word candidacy statement. The statement can be used to respond to the following question: "*What are the two most important initiatives that you want to champion as a CUHMA board member?*" Examples of campaign materials are available in the October 2018 E-News.

#### Board Service FAQs

**Q.** I might be interested in running for an executive officer position (President-Elect, Vice-President, Secretary, Treasurer). Is it hard?

**A.** Running is easy; but there is work in holding any position. Fortunately, there is a lot of corporate knowledge to help new members, including from the incoming President who will generally have already served for 2 years as President-Elect, the Past President, and all the other members of the board.

**Q.** Will it be OK if I try things out as a Director instead?

**A.** Of course! As a Director, there is lots of flexibility on how you can contribute. The Board needs directors who can represent both Associate and Regular members, from as many provinces and territories as possible. It's a great way to engage in CUHMA and network with colleagues.

**Q.** Is there a lot of administrative commitment?

**A.** Board members are expected to attend video/phone meetings as frequently as possible (up to 8-10 per year) and actively serve on at least one committee. Member time is spent shaping the nature and direction of the organization.

**Q.** Why are CUHMA elections important?

**A.** CUHMA exists to represent, in a non-partisan way, our Canadian academic and practicing diving medical and scientific community. Board leadership makes this possible.

**Q.** I am not running for election, why should I vote?

**A.** Each member's vote is important, and a good proxy demonstrating the strength of an organization.

**Q.** How do nominations happen?

**A.** You can nominate yourself or other CUHMA members with a simple nomination form. Contact Paul Cervenko ([cervemp123@yahoo.ca](mailto:cervemp123@yahoo.ca)) for the forms.

**Q.** What else do I need to know?

**A.** Some positions (President, and a number of Director positions) must be held by a physician Regular member, and CUHMA also requires inclusion of Associate members and representation from various provinces and territories.

### UPCOMING EVENTS

#### UHN Introductory Hyperbaric Medicine Course

The University Health Network, Toronto General Hospital, course runs November 24-28. The program is suitable for physicians and other health professionals looking to become CHT certified or obtain Level 1 certification. It is accredited by the Undersea and Hyperbaric Medical Society for 40 CME credits, and by the National Board of Diving and Hyperbaric Medical Technology for 40 CME credits. For more information and registration:

[https://www.uhn.ca/Surgery/Treatments\\_Procedures/Hyperbaric\\_Medicine\\_Unit#tab4](https://www.uhn.ca/Surgery/Treatments_Procedures/Hyperbaric_Medicine_Unit#tab4)

## RECENT PUBLICATIONS

**Babu G, Upchurch BD, Young WH, Levine BD. Medicine in extreme environments: a new medical student elective class for wilderness, aerospace, hyperbaric, exercise, and combat medicine. Wilderness Environ Med. 2020;31(1):110-5.**

We developed an elective course titled Medicine in Extreme Environments (MEE) at the University of Texas Southwestern Medical Center for first- and second-year medical students. This course covered physiology, research, clinical practice, and career guidance regarding the fields of wilderness, space, hyperbaric, combat, and exercise medicine. The primary aim was to generate interest in and awareness of these seldom covered fields of medicine by exposing medical students to these disciplines during their preclinical years. A postcourse questionnaire was implemented to investigate whether the MEE course increased awareness of, interest in, and knowledge in the fields of medicine included in the curriculum. Through 2 iterations of the class, a total of 67 students enrolled in the course, and 38 students completed the questionnaire. After course completion, 95% felt they better understood the work and lifestyle of the fields covered, 100% learned more about concepts of each field, and 74% agreed that the elective influenced the direction of their future careers to include some part of the fields emphasized. Although only a limited number of students enrolled in this course, these initial findings suggest that the MEE curriculum may have some utility in promoting awareness of and interest in these medical disciplines among students who attend the course. With continued student and faculty support, this course will likely be continued annually at our institution. We believe that certain aspects of this course may be useful in helping develop similar courses at other medical schools.

**Baiula M, Greco R, Ferrazzano L, Caligiana A, Hoxha K, Bandini D, Longobardi P, Spampinato S, Tolomelli A. Integrin-mediated adhesive properties of neutrophils are reduced by hyperbaric oxygen therapy in patients with chronic non-healing wound. PLoS One. 2020 Aug 18;15(8):e0237746.**

In recent years, several studies suggested that the ability of hyperbaric oxygen therapy (HBOT) to promote healing in patients with diabetic ulcers and chronic wounds is due to the reduction of inflammatory cytokines and to a significant decrease in neutrophils recruitment to the damaged area.  $\alpha 4$  and  $\beta 2$  integrins are receptors mediating the neutrophil adhesion to the endothelium and the comprehension of the effects of hyperbaric oxygenation on their expression and functions in neutrophils could be of great importance for the design of novel therapeutic protocols focused on anti-inflammatory agents. In this study, the  $\alpha 4$  and  $\beta 2$  integrins' expression and functions have been evaluated in human primary neutrophils

obtained from patients with chronic non-healing wounds and undergoing a prolonged HBOT (150 kPa per 90 minutes). The effect of a peptidomimetic  $\alpha 4\beta 1$  integrin antagonist has been also analyzed under these conditions. A statistically significant decrease (68%) in  $\beta 2$  integrin expression on neutrophils was observed during the treatment with HBO and maintained one month after the last treatment, while  $\alpha 4$  integrin levels remained unchanged. However, cell adhesion function of both neutrophilic integrins  $\alpha 4\beta 1$  and  $\beta 2$  was significantly reduced (70 and 67%, respectively), but  $\alpha 4\beta 1$  integrin was still sensitive to antagonist inhibition in the presence of fibronectin, suggesting that a combined therapy between HBOT and integrin antagonists could have greater anti-inflammatory efficacy.

**Bouten J, Bourgois JG, Boone J. Hold your breath: peripheral and cerebral oxygenation during dry static apnea. Eur J Appl Physiol. 2020 Aug 3. doi: 10.1007/s00421-020-04445-y. Online ahead of print.**

Purpose: Acute breath-holding deprives the human body from oxygen. In an effort to protect the brain, the diving response is initiated, coupling several physiological responses. The aim of this study was to describe the physiological responses to apnea at the cardiac, peripheral and cerebral level. Methods: 31 physically active subjects (17 male, 14 female,  $23.3 \pm 1.8$  years old) performed a maximal static breath-hold in a seated position. Heart rate (HR), muscle and cerebral oxygenation (by means of near-infrared spectroscopy, NIRS) were continuously measured. RM MANOVAs were used to identify changes in HR, peripheral (mTOI) and cerebral (cTOI) tissue oxygenation and oxygenated ( $O_2Hb$ ) and deoxygenated (HHb) hemoglobin during apnea. Results: Average apnea duration was  $157 \pm 41$  s. HR started decreasing after 10 s ( $p < 0.001$ ) and dropped on average by  $27 \pm 14$  bpm from baseline ( $p < 0.001$ ). mTOI started decreasing 10 s after apnea ( $p < 0.001$ ) and fell by  $8.6 \pm 4.0\%$  ( $p < 0.001$ ). Following an immediate drop after 5 s ( $p < 0.001$ ), cTOI increased continuously, reaching a maximal increase of  $3.7 \pm 2.4\%$  followed by a steady decrease until the end of apnea. cTOI fell on average  $5.4 \pm 8.3\%$  below baseline ( $p < 0.001$ ). Conclusion: During apnea, the human body elicits several protective mechanisms to protect itself against the deprivation of oxygen. HR slows down, decreasing  $O_2$  demand of the cardiac muscle. The decrease in mTOI and increase in cTOI imply a redistribution of blood flow prioritizing the brain. However, this mechanism is not sufficient to maintain cTOI until the end of apnea.

**Chang C, White C, Katz A, Hanna MK. Management of ischemic tissues and skin flaps in Re-Operative and complex hypospadias repair using vasodilators and hyperbaric oxygen. J Pediatr Urol. 2020;S1477-5131(20)30445-9. doi: 10.1016/j.jpuro.2020.07.034. Online ahead of print.**

**Introduction:** Repeated and multiple surgeries for hypospadias result in varying degrees of scarring and hypovascularity of penile tissues which may result in poor healing and increasing complication rates with each additional repair. Vasodilator agents such as Nitroglycerine (NTG) can be helpful in the immediate postoperative period to improve flap viability. Hyperbaric oxygen therapy (HBOT) has well-established benefits to promote angiogenesis and wound healing. We hypothesized that NTG and HBOT, methods to promote blood flow and wound healing, would provide better outcomes in redo hypospadias surgeries and reduce complication rates; and, that HBOT and NTG would provide better outcomes compared to NTG alone. **Objectives:** Herein, the authors review the results of their strategy of the past 5.5 years in managing these compromised hypovascular tissues using 2% NTG and HBOT for redo surgery of hypospadias. **Study design:** Between 2014 and 2019, 82 patients (2-24 years old) exhibiting varying degrees of scarring of skin and subcutaneous tissues underwent re-operative repair of hypospadias complications following failed surgeries (3-9 operations, average 5.5 failed previous repairs). There were two groups of patients: Group I (49 patients) received trimodal therapy consisting of NTG, HBOT, and local steroids. The patients were examined every 3 weeks and every 3 months thereafter. The postoperative site was photographed by the parents or by the older patient prior to each visit. Group II (33 patients) received NTG and local steroids, but not HBOT for various reasons. **Results:** In Group I: 44/49 (88.8%) of the repairs were successful. The complications in this group included a distal repair breakdown (n = 2) and urethral fistula (n = 3). In Group II, a successful outcome was noted in 23/33 (69.6%). The follow up of the 78 patients who completed their repairs varied between 5 months and 4 years. Results are highlighted in the table. **Discussion:** In accordance to previously published data, the study results further support promising outcomes of application of NTG and HBOT to improve flap viability. Limitations include non-randomization of our treatment groups resulting in a retrospective evaluation of our protocol; and, the intrinsic heterogeneity of our patient population, previous surgical repairs, and scar tissues. **Conclusions:** The proposed treatment of combining NTG and HBOT appears to result in reversal of tissue hypoxia and improved wound healing. This preliminary report shows improved outcomes with less morbidity in a group of patients with multiple hypospadias surgical failures and it warrants further application in a larger number of patients.

**Dulai PS, Raffals LE, Hudesman D, Chiorean M, Cross R, Ahmed T, Winter M, Chang S, Fudman D, Sadler C, Chiu EL, Ross FL, Toups G, Murad MH, Sethuraman K, Holm JR, Guilliod R, Levine B, Buckley JC Jr, Siegel CA. A phase 2B randomised trial of hyperbaric oxygen therapy for ulcerative colitis patients hospitalised for moderate to severe flares. Aliment Pharmacol Ther. 2020 Aug 3. doi: 10.1111/apt.15984. Online ahead of print.**

**Background:** Hyperbaric oxygen has been reported to improve disease activity in hospitalised ulcerative colitis (UC) patients. **Aim:** To evaluate dosing strategies with hyperbaric oxygen for hospitalised UC patients. **Methods:** We enrolled UC patients hospitalised for acute flares (Mayo score 6-12). Initially, all patients received 3 days of hyperbaric oxygen at 2.4 atmospheres (90 minutes with two air breaks) in addition to intravenous steroids. Day 3 responders (reduction of partial Mayo score  $\geq 2$  points and rectal bleeding score  $\geq 1$  point) were randomised to receive a total of 5 days vs 3 days of hyperbaric oxygen. **Results:** We treated 20 patients with hyperbaric oxygen (75% prior biologic failure). Day 3 response was achieved in 55% (n=11/20), with significant reductions in stool frequency, rectal bleeding and CRP (P<0.01). A more significant reduction in disease activity was observed with 5 days vs 3 days of hyperbaric oxygen (P=0.03). Infliximab or colectomy was required in only three patients (15%) despite a predicted probability of 80% for second-line therapy. Day 3 hyperbaric oxygen responders were less likely to require re-hospitalisation or colectomy by 3 months vs non-responders (0% vs 66%, P=0.002). No treatment-related adverse events were observed. **Conclusion:** Hyperbaric oxygen appears to be effective for optimising response to intravenous steroids in UC patients hospitalised for acute flares, with low rates of re-hospitalisation or colectomy at 3 months. An optimal clinical response is achieved with 5 days of hyperbaric oxygen. Larger phase 3 trials are needed to confirm efficacy and obtain labelled approval.

**Eski E, Babakurban S, Yilmaz S, Yilmazer C, Erkan AN, Çaylaklı F, Yılmaz I. Comparing the efficiencies of hyperbaric oxygen therapy and intratympanic steroid treatment for sudden hearing loss. J Int Adv Otol. 2020;16(2):263-5.**

**Objectives:** To compare the efficiencies of hyperbaric oxygen therapy (HBOT) and intratympanic steroid (ITS) treatment for idiopathic sudden sensorineural hearing loss (ISSHL). **Materials and Methods:** A total of 136 patients who were treated for ISSHL were reviewed from the medical records. All of the patients were given systemic steroid therapy (SST). Among them, 33 patients received HBOT and 36 patients received ITS treatment following SST. The starting time to treatment, risk factors, hearing level, hearing gain (HG), and recovery rate were evaluated from retrospective records. **Results:** No substantial change

in HG was observed for either the HBOT or ITS treatment cohort ( $p>0.05$ ). But the time to recovery was higher in the ITS treatment cohort (40%) than in the HBOT cohort (17%). The starting time to ITS treatment was 4 days (range: 1-30) and that to HBOT was 8 days (range: 3-30). There was a significant difference in the starting time to treatment (Mann-Whitney U-test,  $p=0.043$ ). Also, hearing loss in the HBOT group was significantly higher than in the ITS treatment group. A significant difference was observed before and after ITS treatment ( $p<0.05$ ). Conclusion: In patients compared with late-onset treatment, ITS may be more effective than HBO after SST failure. It can be used as salvage therapy in patients with ISSHL who are unresponsive to a primary systemic steroid. We observed that HBOT did not improve results when it was started late. Therefore, more studies that include both ITS treatment and HBOT as an early treatment option are needed.

**Fan ZX, Gan Y, Qu Q, Wang J, Lunan Y, Liu B, Chen R, Hu ZQ, Miao Y. The effect of hyperbaric oxygen therapy combined with hair transplantation surgery for the treatment of alopecia. J Cosmet Dermatol. 2020 Aug 8. doi: 10.1111/jocd.13665. Online ahead of print.**

Background: Transplanted hair follicles suffer from various injury, which are difficult to prevent. Hyperbaric Oxygen Therapy (HBOT) was reported to be an excellent procedure to promote capillary regeneration and reduce ischemia-reperfusion injury. Aim: To evaluate the clinical efficacy of HBOT as an adjuvant therapy for hair transplantation surgery. Methods: 34 patients with II-IV alopecia were divided into the control group and HBOT group randomly. The control group were treated with routine FUE procedure, while HBOT group combined with HBOT. Patients were treated with 100% oxygen under 2.0 atmospheres absolute pressure for 60 minutes through a facemask during HBOT and take the therapy daily for 7 days continuously after operation. Satisfaction and clinical improvement were evaluated at the fourth week and the sixth month postoperatively. Result: Itching and folliculitis was significantly decreased in HBOT group (11.8% versus 35.3%). In addition, HBOT resulted in a lower postoperative shedding rate ( $27.6\pm 2.6\%$  versus  $69.1\pm 2.4\%$ ), nevertheless, the survival rate at 9 months showed no significant difference between HBOT ( $96.9\pm 0.5\%$ ) and control ( $93.8\pm 0.6\%$ ). The early postoperative satisfaction in control group was much lower than HBOT group (52.9% versus 88.2%), whereas all patients showed satisfaction with the final result. Conclusion: HBOT is able to minimize the postsurgical follicle shedding and lead to less folliculitis and itching, which provides evidence for HBOT to act as an adjuvant therapy for hair transplantation surgery.

**Huang X, Liang P, Jiang B, Zhang P, Yu W, Duan M, Guo L, Cui X, Huang M, Huang X. Hyperbaric oxygen potentiates diabetic wound healing by promoting fibroblast cell proliferation and endothelial cell angiogenesis. Life Sci. 2020 Aug 10;118246. doi: 10.1016/j.lfs.2020.118246. Online ahead of print.**

Background: Diabetic foot ulcer (DFU), one of the diabetic complications, brings high burden to diabetic patients. Hyperbaric oxygen therapy (HBOT) has been proven to be an effective clinical method for the treatment of DFU. However, the mechanisms still to be elucidated. Methods: Diabetic foot mice model was established, and treated with hyperbaric oxygen. Haematoxylin & eosin (H&E) staining and Masson's trichrome staining were used for the analysis of wound healing. Human skin fibroblast (HSF) and human umbilical vein endothelial cell (HUVECS) were exposed to high glucose and hyperbaric oxygen for studying the mechanism of hyperbaric oxygen promoted wound healing in vitro. Wound healing assay, reactive oxygen species (ROS) assay, cell proliferation assay and tube formation assay were used for the analysis of wound healing. Quantitative-polymerase chain reaction (Q-PCR), Western blotting and enzyme-linked immunosorbent assay (ELISA) were used for the analysis of gene expression. Results: HBOT facilitated wound healing in DFU mice model, and promoted the expression of HIF-1 $\alpha$ , NF- $\kappa$ B, VEGFA, SDF-1, VEGFR2 and CXCR4. Hyperbaric oxygen promoted the proliferation, migration and ROS production, as well as the expression of SDF-1 and VEGFA in HSF. HBOT stimulated the proliferation, migration and tube formation, as well as the expression of CXCR4 and VEGFR2 in HUVECS. Conclusion: Hyperbaric oxygen potentiates angiogenesis and diabetic wound healing by activating HIF-1 $\alpha$  signaling, so as to promote the expression of VEGF/SDF-1 in HSF and the expression of VEGFR/CXCR4 in HUVECS, ultimately to promote the proliferation of HSF and the angiogenesis of HUVECS.

**Ince B, Ismayilzade M, Arslan A, Oltulu P, Baycar Z, Dadaci M. Evaluation of the effect of hyperbaric oxygen therapy on hypertrophic scar formation in a rabbit ear model: An experimental study. Dermatol Ther. 2020 Aug 5;e14146.**

Background: Hypertrophic scar is a disease with complicated treatment methods. Although there are numerous studies in the literature definitive therapy has not been reported yet. Objective: In this study, we aimed to evaluate the short and long-term effects of HBOT on hypertrophic scar formation in a rabbit ear model. Material and methods: A total of 20 male New Zealand rabbits weighing 2.1- 2.4 kg were used in this study. The rabbits in group 2 were exposed to hyperbaric oxygen treatment for 7 days starting from the first day following biopsy punch, while no extra treatment was applied to the rabbits

in group 1. Macroscopic scar thickness, histopathological parameters and HI were assessed in both of the 30th day and 60th day scars. Results: Scar thickness was found significantly less in the scars of the rabbits exposed to HBOT ( $p < 0.05$ ). And less dermal hypertrophy was also found in HI results of group 2 ( $p \approx 0.022$ ). There were differences between groups in terms of inflammation, vascularization and density of collagen fibrils. Conclusion: HBOT applied for 7 days from the first day of wound formation has both short and long-term effects on the triggering factors of hypertrophic scar, especially on inflammation.

**Kevrekidis DP, Brousa E, Mastrogianni O, Orfanidis A, Gika HG, Raikos N. Risk factors for fatal drowning in a Greek region: a retrospective case-control study. *Inj Prev.* 2020 Aug 7; [injuryprev-2020-043788](https://doi.org/10.1136/injuryprev-2020-043788). doi: 10.1136/injuryprev-2020-043788. Online ahead of print.**

Background: Fatal drowning is one of the leading causes of unintentional injury mortality worldwide and a persistent public health concern in Greece. While several pathologic and sociodemographic contributing factors have been previously identified, these have not been extensively investigated in conjunction with the effects of psychoactive substances. Methods: A retrospective case-control study of drowning deaths was conducted in the Greek regions of Northern Greece and Thessaly during a 10-year period. A regression model was constructed examining differences in detected substances, autopsy findings and sociodemographic characteristics between 240 victims of unintentional fatal submersion and 480 victims of other causes of sudden or violent death. Results: The majority of victims were males (69.4%) and foreign nationality was associated with increased odds of drowning. Cardiomegaly and coronary bypass grafts were significantly more likely to have been recorded among drowning victims, while the frequency of other circulatory system disorders was also elevated. Several of these findings were potential arrhythmogenic substrates which could adversely interact with the diving reflex. Selective serotonin reuptake inhibitors (SSRIs) were the most commonly detected pharmacological group (9.0%), and along with tramadol, there was an increased likelihood of exposure to them. These drugs have been previously associated with QT prolongation and other adverse effects which may contribute to fatal outcomes in a seawater environment. In contrast, there was a decreased risk of exposure to dependence-inducing drugs and paracetamol. Conclusions: Male sex, older age, foreign nationality and cardiovascular disease predisposed individuals to an elevated risk of fatal submersion. SSRI antidepressants and tramadol may contribute to this outcome.

**Ko SF, Chen KH, Wallace CG, Yang CC, Sung PH, Shao PL, Li YC, Chen YT, Yip HK. Protective effect of combined therapy with hyperbaric oxygen and autologous adipose-derived mesenchymal stem cells on renal function in rodent after acute ischemia-reperfusion injury. *Am J Transl Res.* 2020;12(7):3272-87.**

Background: This study tested the hypothesis that combined hyperbaric oxygen (HBO) and autologous adipose-derived mesenchymal stem cell (ADMSC) therapy was superior to either alone at protecting renal function in rodents after acute ischemia-reperfusion (IR) injury. Methods and Results: Adult-male SD rats ( $n = 40$ ) were equally categorized: group 1 (sham-operated control); group 2 (IR + 50  $\mu$ g medium intra-renal artery administration); group 3 [IR + HBO (at 1.5 h and days 1 and 2 after IR)]; group 4 [IR + ADMSC ( $2.0 \times 10^6$  cells/ $5.0 \times 10^5$ /per each renal artery and  $1.0 \times 10^6$  by intravenous injection at 1.5 h after IR)]; and group 5 (IR + HBO-ADMSC). By 72 hr after IR, the circulating levels of BUN/creatinine and ratio of urine protein/creatinine were significantly highest in group 2, lowest in group 1, significantly increased in group 5 than in groups 3 and 4, but not different between latter two groups, whereas the circulating levels of EPCs and soluble-angiogenesis biomarkers (SDF-1 $\alpha$ /HIF-1 $\alpha$ ) exhibited an opposite pattern to BUN/creatinine among the five groups (all  $P < 0.001$ ). The kidney injury score, ROS (fluorescent intensity of H2DCFDA dye in kidney), inflammation (F4/80+, CD14+ cells) and glomerular-tubular injury score (WT-1/KIM-1) displayed an identical pattern whereas the integrity of podocyte components exhibited an opposite pattern to BUN/creatinine among the five groups (all  $P < 0.0001$ ). The protein expressions of inflammatory (MMP-9/TNF- $\alpha$ /NF- $\kappa$ B/ICAM-1), oxidative-stress (NOX-1/NOx-2/oxidized protein) and apoptotic (mitochondrial-Bax/cleaved-caspase3/PARP) markers showed an identical pattern to BUN/creatinine (all  $P < 0.001$ ). Conclusion: Combined ADMSC-HBO therapy was superior to either one alone at protecting the kidney from acute IR injury.

**Longobardi P, Hartwig V, Santarella L, Hoxha K, Campos J, Laurino M, Salvo P, Trivella MG, Cocceani F, Rocco M, L'Abbate A. Potential markers of healing from near infrared spectroscopy imaging of venous leg ulcer. A randomized controlled clinical trial comparing conventional with hyperbaric oxygen treatment. *Wound Repair Regen.* 2020 Aug 12. doi: 10.1111/wrr.12853. Online ahead of print.**

The aim of this study is to ascertain whether the simultaneous measurement of hemoglobin O<sub>2</sub> saturation (StO<sub>2</sub>) and dimension of venous leg ulcers (VLU) by Near Infrared Spectroscopy (NIRS) imaging can predict the healing course with protocols employing a conventional treatment alone or in combination with hyperbaric oxygen therapy (HBOT). NIRS 2D images of wound region were

obtained in 81 patients with hard-to-heal VLU that had been assigned, in a randomized controlled clinical trial, to the following protocols: 30 HBOT sessions, adjunctive to the conventional therapy, either twice daily over three weeks (Group A) or once daily over six weeks (Group B), and conventional therapy without HBOT (Group C). Seventy-three patients completed the study with a total of 511 NIRS images being analyzed. At the end of treatment, wound area was significantly smaller in all three groups. However, at the 3-week mark the wound area reduction tended to be less evident in Group A than in the other groups. This trend continued up to the 6-week end-point when a significantly greater area reduction was found with Group B (65.5%) and Group C (56.8%) compared to Group A (29.7%) ( $p<0.01$ ). Furthermore, a higher incidence of complete healing was noted with Group B (20%) than with Group A (4.5%) and Group C (3.8%). When using a final wound reduction in excess of 40% to distinguish healing from non-healing ulcers, it was found that only the former present NIRS StO<sub>2</sub> values abating over the study period both at center and edge of lesions. In conclusion, NIRS analysis of StO<sub>2</sub> and wound area can predict the healing course of VLU. Adjunctive HBOT significantly facilitates VLU healing compared to the conventional treatment alone. This positive action, however, becomes manifest only with a longer and less intensive treatment schedule.

**Martín-Hernández P, Gutiérrez-Leonard H, Reymon Quintana A, Ojeda-Delgado JL, Montes-Bautista C, Valdéz-Becerril G, Aguirre-Alvarado A, Hernández-Jiménez L. Hyperbaric oxygen therapy following percutaneous coronary intervention for ST-segment elevation myocardial infarction. *Cardiovasc Revasc Med.* 2020 Apr 30;S1553-8389(20)30237-2. doi: 10.1016/j.carrev.2020.04.031.** Online ahead of print.

**Introduction:** Hyperbaric oxygen therapy (HBOT) is a promising treatment modality for ischemic heart disease including myocardial infarction where outcomes are frequently poor despite early revascularization. **Objective:** To compare single-photon emission computed tomography (SPECT) findings in patients undergoing primary percutaneous coronary intervention (PPCI) for ST-elevation myocardial infarction (STEMI) treated with HBOT vs. control at 6 weeks. **Methods:** In this pilot study, 24 patients were randomly allocated to HBOT ( $n=13$ ) and control groups ( $n=11$ ). Both groups underwent PPCI and were treated following the guidelines for STEMI management. The HBOT group received additional 15 and 90-minute HBOT sessions. All participants underwent SPECT at initial presentation (within 48 h of PPCI) and at follow up. **Results:** Baseline characteristics were similar in both groups. The number of affected SPECT segments in the HBOT group at baseline and 6 weeks were  $47.1\pm 14.6\%$  vs.  $33.7\pm 16.2\%$ , respectively, with  $p=0.039$ , and in the control group, the number of affected segment

at these times were  $55.5\pm 19.5\%$  vs.  $45.9\pm 17.9\%$ , respectively, with  $p=0.090$ . At follow-up, a decrease in the summed rest score was noted in both groups (HBOT:  $20\pm 6.0$  vs.  $12.7\pm 8.1$ ;  $p=0.0017$ ; control:  $23\pm 8.2$  vs.  $16.7\pm 6.6$ ;  $p=0.031$ ). The left ventricular ejection fraction in the HBOT group improved from  $44\pm 22.1\%$  to  $57.2\pm 15.4\%$  ( $p=0.011$ ) and in the control group from  $45.9\pm 18.2\%$  to  $55\pm 12.1\%$  ( $p=0.044$ ). **Conclusions:** HBOT use in STEMI patients was associated with an improvement in perfusion and an increase in ejection fraction following PPCI. These observations warrant a larger randomized clinical trial.

**Paprocki J, Pawłowska M, Sutkowy P, Piechocki J, Woźniak A. Evaluation of oxidative stress in patients with difficult-to-heal skin wounds treated with hyperbaric oxygen. *Oxid Med Cell Longev.* 2020 Jul 31;2020:1835352.**

**Objective:** To determine the concentration of thiobarbituric acid reactive substances (TBARS) in erythrocytes and blood plasma, and the activities of selected antioxidant enzymes: catalase (CAT), superoxide dismutase (SOD), and glutathione peroxidase (GPx) in erythrocytes in patients receiving hyperbaric oxygen (HBO) treatment due to difficult-to-heal "skin wounds." **Material and Methods.** Indices of oxidative stress were assessed in venous blood taken from 23 patients three times: immediately before HBO procedure, approximately 5 minutes after leaving the hyperbaric chamber, and after 25 HBO procedures. Moreover, selected blood counts were measured in the collected material two times: prior to treatment and after 25 HBO procedures. **Results:** A statistically significant positive correlation between the CAT activity and the TBARS concentration in the erythrocytes of patients was found before treatment in the hyperbaric chamber ( $r=0.394$ ;  $P\leq 0.05$ ). No statistically significant changes in the TBARS concentration in erythrocytes and blood plasma were observed both after the first HBO procedure and after 25 procedures. No statistically significant changes in the activities of CAT, SOD, and GPx were noted. Platelet count decreased by 18.7% ( $P\leq 0.05$ ) after 25 HBO procedures. Granulocyte count decreased by approximately 21% ( $P\leq 0.05$ ), and granulocyte percentage by 11.8% ( $P\leq 0.01$ ). In turn, the percentage of lymphocytes and monocytes increased after the treatment by 16.6% ( $P<0.05$ ) and 16.4% ( $P<0.05$ ), respectively. **Conclusions:** Exposure to HBO due to difficult-to-heal skin wounds does not significantly affect the levels of oxidative stress in the peripheral blood of patients and, from the point of view of oxidation-reduction processes, appears to be a safe therapeutic method for the treatment of chronic wounds.

**Yoshinoya Y, Böcker AH, Ruhl T, Siekmann U, Pallua N, Beier JP, Kim BS. The effect of hyperbaric oxygen therapy on human adipose-derived stem cells. *Plast Reconstr Surg.* 2020;146(2):309-20.**

Background: Adipose-derived stem cells are considered as candidate cells for regenerative plastic surgery. Measures to influence cellular properties and thereby direct their regenerative potential remain elusive. Hyperbaric oxygen therapy-the exposure to 100% oxygen at an increased atmospheric pressure-has been propagated as a noninvasive treatment for a multitude of indications and presents a potential option to condition cells for tissue-engineering purposes. The present study evaluates the effect of hyperbaric oxygen therapy on human adipose-derived stem cells. Methods: Human adipose-derived stem cells from healthy donors were treated with hyperbaric oxygen therapy at 2 and 3 atm. Viability before and after each hyperbaric oxygen therapy, proliferation, expression of surface markers and protein contents of transforming growth factor (TGF)- $\beta$ , tumor necrosis factor- $\alpha$ , hepatocyte growth factor, and epithelial growth factor in the supernatants of treated adipose-derived stem cells were measured. Lastly, adipogenic, osteogenic, and chondrogenic differentiation with and without use of differentiation-inducing media (i.e., autodifferentiation) was examined. Results: Hyperbaric oxygen therapy with 3 atm increased viability, proliferation, and CD34 expression and reduced the CD31/CD34/CD45 adipose-derived stem cell subset and endothelial progenitor cell population. TGF- $\beta$  levels were significantly decreased after two hyperbaric oxygen therapy sessions in the 2-atm group and decreased after three hyperbaric oxygen therapy sessions in the 3-atm group. Hepatocyte growth factor secretion remained unaltered in all groups. Although the osteogenic and chondrogenic differentiation were not influenced, adipogenic differentiation and autodifferentiation were significantly enhanced, with osteogenic autodifferentiation significantly alleviated by hyperbaric oxygen therapy with 3 atm. Conclusion: Hyperbaric oxygen therapy with 3 atm increases viability and proliferation of adipose-derived stem cells, alters marker expression and subpopulations, decreases TGF- $\beta$  secretion, and skews adipose-derived stem cells toward adipogenic differentiation.

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  
10 Plumtree Place, Portugal Cove-St. Philips,  
Newfoundland and Labrador, A1M 3T1  
[info@cuhma.ca](mailto:info@cuhma.ca) <https://cuhma.ca>

**Editor:** Neal W. Pollock, PhD - [neal.pollock@kin.ulaval.ca](mailto:neal.pollock@kin.ulaval.ca)

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