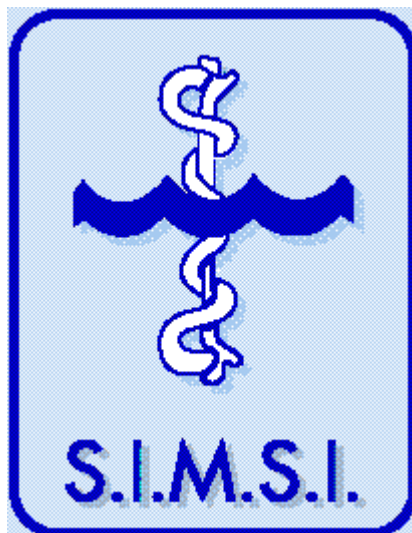


**SOCIETA' ITALIANA  
DI  
MEDICINA SUBACQUEA E IPERBARICA**



**RICERCA IN MEDLINE DEI LAVORI DI  
OSSIGENO TERAPIA IPERBARICA  
INDICIZZATI CON PAROLA CHIAVE DI IMPORTANZA RILEVANTE**

**2004  
PRIMO SEMESTRE**

a cura del  
Dott. Francesco Ruocco  
Servizio di Medicina Iperbarica e Subacquea  
Anestesia e Rianimazione del Dipartimento di Emergenza  
della Azienda Ospedaliera Universitaria di Careggi

Search "Hyperbaric Oxygenation"[MAJR] Field: All Fields, Limits:  
Publication Date from 2004/01 to 2004/06

**Search "Hyperbaric Oxygenation"[MAJR] Field: All Fields, Limits: Publication Date from 2004/01 to 2004/06**

1: Undersea Hyperb Med. 2004 Winter;31(4):417-29. Venous gas embolism in chamber attendants after hyperbaric exposure.

Risberg J, Englund M, Aanderud L, Eftedal O, Flook V, Thorsen E.

Haukeland University Hospital, Bergen.

An initial occupational survey (OS) was initiated to investigate the prevalence of venous gas embolism (VGE) in chamber attendants assisting hyperbaric oxygen (HBO2) treatments. Nine female subjects were exposed for three consecutive days to the routine hospital procedure of compressed air exposure to 240 kPa for approximately 115 min with 12 min of terminal oxygen (O2) breathing. VGE was monitored with ultrasound Doppler in 15 min intervals for 2h after the first and third exposure. A follow-up experimental study was completed to investigate whether changed breathing gases and decompression would affect the high incidence of VGE observed in the OS. Ten female subjects were randomly exposed to the routine or revised profile (12 and 24 min of terminal O2 breathing respectively), and a Nitrox profile (breathing gas 40.5% O2 in Nitrogen during 90 min of the isobaric phase). VGE was monitored with transthoracic ultrasound scanner and Doppler. In the OS precordial VGE grade III (Doppler) was observed in five subjects, but median resting precordial VGE was Grade 0 both days and VGE score at all sites were equal Days 1 and 3. In the experimental study, median resting precordial VGE was Grade 0 (Doppler) and Grade 1 (Scanner). VGE Grade III (Doppler) was observed in all series, but VGE scores were not significantly different between the series. We conclude that chamber attendants assisting HBO2 treatment at 240 kPa for approximately 115 min are exposed to a significant decompression stress using the profiles tested in the present study.

Publication Types: Clinical Trial Randomized Controlled Trial

PMID: 15686273 [PubMed - indexed for MEDLINE]

2: Undersea Hyperb Med. 2004 Winter;31(4):395-406.

Regional CBF in chronic stable TBI treated with hyperbaric oxygen.

Barrett KF, Masel B, Patterson J, Scheibel RS, Corson KP, Mader JT.

The Transitional Learning Center at Galveston, USA. To investigate whether Hyperbaric Oxygen Therapy (HBO2) could improve neurologic deficits and regional cerebral blood flow (rCBF) in chronic

traumatic brain injuries (TBI), the authors employed a nonrandomized control pilot trial. Five subjects, at least three years post head injury, received HBO2. Five head injured controls (HIC) were matched for age, sex, and type of injury. Five healthy subjects served as normal controls. Sixty-eight normal volunteers comprised a reference data bank against which to compare SPECT brain scans. HBO2 subjects received 120 HBO2 in blocks of 80 and 40 treatments with an interval five-month break. Normal controls underwent a single SPECT brain scan, HBO2, and repeat SPECT battery. TBI subjects were evaluated by neurologic, neuropsychometric, exercise testing, and pre and post study MRIs, or CT scans if MRI was contraindicated. Statistical Parametric Mapping was applied to SPECT scans for rCBF analysis. There were no significant objective changes in neurologic, neuropsychometric, exercise testing, MRIs, or rCBF. In this small pilot study, HBO2 did not effect clinical or regional cerebral blood flow improvement in TBI subjects.

Publication Types: Clinical Trial Controlled Clinical Trial

PMID: 15686271 [PubMed - indexed for MEDLINE]

3: Undersea Hyperb Med. 2004 Winter;31(4):387-93. Evaluation of HBO2 therapy in pneumatosis cystoides intestinalis.

Togawa S, Yamami N, Nakayama H, Shibayama M, Mano Y.

Department of Hyperbaric Therapy, Tokyo Medical and Dental University Hospital, Faculty of Medicine, Tokyo, Japan.

Pneumatosis cystoides intestinalis (PCI) is a disease characterized by retention of gas in the intestinal wall. Retention of gas can be caused by three mechanisms; gas entry through the intestinal mucosa, gas dissection from the pulmonary alveoli and bronchi, and gas generation in the mucous membrane. Since gas in cysts is composed almost entirely of nitrogen, hyperbaric oxygen therapy (HBO2) is effective for treating PCI due to the oxygen windows effect. However, PCI, caused by a mechanism involving pulmonary alveoli or branches, can become aggravated by HBO2. Therefore, we propose modifying HBO2 protocols for cases that do not require an invasive treatment. This study describes favorable results obtained in 2 PCI cases after HBO2 therapy according to our protocol.

Publication Types: Case Reports

PMID: 15686270 [PubMed - indexed for MEDLINE]

4: Otolaryngol Pol. 2004;58(4):821-30.

[Sudden sensorineural hearing loss: a treatment protocol including glucocorticoids and hyperbaric oxygen therapy]

[Article in Polish]

Narozny W, Sicko Z, Przewozny T, Stankiewicz C, Kot J, Kuczkowski J.

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The aim of this study was to evaluate the efficacy of pharmacological treatment (corticosteroids, vasodilators, vitamins, Betaserc) combined with hyperbaric oxygen therapy (HBO) in the sudden sensorineural hearing loss (SSNHL). We reviewed 52 patients with SSNHL treated pharmacologically and with HBO (group A) between 1997 and 2000. All patients in this group received once daily, five days a week, 100% oxygen in a multiplace chamber under pressure of 2.5 ATA for 60 minutes (plus two 5 minutes air breaks). The other group (group B) consisted of 81 patients treated only pharmacologically between 1980 and 1997. Both groups were similar regarding age, season of the year in which deafness occurred, presence of vestibular symptoms and tinnitus, therapeutic delay from initial symptoms to start of treatment, and initial hearing loss, however there were significant differences in gender and shape of hearing loss. The improvement after treatment was measured by tonal audiometry. The retrospective analysis of audiometries performed in all patients was conducted. The improvement of hearing loss was statistically significantly better for group A (vasodilators, high-dose of corticosteroids, vitamins, Betaserc, HBO) than group B (vasodilators, lower-dose of corticosteroids, vitamins) in any single frequency (500-1000-2000-3000-4000-6000-8000 Hz) and in 4 ranges of frequencies (PTA, HTA, PMTA, OAA) both for relative and absolute values. We concluded that the combined therapy of high-dose corticosteroids and HBO improved the clinical results of treatment in the SSNHL, and therefore should be performed in such cases. We also observed that therapeutic delay and flat hearing loss are predictors of poor clinical outcome.

PMID: 15603397 [PubMed - indexed for MEDLINE]

5: Ostomy Wound Manage. 2004 May;50(5A Suppl):1-11; quiz 12.

The management of lower extremity wounds complicated by acute arterial insufficiency and ischemia.

Niezgoda JA, Mewissen M.

Center for Comprehensive Wound Care and Hyperbaric Oxygen Therapy, St. Luke's Medical Center, Aurora Health Care, Milwaukee, Wis, USA.  
niezgoda@execpc.com

Although wound care therapy has made significant advances in the past several years, clinicians encounter dilemmas on a day-to-day basis. One of these dilemmas is managing ischemic wounds. Certain characteristics (ischemic appearance, a history of a lack of healing, physical examination that finds no pulses, or a transcutaneous oxygen evaluation to suggest tissue hypoxia) will identify the wound as hypoxic or related to arterial disease. The clinician faces several decisions: Should an arteriogram be performed? Should an MRI or ABIs be ordered? Is a vascular surgery consult necessary? In response to this area of diagnostic and

management conflict, the authors developed an algorithm for the treatment of patients with ischemic wounds. This article addresses the management of wounds primarily caused by peripheral arterial occlusive disease and includes discussion of the initial wound care consult, the factors that identify and classify patients with arterial wounds, and a description of how transcutaneous oximetry is used to evaluate this subgroup of patients. In addition, the concept of the Vascular Center is introduced and explained, including arterial vascular consultation and evaluation, arterial vascular anatomy, and noninvasive vascular studies that are important tools in the Vascular Center, as well as endovascular interventions such as arteriography, angioplasty and arterial stenting. The basics of arterial revascularization, the use of hyperbaric oxygen therapy to manage the patients with ischemic wounds, and outcome data from a case study illustrating the management algorithm utilized at the authors' facility also are presented.

Publication Types: Case Reports

PMID: 15366447 [PubMed - indexed for MEDLINE]

6: Anesteziol Reanimatol. 2004 May-Jun;(3):57-8.

[The condition of cellular membranes in diabetes mellitus and its changes under the influence from hyperbaric oxygen]

[Article in Russian]

[No authors listed]

PMID: 15314864 [PubMed - indexed for MEDLINE]

7: Anesteziol Reanimatol. 2004 May-Jun;(3):54-7.

[The adaptogenic effects of hyperbaric oxygenation within the complex therapy of inflammation diseases of the internal female genitals]

[Article in Russian]

Sogikian AS, Beliavskii SA.

The effects of hyperbaric oxygenation (HBO), when used jointly with the routine complex therapy, made in the clinical signs of inflammatory diseases of the internal female genitals as well as in the lipid peroxidation/antioxidant system were investigated within the case study. The reaction of the antioxidant system to the HBO action was found to depend on a degree of its original exhaustion. An opinion was put forward on the need in the individual approach to whether to add the HBO method to the complex therapy or not. If the reaction to the hyperbaric effects is positive, the HBO method must be used to the full extent. If there is progressing of the exhaustion degree of the antioxidant system, the HBO course must be interrupted.

Publication Types: Evaluation Studies

PMID: 15314863 [PubMed - indexed for MEDLINE]

8: Anesteziol Reanimatol. 2004 May-Jun;(3):51-4.

[Hyperbaric oxygenation with low excess pressure implemented in the pressure chamber within the complex intensive care for combined craniocerebral trauma]

[Article in Russian]

Uianaeva ZR, Markarian EG.

An attempt was made to apply the hyperbaric oxygenation (HBO) in victims with craniocerebral trauma. HBO sessions were carried out in a low excess pressure (0.2 ATA) with the simultaneous use of clonidin as antihinoxant and antioxidant (2 mkg/kg), which was done for the purpose of eliminating or decreasing the pronouncement degree of additional stimulation of the lipid-peroxidation processes by hyperbaric oxygen (such processes were already stimulated by combined trauma). Requirements are substantiated on the need in a differential approach to the indication of the HBO course even if it is implemented in the described (sparing) regime. If there is a negative body response to the HBO effect, which happened in 8 of 18 persons according to our observations, the HBO course must be interrupted.

PMID: 15314862 [PubMed - indexed for MEDLINE]

9: Undersea Hyperb Med. 2004 Spring;31(1):1-183. Oxygen 2002. Proceedings of the 10th Symposium on Underwater and Hyperbaric Physiology. La Jolla, California, USA, July 1-2, 2002. Symposium in honor of Dr. Christian J. Lambertsen.

Lambertsen CJ.

Publication Types: Biography Congresses Festschrift Historical Article

PMID: 15279000 [PubMed - indexed for MEDLINE]

10: Cochrane Database Syst Rev. 2004;(3):CD004727.

Hyperbaric oxygen therapy for thermal burns.

Villanueva E, Bennett MH, Wasiak J, Lehm JP.

**BACKGROUND:** Hyperbaric oxygen therapy (HBOT) consists of intermittently administering 100% oxygen at pressures greater than 1 atmosphere in a pressure vessel. This technology has been used to treat a variety of disease states and has been described as helping patients who have sustained burns. **OBJECTIVES:** The aim of this review was to assess the evidence for the benefit of hyperbaric oxygen treatment (HBOT) for the treatment of thermal burns. **SEARCH STRATEGY:** We searched the Cochrane Controlled Trials Register (The Cochrane Library, Issue 3, 2002), MEDLINE (Ovid 1966 to November Week 2, 2003), CINAHL (Ovid 1982 to December Week 2 2003), EMBASE (Ovid 1980 to September 2003), DORCTHIM (Database of Randomised Controlled Trials in Hyperbaric Medicine) from inception to 2003, and reference lists of articles. **SELECTION CRITERIA:** We included all randomised controlled trials that compared the effect of HBOT with no HBOT (no treatment or sham). **DATA COLLECTION AND ANALYSIS:** Two authors using standardised forms extracted the data independently. Each trial was assessed for internal validity with differences resolved by discussion. Data was extracted and entered into RevMan 4.2.3. **MAIN RESULTS:** Four randomised controlled trials were identified, of which two satisfied the inclusion criteria. The trials were of poor

methodological quality. As a result, it was difficult to have confidence in the individual results and it would not have been appropriate to attempt to pool the data. One trial reported no difference in length of stay, mortality, or number of surgeries between the control and HBO-treated groups once these variables were adjusted for the patient's condition. The second trial reported mean healing times that were shorter in patients exposed to HBOT (mean: 19.7 days versus 43.8 days). **REVIEWERS' CONCLUSIONS:** This systematic review has not found sufficient evidence to support or refute the effectiveness of HBOT for the management of thermal burns. Evidence from the two randomised controlled trials is insufficient to provide clear guidelines for practice. Further research is needed to better define the role of HBOT in the treatment of thermal burns.

Publication Types: Review

PMID: 15266540 [PubMed - indexed for MEDLINE]

11: Ostomy Wound Manage. 2004 Apr;50(4):36-8, 40, 42 passim.

A retrospective evaluation of digital wound imaging to predict response to hyperbaric oxygen treatment.

Kalns J, Roy A, Loeffler C, Wright JK.

United States Air Force School of Aerospace Medicine, Davis Hyperbaric Laboratory, Brooks City-Base, TX 78235-5116, USA. john.kalns@brooks.af.mil

As new wound care treatments become available, correct initial treatment selection and dynamic modification of regimens, based on wound response to treatment, must be applied to improve outcomes and reduce cost. One alternative is wound morphometry using digital wound images to evaluate wound response to treatment in realtime. To determine whether wound area measurements taken during the first 3 weeks of hyperbaric oxygen treatment predict eventual treatment response and how demographic and disease factors impact hyperbaric oxygen treatment response, a retrospective study using digital wound images, demographic data, and available clinical laboratory values was conducted. Participants included 29 wound care patients with nonhealing wounds of the lower extremities receiving treatment at a hyperbaric wound care facility. Conventional wound care (ie, debridement, dressing changes, and topical agents) plus hyperbaric oxygen treatment (100% oxygen breathing at 2.4 atmospheres absolute for 90 minutes) given once every weekday for up to 20 weeks was provided. Graphical analysis of normalized wound area over time revealed two groups: minimal responders (n=13) and robust responders (n=16). Minimal response was characterized by delayed onset of wound area reduction and virtual cessation of reduction by week 3. Robust response was continuous, sustained, and resulted in average wound area reduction of 80% by end of treatment, compared to 47% in minimally responsive patients. Age, blood glucose, and serum creatinine significantly affected the wound healing response to hyperbaric oxygen

treatment ( $P < 0.05$ ). Digital images obtained during the first 3 weeks of treatment predicted if a patient is minimally responsive to hyperbaric oxygen treatment with 100% accuracy. Area measurements obtained in this manner can be used to identify patients minimally responsive to hyperbaric oxygen treatment, enabling rapid assessment of treatment response to make timely changes in therapy in order to optimize treatment outcomes.

PMID: 15259800 [PubMed - indexed for MEDLINE]

12: Acta Med Okayama. 2004 Apr;58(2):91-5.

The close relationship between decreases in extracellular GABA concentrations and increases in the incidence of hyperbaric oxygen-induced electrical discharge.

Zhang S, Takeda Y, Hagioka S, Goto K, Morita K. Department of Anesthesiology and Resuscitology, Okayama University Medical School, Okayama 700 8558, Japan.

To elucidate the mechanism by which hyperbaric oxygen (HBO<sub>2</sub>) induces electrical discharge, changes in the extracellular concentrations of GABA and glutamate were measured every 5 min using a microdialysis technique in rats during a period of exposure to HBO<sub>2</sub> (5 atm abs). Electrical discharge was observed at 28  $\pm$  4 min after the onset of exposure. Though the extracellular concentrations of glutamate remained unchanged, the extracellular GABA concentrations (pre-exposure level, 0.026  $\pm$  0.005 microM in dialysate) began to decrease 15 min after the onset of exposure and reached their lowest level (74  $\pm$  14%, 0.019  $\pm$  0.004 microM) at the time of appearance of the discharge. There was a close logistic relationship between extracellular GABA concentrations and the discharge incidence, and the extracellular concentrations of GABA causing electrical discharge in 50% of the animals were estimated to be 80% of the pre-exposure level. These results suggest a possible mechanism that HBO<sub>2</sub> exposure-induced discharge is caused by the decrease in extracellular concentration of GABA.

PMID: 15255510 [PubMed - indexed for MEDLINE]

13: Emerg Med Australas. 2004 Apr;16(2):151-4.

Comment in: Emerg Med Australas. 2004 Apr;16(2):101-2. Emerg Med Australas. 2004 Oct-Dec;16(5-6):394-9; discussion 481-2. Emerg Med Australas. 2004 Oct-Dec;16(5-6):480-1; discussion 481-2. Emerg Med Australas. 2004 Oct-Dec;16(5-6):481; discussion 481-2.

Where to now with carbon monoxide poisoning?

Scheinkestel CD, Jones K, Myles PS, Cooper DJ, Millar IL, Tuxen DV.

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The controversy regarding the role of hyperbaric oxygen (HBO) in the treatment of carbon monoxide (CO) poisoning has been re-ignited following the publication of a further randomized controlled trial by Weaver et al., the results of which appear to

conflict with our findings. Comparative analysis suggests that the apparent outcome differences may be secondary to the design, analysis and interpretation of the results of the two studies. Following careful analysis of these two papers and further results from a study by Raphael et al on 385 CO-poisoned patients, we can still find no convincing evidence favouring HBO therapy. Pending further research to determine optimal oxygen therapy for CO-poisoning, current therapy should involve stratifying patients for risk of a poor outcome. This stratification may be aided by the evolving availability of biochemical markers of brain injury and the finding that patients with transient loss of consciousness and poor performance on neuropsychological tests of the supervisory attention system are at higher risk of neuropsychological sequelae. We propose that those patients most at risk be admitted and receive more prolonged normobaric oxygen therapy whilst those with more minor CO-poisoning should be provided with normobaric oxygen of no less than 6 h duration and certainly until sign and symptom free.

Publication Types: Review

PMID: 15239731 [PubMed - indexed for MEDLINE]

14: Emerg Med Australas. 2004 Apr;16(2):101-2.

Comment in: Emerg Med Australas. 2004 Oct-Dec;16(5-6):394-9; discussion 481-2.

Comment on: Emerg Med Australas. 2004 Apr;16(2):151-4.

The dilemma of managing carbon monoxide poisoning.

Emerson G.

Department of Emergency Medicine, Royal Brisbane Hospital and Wesley Centre for Hyperbaric Medicine, Brisbane.

Publication Types: Comment

PMID: 15239722 [PubMed - indexed for MEDLINE]

15: Ann Fr Anesth Reanim. 2004 Jun;23(6):597-600.

[Spontaneous anaerobic osteomyelitis with necrotizing fasciitis of femur: two reasons for the use of hyperbaric oxygenotherapy]

[Article in French]

Bilbault P, Ba-Faye A, Assemi P, Jaeger A, Schneider F.

Service de reanimation medicale et centre regional d' oxygenotherapie hyperbare, hopital de Hautepierre, 67098 Strasbourg, France. pascal.bilbault@chru-strasbourg.fr

This is a case report of a 50-year-old male patient who had septic shock with anaerobic bacterial septicaemia coming from a spontaneous left femoral osteomyelitis. The combined treatment with antibiotics, surgery and hyperbaric oxygenotherapy restored normal mobility of the lower limb. Two years later, there was no recurrence. Despite many efforts the aetiology of the disease is unknown. The authors, discuss the relevance of hyperbaric oxygenotherapy in such cases.

Publication Types: Case Reports

PMID: 15234725 [PubMed - indexed for MEDLINE]

16: Undersea Hyperb Med. 2004 Spring;31(1):183.  
Acupuncture-HBO2 combined therapy in a persistent left hemiface hyperalgesia: a case report.  
Zanon V, Garetto G, Bosco G.  
Hyperbaric Med Unit, Anaesthetics Dept., University of Padova, Padova, Italy.  
Publication Types: Case Reports  
PMID: 15233175 [PubMed - indexed for MEDLINE]

17: Undersea Hyperb Med. 2004 Spring;31(1):179-81.  
Hyperbaric oxygen as adjunctive therapy in *Vibrio vulnificus* septicemia and cellulitis.  
Wang J, Corson K, Mader J.  
Department of Internal Medicine, University of Texas Medical Branch, Galveston, TX 77555-1188, USA.  
Publication Types: Case Reports  
PMID: 15233174 [PubMed - indexed for MEDLINE]

18: Undersea Hyperb Med. 2004 Spring;31(1):167-77.  
Carbon monoxide poisoning.  
Piantadosi CA.  
Department of Pulmonary Medicine, Duke University Medical Center, Durham, NC 27710, USA.  
PMID: 15233173 [PubMed - indexed for MEDLINE]

19: Undersea Hyperb Med. 2004 Spring;31(1):163-6.  
Brain "implications for HBO2".  
Mitani M.  
Department of Neurosurgery, Yagi Hospital, Fukuoka, Japan.  
PMID: 15233172 [PubMed - indexed for MEDLINE]

20: Undersea Hyperb Med. 2004 Spring;31(1):155-62.  
Hyperbaric oxygen therapy in orthopedic conditions.  
Kawashima M, Tamura H, Nagayoshi I, Takao K, Yoshida K, Yamaguchi T.  
Kawashima Orthopaedic Hospital, Nakatsu, Oita-Ken, Japan 871-0012.  
As is well known, the origins and development of hyperbaric medicine are closely tied to the history of diving medicine. Our HBO2 studies stemming from diving medicine date back to 1972. We concentrated our early basic research on dysbaric osteonecrosis. There are now good indications that HBO2 is helpful in a variety of orthopedic conditions. However, hyperbaric medicine in orthopedics is still relatively new and some aspects of it remain controversial.  
PMID: 15233171 [PubMed - indexed for MEDLINE]

21: Undersea Hyperb Med. 2004 Spring;31(1):133-45.  
Hyperbaric oxygen for delayed radiation injuries.  
Feldmeier JJ.  
Toledo Radiation Oncology and the Medical College of Ohio, Toledo, Ohio, USA.

Hyperbaric oxygen has shown consistent benefit in treating patients with delayed radiation injury. It has also had success in preventing radiation injury in some instances. Additional study in identifying patients at risk for injury and delivering hyperbaric oxygen with prophylactic intent to prevent these injuries appears to be promising. Additional approaches to applying hyperbaric oxygen as a radiosensitizer also deserve further study. No convincing evidence exists to support concerns that hyperbaric oxygen enhances or stimulates malignant growth.

Publication Types: Review Review, Tutorial  
PMID: 15233169 [PubMed - indexed for MEDLINE]

22: Undersea Hyperb Med. 2004 Spring;31(1):123-31.  
Effects of hyperoxia on neutrophil adhesion.  
Thom SR.  
Institute for Environmental Medicine and Department of Emergency Medicine, University of Pennsylvania Medical Center, Philadelphia, PA 19104-6068, USA.  
PMID: 15233168 [PubMed - indexed for MEDLINE]

23: Undersea Hyperb Med. 2004 Spring;31(1):73-9.  
Hyperbaric oxygen therapy: oxygen and bubbles.  
Brubakk AO.  
Department of Circulation and Medical Imaging, NTNU, N-7006 Trondheim, Norway.  
Publication Types: Review Review, Tutorial  
PMID: 15233162 [PubMed - indexed for MEDLINE]

24: Undersea Hyperb Med. 2004 Spring;31(1):63-72.  
CNS oxygen toxicity.  
Bitterman N.  
Technion, Israel Institute of Technology, Haifa 32000, Israel.  
Publication Types: Review  
PMID: 15233161 [PubMed - indexed for MEDLINE]

25: Clin Orthop Relat Res. 2004 Jun;(423):268-74.  
Effect of hyperbaric oxygen on the ligament healing process in rats.  
Mashitori H, Sakai H, Koibuchi N, Ohtake H, Tashiro T, Tamai K, Saotome K.  
Department of Orthopaedic Surgery, Dokkyo University School of Medicine, Tochigi, Japan.  
Animal experiments were done to investigate whether administration of hyperbaric oxygen promotes scar tissue formation, increases expression of the Type I procollagen gene, and improves the tensile properties of healing ligament. In 76 Sprague-Dawley rats, a 2-mm segment of the medial collateral ligament was removed. Thirty-eight rats were exposed to hyperbaric oxygen at 2.5 atmospheres absolute for 2 hours 5 days per week (Group H), whereas the remaining rats were exposed to room air (Group C). The animals were sacrificed at 3, 7, 14, and 28 days postoperatively. In situ hybridization histochemistry was done to examine the Type I procollagen gene expression in healing ligaments in 40 rats, whereas a tensile failure test was done in the remaining rats.

The amount of scar tissue was greater in Group H than in Group C. Type I procollagen gene expression at 7 or 14 days was significantly greater in Group H than in Group C. The ultimate load and stiffness in Group H were significantly greater than in Group C at 14 days. Administration of hyperbaric oxygen promotes scar tissue formation and increases Type I procollagen gene expression in healing ligaments. These effects are associated with the improvement of their tensile properties.

PMID: 15232461 [PubMed - indexed for MEDLINE]

26: Aviat Space Environ Med. 2004 Jun;75(6):496-9. Altitude decompression sickness symptom resolution during descent to ground level.

Muehlberger PM, Pilmanis AA, Webb JT, Olson JE. Wright State University/Wright Patterson Air Force Base Emergency Medicine Residency Program, Dayton, OH, USA. Patrick.muehlberger@yokota.af.mil

**INTRODUCTION:** Altitude decompression sickness (DCS) is a health risk associated with the conduct of high altitude airdrop operations, high altitude reconnaissance, future fighter operations, hypobaric chamber training, unpressurized flight, and extravehicular activity (EVA) in space. The treatment for DCS includes the provision of 100% oxygen (O<sub>2</sub>) at ground level (GLO) and/or hyperbaric oxygen therapy (HBO). In this paper we examine the effect of repressurization to ground level from hypobaric conditions on DCS symptoms. Timely recompression (descent at first recognition of any DCS symptom) may be a safe, effective treatment for the large majority of DCS symptoms. **METHODS:** Data from altitude chamber exposures recorded in the Air Force Research Laboratory (AFRL) Altitude DCS Database were reviewed to determine the level of recompression required for complete resolution of 1,699 observed symptoms. **RESULTS:** Of the 1,699 DCS symptoms reviewed, 66 (3.9%) resolved at altitude, 117 (6.9%) resolved at ground level, and 1,433 (84.3%) resolved during descent. Increasing the pressure by 138 mmHg from the altitude of exposure where symptoms occurred resolved roughly 50% of symptoms. Little resolution of symptoms was noted with recompressions of < 50 mmHg. The greatest rate of symptom resolution occurred with recompressions of 50-250 mmHg. **CONCLUSION:** These findings support the concept that descent and postflight, ground-level oxygen may be sufficient to relieve the majority of altitude DCS symptoms. HBO may be reserved for serious, recurring, delayed, or refractory symptoms. The findings also suggest a need for further study of DCS symptom resolution.

PMID: 15198274 [PubMed - indexed for MEDLINE]

27: Am J Cardiol. 2004 Jun 15;93(12):1533-5.

Usefulness of hyperbaric oxygen therapy to inhibit restenosis after percutaneous coronary intervention for acute myocardial infarction or unstable angina pectoris.

Sharifi M, Fares W, Abdel-Karim I, Koch JM, Sopko J, Adler D; Hyperbaric Oxygen Therapy in Percutaneous Coronary Interventions Investigators.

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The purpose of this trial was to assess whether the addition of hyperbaric oxygen to percutaneous coronary intervention can reduce clinical restenosis. Major adverse cardiac events at 8 months were found in only 1 of 24 patients (4%) who received hyperbaric oxygen compared with 13 of 37 patients (35%) who did not.

Publication Types: Clinical Trial Randomized Controlled Trial

PMID: 15194029 [PubMed - indexed for MEDLINE]

28: Biomed Khim. 2004 Mar-Apr;50(2):164-71.

[Effect of hyperbaric oxygenation on glutamine metabolism in damaged and intact lobes of the operated liver]

[Article in Russian]

Savilov PN.

Burdenko Voronezh State Medical Academy, Voronezh, 395066 Russia. p\_savilov@rambler.ru

Employment of hyperbaric oxygenation (HBO, 3 bar, 50 min, 1 session per day) during the first three days after resection of liver (15-20% of mass) normalized glutamine metabolism impairments caused by operational trauma.

PMID: 15179823 [PubMed - indexed for MEDLINE]

29: J Vasc Nurs. 2004 Jun;22(2):42-8.

Hyperbaric oxygenation and wound healing.

Broussard CL.

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The purpose of this article is to review literature related to hyperbaric oxygenation and wound healing. The article discusses the role of oxygen in wound healing, as well as the effects of hyperbaric oxygenation to promote wound healing, and focuses on the use of hyperbaric oxygenation to treat foot wounds in patients with diabetes. A review of salient literature to support the use of hyperbaric oxygenation as a viable adjunct to healing foot wounds in patients with diabetes is provided. In addition, this article discusses appropriate patient selection for treatment with hyperbaric oxygenation. A discussion of the hyperbaric treatment, including preparation of the patient, contraindications, adverse effects, and treatment protocols, is provided. This article was designed to provide WOC nurses with information to provide appropriate referrals to technology that promises to increase the healing potential of foot wounds in patients with diabetes and subsequently reduce amputations in this population.

Publication Types: Review Review, Tutorial

PMID: 15179416 [PubMed - indexed for MEDLINE]

30: J Int Med Res. 2004 May-Jun;32(3):263-7.

A new treatment modality for fibromyalgia syndrome: hyperbaric oxygen therapy.

Yildiz S, Kiralp MZ, Akin A, Keskin I, Ay H, Dursun H, Cimsit M.

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Fibromyalgia syndrome (FMS) is characterized by longstanding multifocal pain with generalized allodynia/hyperalgesia. There are several treatment methods but none has been specifically approved for this application. We conducted a randomized controlled study to evaluate the effect of hyperbaric oxygen (HBO) therapy in FMS (HBO group: n = 26; control group: n = 24). Tender points and pain threshold were assessed before, and after the first and fifteenth sessions of therapy. Pain was also scored on a visual analogue scale (VAS). There was a significant reduction in tender points and VAS scores and a significant increase in pain threshold of the HBO group after the first and fifteenth therapy sessions. There was also a significant difference between the HBO and control groups for all parameters except the VAS scores after the first session. We conclude that HBO therapy has an important role in managing FMS.

Publication Types: Clinical Trial Randomized Controlled Trial

PMID: 15174219 [PubMed - indexed for MEDLINE]

31: J Int Med Res. 2004 May-Jun;32(3):258-62.

Effectiveness of hyperbaric oxygen therapy in the treatment of complex regional pain syndrome.

Kiralp MZ, Yildiz S, Vural D, Keskin I, Ay H, Dursun H.

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In this double-blind, randomized, placebo-controlled study we aimed to assess the effectiveness of hyperbaric oxygen (HBO) therapy for treating patients with complex regional pain syndrome (CRPS). Of the 71 patients, 37 were allocated to the HBO group and 34 to the control (normal air) group. Both groups received 15 therapy sessions in a hyperbaric chamber. Pain, oedema and range of motion (ROM) of the wrist were evaluated before treatment, after the 15th treatment session and on day 45. In the HBO group there was a significant decrease in pain and oedema and a significant increase in the ROM of the wrist. When we compared the two groups, the HBO group had significantly better results with the exception of wrist extension. In conclusion, HBO is an effective and well-tolerated method for decreasing pain and oedema and increasing the ROM in patients with CRPS.

Publication Types: Clinical Trial Randomized Controlled Trial

PMID: 15174218 [PubMed - indexed for MEDLINE]

32: Microsurgery. 2004;24(3):255-61.

Effect of hyperbaric oxygen therapy on nerve regeneration in early diabetes.

Aydin A, Ozden BC, Karamursel S, Solakoglu S, Aktas S, Erer M.

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Nerve regeneration in diabetes is essential for reversal of neuropathy as well as the recovery of nerves from injury due to acute nerve compression and entrapment. Endoneural hypoxia due to hyperglycemia-induced blood flow reductions is observed early in the course of diabetes, and the resultant ischemia plays a role in the diminished neural regeneration. Hyperbaric oxygen therapy is capable of producing tissue hyperoxia by raising oxygen tensions in ischemic tissues, and was shown to be beneficial in the reversal of experimental ischemic neuropathy. In this study, an experimental diabetes model was used to evaluate the functional and histomorphological effects of hyperbaric oxygen therapy on early diabetic nerve regeneration. Our results indicate that there is significant histomorphological impairment of nerve regeneration, even in very early stages of diabetes. However, no beneficial effects of hyperbaric oxygen therapy could be demonstrated at this stage. Copyright 2004 Wiley-Liss, Inc.

PMID: 15160386 [PubMed - indexed for MEDLINE]

33: AJR Am J Roentgenol. 2004 Jun;182(6):1606-7.

Hyperbaric oxygen therapy for air embolism complicating CT-guided needle biopsy of the lung.

Ashizawa K, Watanabe H, Morooka H, Hayashi K. Nagasaki University, Nagasaki 852-8501, Japan.

Publication Types: Case Reports

PMID: 15150026 [PubMed - indexed for MEDLINE]

34: Br J Ophthalmol. 2004 Jun;88(6):771-5.

Diameter variations of retinal blood vessels during and after treatment with hyperbaric oxygen.

Vucetic M, Jensen PK, Jansen EC.

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AIMS: To quantify retinal vascular change during and after hyperbaric oxygenation (HO) for 6x5 weekly 90 minute treatments. METHODS: Fundus photographs were taken before, during, and after HO at 2.5 atmospheres absolute pressure (ATA) on days 1, 2, 3, 10, 20, 29, and 30 of treatment on three patients using a specially developed hand held ophthalmoscope with a digital colour camera. Blood vessel diameter was estimated on red free retinal images. The mean of three measurements of arterioles and venules close to the optic disc was calculated. Consistency and repeatability of the method was verified by estimating the diameter of the vessels by three measurements in each of seven images taken within 70 seconds on the same person. Analysis of variance with Bonferroni correction for multiple comparisons was conducted to ascertain whether significant intergroup differences existed. RESULTS: Breathing 100% oxygen at 2.5 ATA

constricts retinal arterioles by 9.6% (standard deviation 0.3%) and venules by 20.6% (SD 0.3%) of their size in air at ambient pressure. Constriction escalates during treatment. Ten minutes after the HO, arterioles dilate to 94.5% (SD 0.3%) and venules to 89.0% (SD 0.3%) of their primary size. This pattern is the same for each day of measurement. Heart frequency falls continually during HO. Systolic, diastolic, and mean arterial pressures stay constant. CONCLUSION: Exposure to hyperbaric oxygen causes constriction of the retinal vessels. It is found that this constriction is constant through the series of treatments. This suggests that oxygen or products thereof are responsible for the vascular changes during and after hyperbaric oxygenation probably through autoregulation of the retinal vessels. PMID: 15148210 [PubMed - indexed for MEDLINE]

35: Life Sci. 2004 Jun 11;75(4):461-7.

Exogenously administered and endogenously produced melatonin reduce hyperbaric oxygen-induced oxidative stress in rat lung.

Topal T, Oter S, Korkmaz A, Sadir S, Metinyurt G, Korkmazhan ET, Serdar MA, Bilgic H, Reiter RJ.

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Hyperbaric oxygen (HBO) is a widely used treatment modality in many diseases. A known side effect of HBO is the production of reactive oxygen species. Many antioxidants such as vitamins C and E, riboflavin and selenium have been used successfully to scavenge the reactive oxygen species caused by HBO administration. In this study, we aimed to see if melatonin, a newly discovered antioxidant, has a protective effect against the overproduction of reactive oxygen species produced by HBO in rat lung tissue. Sixty male Sprague-Dawley rats were divided into 5 groups as follows: control, daytime HBO (3 ATA, 120 min), daytime HBO plus melatonin (10 mg/kg), nighttime HBO and nighttime HBO (under light exposure). The MDA, SOD and CAT levels of daytime and nighttime HBO (under light exposure) increased significantly. This significance was not found in the daytime HBO plus melatonin and nighttime HBO groups when compared with the control. In this study, HBO caused oxidant stress, and melatonin decreased the levels of MDA, SOD and CAT. Moreover, endogenous melatonin was found to be a more effective antioxidant than exogenous 10 mg/kg melatonin.

PMID: 15147832 [PubMed - indexed for MEDLINE]

36: Rev Invest Clin. 2004 Jan-Feb;56(1):51-5.

[Treatment of mucormycosis with adjunctive hyperbaric oxygen: five cases treated at the same institution and review of the literature]

[Article in Spanish]

Garcia-Covarrubias L, Barratt DM, Bartlett R, Van Meter K.

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INTRODUCTION: Mucormycosis is an invasive fungal infection that affects decompensated diabetics, immunosuppressed patients and occasionally healthy individuals. Despite advances in anti-fungal therapy and surgical techniques, the morbidity and mortality remain high. Adjuvant hyperbaric oxygen therapy (HBO) has been proposed based on pathophysiology and several favorable clinical reports. MATERIAL AND METHODS: A chart review of mucormycosis patients referred to the HBO service was performed. Also an electronic search in Medline of relevant literature was undertaken. RESULTS: Five mucormycosis patients referred for HBO had complete charts available. Four had craniofacial involvement and one had left upper extremity involvement. The predisposing diseases were leukemia (n = 3), diabetes mellitus plus sarcoidosis (n = 1), and trauma (n = 1). All patients were managed with amphotericin B, surgical debridement and HBO. Survival was 60% (3/5) three months after the diagnosis was established. The literature was scarce but favors HBO. CONCLUSION: Considering the pathophysiology of mucormycosis adjuvant HBO therapy seems reasonable. However, the clinical experience is still too limited to make HBO part of the standard of care. Prospective, randomized, controlled trials will help to define the role of HBO in this devastating infection.

Publication Types: Review

PMID: 15144043 [PubMed - indexed for MEDLINE]

37: Sheng Li Xue Bao. 2004 Apr 25;56(2):158-62.

[Effect of acetazolamide on the latency of hyperbaric oxygen-induced convulsion]

[Article in Chinese]

Huang JL, Ma YW, Lian QL, Xu JP, Jiang CL, Guo MZ, Sun XJ.

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The purpose of the present study was to explore the relation between the modulation of cerebral blood flow and the latency of hyperbaric oxygen-induced convulsion. There were two parts in this study. First, the effect of acetazolamide on the latency of hyperbaric oxygen-induced convulsion was observed. 32 Sprague-Dawley (SD) rats were randomly divided into four groups: the acetazolamide 200, 20, 2 mg/kg body weight and normal saline (NS) group. The animals were given intraperitoneally acetazolamide or NS, respectively, before being exposed to the pressure of 6 ATA (absolute atmosphere) of pure oxygen. The time from exposure to the onset of seizure (clonic-tonic convulsion) was recorded for each animal according to behavioral observation. Second, the changes in maleic dialdehyde (MDA) and the activity of glutathione peroxidase (GSH-PX) were measured after acetazolamide treatment. 40 SD rats were randomly divided into five groups: NS

group, 6 min with NS group, 6 min with acetazolamide group, 16 min with NS group, and 16 min with acetazolamide group. The dose of acetazolamide was 20 mg/kg body weight. After injection of NS or acetazolamide, the animals were subjected to the pressure of 6 ATA of pure oxygen in respect to its time course group. The rats were decapitated and the cortex, hippocampus, and striatum of brains were dissected and homogenized. The content of MDA and the activity of GSH-PX in these tissues were determined. We found that (1) there was a significant difference in the latency of hyperbaric oxygen-induced convulsion between the acetazolamide 200 mg/kg group and the NS control group, as well as between the acetazolamide 20 mg/kg group and the NS control group ( $P < 0.01$ ), whereas there was no significant difference between the NS group and the acetazolamide 2 mg/kg weight group ( $P > 0.05$ ). The latency of these groups were listed as follows: 9.78 $\pm$ 1.94 min for 200 mg/kg body weight group, 10.92 $\pm$ 1.68 min for 20 mg/kg body weight group, 24.32 $\pm$ 4.33 min for 2 mg/kg body weight group and 22.02 $\pm$ 4.32 min for NS control group. (2) there was no significant difference between all groups in the activity of GSH-PX, though it varied with the oxidation levels. In the cortex and hippocampus, the activity of GSH-PX boosted up at first, but with the progress of the oxidation it was impaired. In the striatum, the activity of GSH-PX increased stepwise with the aggravation of the oxidation. The MDA content in the cortex increased significantly in the group of 6 min with acetazolamide ( $P < 0.01$ ), as well as the group of 16 min with acetazolamide group both in cortex and hippocampus ( $P < 0.01$ ,  $P < 0.05$ ). The MDA content of all groups is correlated with the dose of acetazolamide and the exposure time. These results suggest that acetazolamide which dilates the brain arteriolar obviously shortens the latency of hyperbaric oxygen-induced convulsion, and that acetazolamide dilates the vessels and increases the supply of the oxygen breaking into the brain tissues and aggravates the oxidation. The hyperbaric oxygen-induced convulsion correlates closely with the oxidation injury.

PMID: 15127124 [PubMed - indexed for MEDLINE]

38: J Perinatol. 2004 May;24(5):333-4; discussion 334.

Comment on: J Perinatol. 2003 Apr-May;23(3):250-3.

Commentary regarding attempt to obtain hyperbaric oxygen treatment and the decision to sue is poorly researched and inaccurate.

Weiss JN.

Publication Types: Comment

PMID: 15116135 [PubMed - indexed for MEDLINE]

39: Acta Ophthalmol Scand. 2004 Jun;82(3 Pt 1):313-4.

Hypermetropic refractive change after hyperbaric oxygen therapy.

Fledelius HC, Jansen E.

Publication Types: Case Reports Letter

PMID: 15115456 [PubMed - indexed for MEDLINE]

40: Cochrane Database Syst Rev. 2004;(2):CD004123.

Hyperbaric oxygen therapy for chronic wounds.

Kranke P, Bennett M, Roeckl-Wiedmann I, Debus S. Department of Anaesthesiology, University of Wuerzburg, Josef-Schneider-Str. 2, Wuerzburg, Germany, 97080.

**BACKGROUND:** Chronic wounds are common and present a health problem with significant effect on quality of life. The wide range of therapeutic strategies for such wounds reflects the various pathologies that may cause tissue breakdown, including poor blood supply resulting in inadequate oxygenation of the wound bed. Hyperbaric oxygen therapy (HBOT) has been suggested to improve oxygen supply to wounds and therefore improve their healing. **OBJECTIVES:** To assess the benefits and harms of adjunctive HBOT for treating chronic ulcers of the lower limb (diabetic foot ulcers, venous and arterial ulcers and pressure ulcers). **SEARCH STRATEGY:** We searched the Cochrane Wounds Group Specialised Trial Register (searched 6 February 2003), CENTRAL (The Cochrane Library Issue 1, 2003), Medline (1966 - 2003), EMBASE (1974 - 2003), DORCTHIM (1996 - 2003), and reference lists of articles. Relevant journals were handsearched and researchers in the field were contacted. **SELECTION CRITERIA:** Randomised studies comparing the effect on chronic wound healing of therapeutic regimens which include HBOT with those that exclude HBOT (with or without sham therapy). **DATA COLLECTION AND ANALYSIS:** Three reviewers independently evaluated the quality of the relevant trials using the validated Oxford-Scale (Jadad 1996) and extracted the data from the included trials. **MAIN RESULTS:** Five trials contributed to this review. Diabetic foot ulcer (4 trials, 147 patients): Pooled data of three trials with 118 patients showed a reduction in the risk of major amputation when adjunctive HBOT was used, compared to the alternative therapy (RR 0.31, 95% CI 0.13 to 0.71). Sensitivity analysis for the allocation of dropouts did not significantly alter that result. This analysis predicts that we would need to treat 4 individuals with HBOT in order to prevent 1 amputation in the short term (NNT 4, 95% CI 3 to 11). There was no statistically significant difference in minor amputation rate (pooled data of two trials with 48 patients). Healing rates were reported in one trial (Abidia 2003) which showed a significant improvement in the chance of healing 1 year after therapy (RR for failure to heal with sham 2.3, 95%CI 1.1 to 4.7,  $P = 0.03$ ), although no effect was determined immediately post HBOT, nor at 6 months. Further, the beneficial effect after 1 year was sensitive to allocation of dropouts. Venous ulcer: (1 trial, 16 patients): This trial reported data at six weeks (wound size reduction) and 18 weeks (wound size

reduction and healing rate) and suggested a significant benefit of HBOT in terms of reduction in ulcer area only at 6 weeks (WMD 33%, 95%CI 19% to 47%,  $P < 0.00001$ ). Arterial and pressure ulcers: No trials that satisfied inclusion criteria were located. REVIEWERS' CONCLUSIONS: In people with foot ulcers due to diabetes, HBOT significantly reduced the risk of major amputation and may improve the chance of healing at 1 year. The application of HBOT to these patients may be justified where HBOT facilities are available, however economic evaluations should be undertaken. In view of the modest number of patients, methodological shortcomings and poor reporting, this result should be interpreted cautiously however, and an appropriately powered trial of high methodological rigour is justified to verify this finding and further define those patients who can be expected to derive most benefit from HBOT. Regarding the effect of HBOT on chronic wounds associated with other pathologies, any benefit from HBOT will need to be examined in further, rigorous randomised trials. The routine management of such wounds with HBOT is not justified by the evidence in this review.

Publication Types: Review

PMID: 15106239 [PubMed - indexed for MEDLINE]

41: Eur J Gastroenterol Hepatol. 2004 May;16(5):475-8.

The effect of hyperbaric oxygen therapy on the adverse effects of octreotide on wound healing.

Yildiz S, Uluutku H, Gunay A, Yildirim I, Yildirim S, Gurbuz AK.

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OBJECTIVE: Octreotide, a long-acting somatostatin analogue, has been used in the treatment of various disorders. Octreotide has significant detrimental impacts upon wound healing. We tested the hypothesis that hyperbaric oxygen therapy may overcome octreotide-mediated suppression of wound healing. DESIGN: Prospective, randomised, parallel-group animal study. METHODS: Operated rats were divided into four groups: (1) controls, (2) octreotide therapy, (3) hyperbaric oxygen therapy and (4) combination of octreotide and hyperbaric oxygen therapy. Wound healing was assessed by breaking-strength measurements, hydroxyproline levels and fibrosis scores. RESULTS: Octreotide decreased the breaking-strength measurements, hydroxyproline levels and fibrosis scores to 72%, 88% and 55%, respectively, of the control group. In the combination group, hyperbaric oxygen therapy increased breaking-strength measurements and hydroxyproline levels to 137% and 126%, respectively, of the control group. In the combination group, hyperbaric oxygen therapy tended to increase the fibrosis scores to 111% of the control group, but without statistical significance. CONCLUSION: Hyperbaric oxygen

therapy tends to reverse the octreotide-induced impairment of wound healing.

PMID: 15097040 [PubMed - indexed for MEDLINE]

42: Chang Gung Med J. 2004 Feb;27(2):91-7.

Results of chronic osteomyelitis of the femur treated with hyperbaric oxygen: a preliminary report.

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BACKGROUND: Although only a few studies have shown the effectiveness, hyperbaric oxygen (HBO) therapy has been used as an adjunct in the management of chronic osteomyelitis in many hospitals in Taiwan. This retrospective study investigated the clinical results of HBO therapy for chronic refractory osteomyelitis of the femur. METHODS: From December 1999 through May 2002, 13 patients with chronic refractory osteomyelitis of the femur were treated with adjunctive HBO. The most common infecting microorganism was *Staphylococcus aureus*. All cases were classified as type III or IV osteomyelitis according to the Cierny-Mader classification. Adequate surgical debridement and parenteral antibiotic treatment were performed. The average number of operations before HBO therapy was 4.6 times. HBO therapy at 2.5 atmospheres absolute for 120 minutes was administered for 5 days per week in all patients for an average of 50 days. The average number of HBO treatments was 32.2 times. The average follow-up period was 22 months, ranging from 12 to 42 months. RESULTS: Complete eradication of infection with no recurrence of infection was noted in 12 of the 13 patients. One patient failed to respond to the treatment. The success rate of the treatment regimen was 92%. There were no HBO therapy related complications. CONCLUSION: Hyperbaric oxygen therapy is an effective and safe adjunctive therapy for the management of chronic refractory osteomyelitis of the femur provided that patients had received adequate surgical debridement and appropriate antibiotic treatment.

PMID: 15095953 [PubMed - indexed for MEDLINE]

43: J Infect. 2004 May;48(4):330-3.

The effect of hyperbaric oxygen therapy on the bout of treatment for soft tissue infections.

Sugihara A, Watanabe H, Oohashi M, Kato N, Murakami H, Tsukazaki S, Fujikawa K.

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OBJECTIVES: Hyperbaric oxygen (HBO) therapy is often combined with antibiotic therapy for infections such as gas gangrene and osteomyelitis. Although numerous investigations have been undertaken to assess the effect of adjunctive HBO therapy on the treatment of infections, the bout of treatment has not

been referred in the previous investigations. The purpose of this retrospective study was to evaluate the efficacy of HBO therapy on the bout of treatment for soft tissue infections. **PATIENTS AND METHODS:** In the period between 1994 and 2001, we treated 23 patients with soft tissue infections. Nine patients were treated with antibiotic chemotherapy alone, and 14 patients were treated with a combination of antibiotic chemotherapy and HBO therapy. The mean bout of treatment was compared between these two groups. **RESULTS:** The mean bout treated with a combination of antibiotic and HBO was significantly shorter than that with antibiotic alone. **CONCLUSION:** Our result indicates that HBO therapy combined with antibiotic therapy is able to shorten the bout of treatment for soft tissue infections. Therefore, we recommend HBO therapy combined with antibiotic therapy for soft tissue infections.

PMID: 15066334 [PubMed - indexed for MEDLINE]

44: *Radiother Oncol.* 2004 Mar;70(3):217-24.

Non-randomised phase II trial of hyperbaric oxygen therapy in patients with chronic arm lymphoedema and tissue fibrosis after radiotherapy for early breast cancer.

Gothard L, Stanton A, MacLaren J, Lawrence D, Hall E, Mortimer P, Parkin E, Pritchard J, Risdall J, Sawyer R, Woods M, Yarnold J.

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**BACKGROUND:** Radiation-induced arm lymphoedema is a common and distressing complication of curative treatment for early breast cancer. Hyperbaric oxygen (HBO(2)) therapy promotes healing in bone rendered ischaemic by radiotherapy, and may help some soft-tissue injuries too, but is untested in arm lymphoedema. **METHODS:** Twenty-one eligible research volunteers with a minimum 30% increase in arm volume in the years after axillary/supraclavicular radiotherapy (axillary surgery in 18/21 cases) were treated with HBO(2). The volunteers breathed 100% oxygen at 2.4 ATA for 100 min in a multiplace hyperbaric chamber on 30 occasions over a period of 6 weeks. The volume of the ipsilateral limb, measured optoelectronically by a perometer and expressed as a percentage of contralateral limb volume, was selected as the primary endpoint. A secondary endpoint was local lymph drainage expressed as fractional removal rate of radioisotopic tracer, measured using lymphoscintigraphy. **RESULTS:** Three out of 19 evaluable patients experienced >20% reduction in arm volume at 12 months. Six out of 13 evaluable patients experienced a >25% improvement in (99)Tc-nanocolloid clearance rate from the ipsilateral forearm measured by quantitative lymphoscintigraphy at 12 months. Overall, there was a statistically significant, but clinically modest, reduction in ipsilateral arm volume at 12 months follow-up compared with baseline ( $P = 0.005$ ). The mean percentage reduction in arm volume from

baseline at 12 months was 7.51. Moderate or marked lessening of induration in the irradiated breast, pectoral fold and/or supraclavicular fossa was recorded clinically in 8/15 evaluable patients. Twelve out of 19 evaluable patients volunteered that their arms felt softer, and six reported improvements in shoulder mobility at 12 months. No significant improvements were noted in patient self-assessments of quality of life. **CONCLUSION:** Interpretation is limited by the absence of a control group. However, measurement of limb volume by perometry is reportedly reliable, and lymphoscintigraphy is assumed to be operator-independent. Taking all data into account, there is sufficient evidence to justify a double-blind randomised controlled trial of hyperbaric oxygen in this group of patients.

Publication Types: Clinical Trial Clinical Trial, Phase II

PMID: 15064005 [PubMed - indexed for MEDLINE]

45: *Stroke.* 2004 May;35(5):1175-9. Epub 2004 Apr 1.

Neuroprotection by hyperbaric oxygenation after experimental focal cerebral ischemia monitored by MRI.

Schabitz WR, Schade H, Heiland S, Kollmar R, Bardutzky J, Henninger N, Muller H, Carl U, Toyokuni S, Sommer C, Schwab S.

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**BACKGROUND:** Hyperbaric oxygenation (HBO) after focal cerebral ischemia reduces infarct size and improves outcome when applied early after stroke. Here, we evaluated effects of HBO on permanent focal cerebral ischemia and applied magnetic resonance imaging (MRI) monitoring to study lesion evolution. **METHODS:** Rats underwent permanent middle cerebral artery occlusion (MCAO). Two hours later, animals were treated with HBO (100% O<sub>2</sub>/2 atm; n=17) for 1 hour or treated with room air (n=17). Animals underwent serial MRI studies (DWI, PI, T<sub>2</sub>) beginning 90 minutes after MCAO. Neuroscore was assessed (5-point rating scale). Animals were euthanized and brains were 2,3,5-triphenyltetrazolium chloride (TTC)-stained for infarct volume calculation 120 hours after MCAO. Immunohistochemistry was performed with antibodies against c-FOS and 4-hydroxy-2-nonenal-modified proteins (HNE) to check for effects of oxidative stress caused by HBO treatment. **RESULTS:** HBO reduced infarct volume by 38% ( $P < 0.001$ ). As shown by MRI, neuroprotection began 5 hours after ischemia and remained effective for 5 days. The relative regional cerebral blood flow was not different between groups at 3.5 and 5 hours after occlusion. There was less neurological deficit in HBO-treated animals compared with controls ( $P < 0.05$ ). Lipid peroxidation of cerebral vessels after HBO treatment as measured by HNE staining and pattern of c-FOS induction were not significantly different between groups at 3.5 and 8 hours after ischemia. **CONCLUSIONS:** As monitored by MRI

HBO treatment reversed ischemic lesion size between 3 and 5 hours after ischemia and achieved a long-lasting neuroprotective effect without significant oxidative damage.  
PMID: 15060313 [PubMed - indexed for MEDLINE]

46: *Exp Eye Res.* 2004 May;78(5):925-31.  
Effect of hyperbaric oxygen on guinea pig lens optical quality and on the refractive state of the eye.  
Bantsev V, Oriowo OM, Giblin FJ, Leverenz VR, Trevithick JR, Sivak JG.  
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The main objective of this study was to investigate the effect of in vivo hyperbaric oxygen (HBO) treatment of albino guinea pigs on ocular refractive state and optical properties of the lens in vitro, as well as on the integrity of the mitochondria of the lens. The animals were treated 30-35 times (2.5-3 months) or 70 times (6 months) with HBO. An increased level of lens nuclear light scattering was evident by slit-lamp at 30 treatments, and this increased at 70 treatments. After 30-35 HBO treatments a myopic shift in refractive state of the eye was seen in two separate studies with two different refractionists. Also, the average back vertex distance of the lens was significantly shorter after 35 HBO treatments while spherical aberration (focal variability) increased after 70 treatments. No difference in refractive state was noted after 70 HBO treatments (a reversal of the initial myopic effect). The mitochondrial distribution and morphology of the lens epithelium and the superficial cortical fibre cells were normal after both 35 and 70 HBO treatments, highlighting that HBO treatment does not affect the superficial cortex of the lens. The results of the in vitro lens optical analysis carried out in this study correlate with the myopia observed after 30-35 HBO in vivo treatments. A similar reversible myopia and increase in lens nuclear light scattering is known to occur in humans treated with HBO for extended periods and the results suggest that the myopia was caused by a change in the refractive index of the lens. The significant loss of sharp focus after 70 HBO treatments can be correlated with previous reports of biochemical and morphological changes associated with HBO-induced loss of lens nuclear transparency in mature guinea pigs. The guinea pig HBO model may be a useful approach for the study of lens development and refractive error.  
PMID: 15051474 [PubMed - indexed for MEDLINE]

47: *J Neurol Sci.* 2004 Apr 15;219(1-2):77-82.  
Continuous measurements of cerebral tissue oxygen pressure during hyperbaric oxygenation--HBO effects on brain edema and necrosis after severe brain trauma in rabbits.  
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INTRODUCTION: Severe brain injury is one of the most frequent causes of severe disability in the young. In acute management of brain trauma, new approaches based on experimental animal investigations should be sought. METHODS: Twenty male, juvenile Chinchilla-Bastard rabbits received standardized cold-injury-induced-brain-trauma (CIBT). A metal probe (temperature -196 degrees C) was applied epidurally over 10 s. The hyperbaric oxygenation (HBO) group (n=10) underwent 90-min HBO sessions with 100% oxygen at 2.5 atmospheres absolute (1 h, 24+/-2 h, 48+/-2 h after CIBT). Cerebral tissue pO<sub>2</sub>-measurements were performed 60 min after CIBT, during the three HBO sessions and on day 4. The control group (n=10) underwent no treatment. Animals were sacrificed on day 4, and brains were analyzed histologically. RESULTS: In the HBO group, pO<sub>2</sub> measurements showed a significant increase in pO<sub>2</sub> between day 1 and day 4, whereas no significant changes were observed in the control group. During the first HBO session, mean pO<sub>2</sub> was 169 mm Hg, during the second 305 mm Hg and during the third 420 mm Hg. The mean area of necrosis was 16.2 mm<sup>2</sup> in the HBO group, in the control group 19.9 mm<sup>2</sup>. The areas of brain edema were significantly smaller in the HBO group. Mortality in the HBO group was 0%, in the control group 20%. CONCLUSION: HBO appears to be beneficial as an adjunct treatment of severe head trauma. To find optimal treatment protocols, further clinical studies must be developed.  
PMID: 15050441 [PubMed - indexed for MEDLINE]

48: *Wien Klin Wochenschr.* 2004 Feb 28;116(4):140-2.  
Hyperbaric oxygenation combined with streptokinase for treatment of arterial thromboembolism of the lower leg.  
Mihaljevic S, Mihaljevic L, Majeric-Kogler V, Oremus K.  
Department of General Surgery, Clinical Hospital Center Zagreb, University of Zagreb Medical School, Zagreb, Croatia.  
Thromboembolic occlusion of peripheral arteries is a common problem in patients referred to vascular surgery departments. Standard treatments include catheter aspiration techniques, use of fibrinolytic agents and surgical thrombendarterectomy. Recent reports have described the use of hyperbaric oxygen therapy in patients with limb ischemia, yet their main focus has been on patients with chronic disorders. We present the case of a 74-year-old woman with atrial fibrillation and acute thromboembolic occlusion of the posterior tibial artery. The patient presented with severe pain in the right calf, unresponsive to non-opioid parenteral analgesia and accompanied by coldness, numbness and partial motor palsy of the right foot. After 60 minutes of oxygenation in a hyperbaric chamber with a pressure of 2.2 bar, the pain receded, although without signs of restored blood flow in the occluded artery. After fibrinolytic therapy with streptokinase, patency of the posterior

tibial artery was verified by return of palpable pulsations and color Doppler ultrasonography. By combining hyperbaric oxygenation and streptokinase in the treatment of lower-leg arterial thromboembolism we achieved regression of ischemic pain, prolongation of the survival time of tissues compromised by ischemia and resolved the cause of the ischemia. We believe the use of this therapeutic strategy in selected cases of peripheral arterial thromboembolism is justified.

Publication Types: Case Reports

PMID: 15038406 [PubMed - indexed for MEDLINE]

49: Intensive Care Med. 2004 Jun;30(6):1011-3. Epub 2004 Mar 18.

Comment on: Intensive Care Med. 2004 Jun;30(6):1175-81.

Hyperbaric oxygen in systemic inflammatory response.

Bitterman H, Muth CM.

Publication Types: Comment Editorial

PMID: 15034647 [PubMed - indexed for MEDLINE]

50: J Urol. 2004 Apr;171(4):1637; author reply 1637.

Comment on: J Urol. 2003 Jun;169(6):2200-2.

Re: treatment of radiation induced hemorrhagic cystitis with hyperbaric oxygen.

Dodds PR, Papowitz AJ.

Publication Types: Case Reports Comment Letter

PMID: 15017250 [PubMed - indexed for MEDLINE]

51: Neurochem Int. 2004 Jun;44(8):585-94.

Hyperbaric oxygen treatment: the influence on the hippocampal superoxide dismutase and Na<sup>+</sup>,K<sup>+</sup>-ATPase activities in global cerebral ischemia-exposed rats.

Mrsic-Pelcic J, Pelcic G, Vitezic D, Antoncic I, Filipovic T, Simoncic A, Zupan G.

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The influence of hyperbaric oxygen (HBO) treatment on the activities of superoxide dismutase (SOD) and Na<sup>+</sup>,K<sup>+</sup>-ATPase was determined during different time periods of reperfusion in rats exposed to global cerebral ischemia. Ischemic animals were either sacrificed or exposed to the first HBO treatment 2, 24, 48 or 168 h after ischemic insult (for SOD activities measurement) or immediately, 0.5, 1, 2, 6, 24, 48, 72 or 168 h after ischemic procedure (for Na<sup>+</sup>,K<sup>+</sup>-ATPase activities measurement). Hyperbaric oxygenation procedure was repeated for seven consecutive days. The results of presented experiments demonstrated the statistically significant increase in the hippocampal SOD activity 24 and 48 h after global cerebral ischemia followed by a decrease in the enzymatic activity 168 h after ischemic insult. In the ischemic rats treated with HBO the level of hippocampal SOD activity was significantly higher after 168 h of reperfusion in comparison to the ischemic, non HBO-treated

animals. In addition, it was found that global cerebral ischemia induced a statistically significant decrease of the hippocampal Na<sup>+</sup>,K<sup>+</sup>-ATPase activity starting from 1 to 168 h of reperfusion. Maximal enzymatic inhibition was obtained 24 h after the ischemic damage. Decline in Na<sup>+</sup>,K<sup>+</sup>-ATPase activity was prevented in the animals exposed to HBO treatment within the first 24 h of reperfusion. Our results suggest that global cerebral ischemia induces significant alterations in the hippocampal SOD and Na<sup>+</sup>,K<sup>+</sup>-ATPase activities during different periods of reperfusion. Enhanced SOD activity and preserved Na<sup>+</sup>,K<sup>+</sup>-ATPase activity within particular periods of reperfusion, could be indicators of a possible beneficial role of HBO treatment in severe brain ischemia.

PMID: 15016473 [PubMed - indexed for MEDLINE]

52: Clin Biochem. 2004 Apr;37(4):312-7.

Oxidative stress and antioxidant status in patients undergoing prolonged exposure to hyperbaric oxygen.

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**OBJECTIVES:** To evaluate the condition of oxidative stress in patients undergoing prolonged exposure to hyperbaric oxygen (HBO) and the possible modifications of the antioxidant defense systems in the absence of antioxidant supplementation. **DESIGN AND METHODS:** Twelve patients exposed to 15 HBO treatments for pathological conditions related to hypoxia were included in the study. Oxidative stress indices as well as plasma and erythrocyte antioxidant levels were measured in blood samples collected both at the 1st and 15th HBO session. **RESULTS:** The repeated exposures to HBO led to a significant accumulation of plasmatic reactive oxygen metabolites (ROM) and malondialdehyde (MDA). After 15 HBO sessions, no relevant differences were detected for reduced glutathione (GSH), alpha-tocopherol, and retinol plasma levels; however, a significant decrease in erythrocyte superoxide dismutase (SOD) and catalase (CAT) activity was observed when compared to the 1st HBO exposure; glutathione peroxidase (GPx) activity remained almost unchanged. **CONCLUSIONS:** In the absence of antioxidant supplementation, the prolonged HBO treatment leads to a condition of oxidative stress that seems to affect in particular the response of the enzymatic antioxidant defense system; the possible relationship between the chemical modifications of the enzymes caused by oxygen reactive species and the consequent inactivation of the proteins is under investigation.

PMID: 15003734 [PubMed - indexed for MEDLINE]

53: J Neurotrauma. 2004 Jan;21(1):41-8.

Hyperbaric oxygen therapy for reduction of secondary brain damage in head injury: an animal model of brain contusion.

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Cerebral contusions are one the most frequent traumatic lesions and the most common indication for secondary surgical decompression. The purpose of this study was to investigate the physiology of perilesional secondary brain damage and evaluate the value of hyperbaric oxygen therapy (HBOT) in the treatment of these lesions. Five groups of five Sprague-Dawley rats each were submitted to dynamic cortical deformation (DCD) induced by negative pressure applied to the cortex. Cerebral lesions produced by DCD at the vacuum site proved to be reproducible. The study protocol entailed the following: (1) DCD alone, (2) DCD and HBOT, (3) DCD and post-operative hypoxia and HBOT, (4) DCD, post-operative hypoxia and HBOT, and (5) DCD and normobaric hyperoxia. Animals were sacrificed after 4 days. Histological sections showed localized gross tissue loss in the cortex at injury site, along with hemorrhage. In all cases, the severity of secondary brain damage was assessed by counting the number of terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling (TUNEL) and caspase 3-positive cells in successive perilesional layers, each 0.5 mm thick. Perilesional TUNEL positive cells suggested the involvement of apoptosis in group 1 (12.24% of positive cells in layer 1). These findings were significantly enhanced by post-operative hypoxia (31.75%,  $p < 0.001$ ). HBOT significantly reduced the severity and extent of secondary brain damage expressed by the number of TUNEL positive cells in each layer and the volume of the lesion (4.7% and 9% of TUNEL positive cells in layer 1 in groups 2 and 4 respectively,  $p < 0.0001$  and  $p < 0.003$ ). Normobaric hyperoxia also proved to be beneficial although in a lesser extent. This study demonstrates that the vacuum model of brain injury is a reproducible model of cerebral contusion. The current findings also suggest that HBOT may limit the growth of cerebral contusions and justify further experimental studies.

PMID: 14987464 [PubMed - indexed for MEDLINE]

54: Wound Repair Regen. 2004 Jan-Feb;12(1):2-10.

Advances in the treatment of the diabetic foot: Is there a role for adjunctive hyperbaric oxygen therapy?

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There have been many advances in the treatment of wounds made in the last decade. Innovative techniques of wound closure, topical agents, aggressive vascular repair, focused wound care

management, and adjunctive hyperbaric oxygen therapy are but a few of these improvements. The vital role of oxygen in wound healing is becoming better understood, in no small part, due to Dr. T. K. Hunt and his colleagues at the Wound Healing Laboratory at the University of California, San Francisco. Elements of that contribution will be examined in this article. How these elements may be applied to improve wound healing will be explained and the possible role of adjunctive hyperbaric oxygen therapy based on sound science in the management of the difficult diabetic foot wound, will be highlighted.

Publication Types: Review, Tutorial  
PMID: 14974958 [PubMed - indexed for MEDLINE]

55: Cochrane Database Syst Rev. 2004;(1):CD003057.

Hyperbaric oxygen therapy for multiple sclerosis.

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**BACKGROUND:** Multiple Sclerosis (MS) is a chronic, recurrent and progressive illness with no cure. On the basis of speculative pathophysiology, it has been suggested that Hyperbaric Oxygen Therapy (HBOT) may slow or reverse the progress of the disease. **OBJECTIVES:** The object of this review was to evaluate the efficacy and safety of HBOT in the treatment of MS. **SEARCH STRATEGY:** We searched the Cochrane MS Group trials register (July 2002), the Cochrane Central Register of Controlled Trials (The Cochrane Library, Issue 2, 2002), MEDLINE (January 1966 to October 2002) and the National Library of Medicine (NLM) database (July 2002), along with specialised hyperbaric resources and handsearching of relevant journals and proceedings. **SELECTION CRITERIA:** All randomised, controlled trials involving a comparison between HBOT and a sham therapy in MS were evaluated. **DATA COLLECTION AND ANALYSIS:** Two reviewers independently appraised all comparative trials identified, extracted data and scored them for methodological quality. **MAIN RESULTS:** We identified ten reports of nine trials that satisfied selection criteria (504 participants in total). Two trials produced generally positive results, while the remaining seven reported generally no evidence of a treatment effect. None of our three a priori subgroup analyses placed these two trials in the same group and were therefore unable to account for this difference. Three analyses (of 21) did indicate some benefit. For example, the mean Expanded Disability Status Scale (EDSS) at 12 months was improved in the HBOT group (group mean reduction in EDSS compared to sham -0.85 of a point, 95% confidence interval -1.28 to -0.42,  $P = 0.0001$ ). Only the two generally positive trials reported on this outcome at this time (16% of the total participants in this review). **REVIEWER'S CONCLUSIONS:** We found no consistent evidence to confirm a beneficial effect of hyperbaric oxygen therapy for the treatment of multiple sclerosis and do not believe routine use is

justified. The small number of analyses suggestive of benefit are isolated, difficult to ascribe with biological plausibility and would need to be confirmed in future well-designed trials. Such trials are not, in our view, justified by this review.

Publication Types: Meta-Analysis Review  
PMID: 14974004 [PubMed - indexed for MEDLINE]

56: Intensive Care Med. 2004 Jun;30(6):1175-81. Epub 2004 Feb 12.

Comment in: Intensive Care Med. 2004 Jun;30(6):1011-3.

Hyperbaric oxygen therapy prevents vascular derangement during zymosan-induced multiple-organ-failure syndrome.

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**OBJECTIVE:** This study investigated the effects of hyperbaric oxygen (HBO) therapy on the cardiovascular alteration (e.g. mean arterial pressure, vascular reactivity of thoracic aorta rings changes) caused by zymosan in rats. **DESIGN:** Rats. **SETTING:** University research laboratory. **INTERVENTION AND MEASUREMENTS:** We investigated the effects of HBO therapy (2 ATA at the fourth and eleventh hours after study onset) on the cardiovascular alteration caused by zymosan (500 mg/kg, administered i.p. as a suspension in saline) in rats. Cardiovascular alterations were assessed 18 h after administration of zymosan and/or HBO therapy. **RESULTS:** Treatment of rats with HBO therapy attenuated the vasoplegic response to zymosan. In fact, the analysis of arterial pressure curves revealed no signs of vasoplegic shock. The aorta rings of animals treated with zymosan and HBO had a significantly increased contraction to norepinephrine (NE) and endothelin-1 (ET-1) and dilation to acetylcholine (ACh) compared with the zymosan group. The HBO therapy also attenuated the increase of malondialdehyde (MDA) levels caused by zymosan in the aorta. Immunohistochemical analysis for nitrotyrosine and for iNOS revealed positive staining in the aorta from zymosan-treated rats. The degree of staining for nitrotyrosine and iNOS was markedly reduced in tissue sections obtained from zymosan-rats treated with HBO therapy. **CONCLUSION:** This study provides the first evidence that HBO therapy attenuates the degree of zymosan-induced cardiovascular derangement in the rat.

Publication Types: Evaluation Studies  
PMID: 14963645 [PubMed - indexed for MEDLINE]

57: World J Surg. 2004 Mar;28(3):307-11. Epub 2004 Feb 17.

Clinical hyperbaric oxygen therapy, wound perfusion, and transcutaneous oximetry. Niinikoski JH.

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Hyperbaric oxygen therapy (HBOT) is an important adjunct in the management of problem wounds which exist in chronic oxygen deficiency and in which the local oxygen tension is below optimal for healing. In the treatment of hypoxic and ischemic wounds, the most important effects of hyperbaric oxygenation are the stimulation of fibroblast proliferation and differentiation, increased collagen formation and cross-linking, augmented neovascularization, and the stimulation of leukocyte microbial killing. Ischemic soft tissues also benefit from hyperoxygenation through improved preservation of energy metabolism and reduction of edema. Hyperbaric oxygen is administered in either a multiplace or a monoplace hyperbaric chamber. Normally, pressures of 2 to 2.5 ATA are used for a period of 90 minutes once or twice daily. For an objective assessment of wound perfusion and oxygenation, transcutaneous oximetry provides a simple, reliable, noninvasive, diagnostic technique. It can be used for assessment of tissue perfusion in the vicinity of the problem wound. Transcutaneous oximetry may be used in the assessment of wound healing potential, selection of amputation level, and patient selection for HBOT. In diabetic patients with chronic foot ulcers peri-wound transcutaneous oxygen tensions (TcP(O<sub>2</sub>)) over 400 mmHg in 2.5 ATA hyperbaric oxygen or over 50 mmHg in normobaric pure oxygen predict healing success with adjunct HBOT with high accuracy.

Publication Types: Review Review, Tutorial  
PMID: 14961187 [PubMed - indexed for MEDLINE]

58: Intensive Care Med. 2004 May;30(5):944-50. Epub 2004 Feb 6.

Comment in: Intensive Care Med. 2004 May;30(5):742-3.

Hyperventilation impairs brain function in acute cerebral air embolism in pigs.

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**OBJECTIVE:** To evaluate, in a model of cerebral air embolism (CAE), the effects of ventilation-induced hypocapnia and hyperoxemia on intracranial pressure (ICP), cerebral perfusion pressure (CPP), brain oxygen (PbrO(2)), brain carbon dioxide (PbrCO(2)), brain pH (brpH) and levels of brain glucose and lactate. **DESIGN AND SETTING:** Prospective animal study in a university medical center. **SUBJECTS:** Fifteen Landrace/Yorkshire pigs. **INTERVENTIONS:** In 15 anesthetized pigs ICP, PbrO(2), PbrCO(2) and brpH were measured with multi-parameter sensors, and brain glucose and lactate by microdialysis. All these parameters were recorded for 2 h after injection of air into the internal carotid artery. Nine animals were hyperventilated (PaCO(2) +/-25 mmHg) and hyperoxygenated (FiO(2) 1.0) and six animals were normoventilated

(PaCO<sub>2</sub>) $\pm$ 40 mmHg with an FiO<sub>2</sub> 0.4) and served as controls. RESULTS. In the treatment group the ICP rose from 8 $\pm$ 1 to 52 $\pm$ 6 mmHg, which was similar to that in the control group (12 $\pm$ 1 to 57 $\pm$ 8 mmHg). At the end of the 2-h study period, there were no significant differences in PbrO<sub>2</sub>, PbrCO<sub>2</sub> and brpH between the two groups. The decreased brain glucose and increased brain lactate reached severe pathological values in both groups by the end of the 2-h study period. CONCLUSIONS: Hypocapnia and hyperoxemia in acute CAE did not improve pathological functional brain parameters compared with normoventilated controls. Similarly, the pathological changes in brain glucose/lactate could also not be improved by hypocapnia and hyperoxemia.

PMID: 14767585 [PubMed - indexed for MEDLINE]

59: J Bone Joint Surg Br. 2004 Jan;86(1):150-1; author reply 151.

Comment on: J Bone Joint Surg Br. 2003 Apr;85(3):371-5.

Hyperbaric oxygen therapy as a treatment for stage-I avascular necrosis of the femoral head.

Kim HJ.

Publication Types: Comment Letter

PMID: 14765887 [PubMed - indexed for MEDLINE]

60: Orthopedics. 2004 Jan;27(1):9; author reply 9.

Comment on: Orthopedics. 2003 Jun;26(6):621-6; discussion 626.

Hyperbaric oxygen use.

Strauss MB.

Publication Types: Comment Letter

PMID: 14763521 [PubMed - indexed for MEDLINE]

61: Microsurgery. 2004;24(1):49-55.

Microsurgical penile replantation facilitated by postoperative HBO treatment.

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Successful microsurgical replantation of a penis amputated at the level of the pubis is a rare occurrence worldwide. Moreover, the use of hyperbaric oxygen (HBO) for a postoperative replant Pseudomonas wound infection has not been reported. There is also disagreement regarding the importance of microsurgical repair of only the dorsal arteries or only the profundus arteries of the penis. A case is reported of penile replantation with a postoperative Pseudomonas wound infection treated with HBO to prevent potential replant loss, with a worldwide literature review. At 1-year postoperative follow-up, the patient has normal urinary flow and reports spontaneous erection, with the ability for intromission and a sensate glans. HBO facilitated the success of a penile replantation complicated by postoperative Pseudomonas wound infection. In addition, a literature review supports the microsurgical repair of at least a single isolated dorsal

penile artery, but not a single or multiple profundus arteries. Copyright 2004 Wiley-Liss, Inc.

Publication Types: Case Reports Review

Review of Reported Cases

PMID: 14748025 [PubMed - indexed for MEDLINE]

62: Microsurgery. 2004;24(1):26-9.

Hyperbaric oxygen for the treatment of early-phase Dupuytren's contracture.

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Dupuytren's disease (DD) is a proliferative disorder of autosomal-dominant inheritance, with variable penetrance of gene expression. The treatment of DD is challenging. Both operative and nonoperative approaches were reported for treatment of the disease, but no perfect approach has gained popularity as the best choice of treatment. Most of the emphasis has been placed on surgical techniques, but outcomes were reported to be dependent on some variables such as case selection, timing of surgery, and the surgeon's training and experience. In this paper, we report on a hyperbaric oxygen (HBO) treatment for early-phase DD. HBO treatment was applied to a female aged 23 years who had a mild form of DD. Physical findings and complaints before and after HBO treatment were compared. Total relief of symptoms as well as physical findings were obtained with HBO treatment. HBO for the treatment of DD is a novel concept. Having treated only one case is not enough to conclude that HBO is the only effective mode of treatment for DD. HBO should also be tried to treat early-phase or mild contractures of DD. Unfortunately, HBO has a disadvantage, i.e., cost. But HBO is not invasive, and because of the nature of HBO treatment, most of the complications seen after surgeries, e.g., wound-healing problems, damage to the digital nerves and vessels, buttonholing of the skin, and tendon sheath opening, are not seen. Copyright 2003 Wiley-Liss, Inc.

Publication Types: Case Reports

PMID: 14748021 [PubMed - indexed for MEDLINE]

63: Clin Experiment Ophthalmol. 2004 Feb;32(1):67-70.

Controlled trial of hyperbaric oxygen treatment for alkali corneal burn in the rabbit.

Hirst LW, Summers PM, Griffiths D, Bancroft J, Lillicrap GR.

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PURPOSE: To evaluate the efficacy of hyperbaric oxygen therapy in the treatment of alkali-induced corneal burns in an animal model. METHODS: Twenty-four rabbits were randomized into a control group (n = 12) and hyperbaric oxygen treatment group (n = 12). After induction of anaesthesia, the

alkali burn model was established by application of 1 N sodium hydroxide to one eye of each rabbit. The hyperbaric oxygen treatment group was treated each day for 21 days with hyperbaric oxygen at 2.4 Atmospheres Absolute (ATA) for 1 h. The eyes of the animals were examined daily for 2 weeks and then weekly until the end of the trial. The principal endpoint was that of perforation of the cornea at which time the animals were killed with a lethal dose of either intravenous or intraperitoneal barbiturate and the eyes immediately enucleated and fixed in 10% neutral buffered formalin. All animals in which complete healing took place were also killed, the eyes removed, fixed and examined histologically. Photographs were taken of the rabbit's eyes at weekly intervals and the area of vascularization and epithelial defects in the hyperbaric and control groups were compared. RESULTS: Equal numbers (seven) of the control and hyperbaric oxygen treated groups had perforated corneas and there was no statistical difference in the mean time to perforation (control 30.1 days; treated 30 days). There was also no statistical difference between the two groups with respect to epithelial defect size. CONCLUSION: Treatment with hyperbaric oxygen for 1 h daily for 21 days had no beneficial effect on alkali-induced corneal burns.

PMID: 14746596 [PubMed - indexed for MEDLINE]

64: HNO. 2004 Jan;52(1):63-6.

Comment in: HNO. 2004 Jul;52(7):648-50.

[Hyperbaric oxygen therapy after unilateral idiopathic sudden deafness]

[Article in German]

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The use of hyperbaric oxygenation therapy (HBOT) after acute one-sided deafness is a treatment option if conventional methods fail. Five cases have been reported in which an improvement in hearing after HBOT was achieved following unsuccessful conventional therapy. In view of this, and after a careful study of the literature, we suggest that timely treatment with HBOT should be used in every case of unilateral idiopathic deafness.

PMID: 14740118 [PubMed - indexed for MEDLINE]

65: Arch Facial Plast Surg. 2004 Jan-Feb;6(1):31-5.

Effect of hyperbaric oxygen on the growth factor profile of fibroblasts.

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OBJECTIVES: Hyperbaric oxygen (HBO) has been used in the clinical setting to heal problem wounds, yet its direct effects on fibroblasts are not clear. The present study evaluates the effects of HBO on the growth and autocrine production of growth factors by fibroblasts grown in an in vitro, serum-free environment. METHODS: Human dermal fibroblasts

were propagated in serum-free media and subjected to daily 90-minute HBO treatments at 1.0, 1.5, 2.0, 2.5, and 3.0 atm of pressure for 7 consecutive days. Cell proliferation and growth-factor assays for basic fibroblast growth factor (bFGF), vascular endothelial growth factor (VEGF), and transforming growth factor beta1 (TGF-beta1) were performed on days 1, 3, 5, and 7. RESULTS: On day 1, HBO inhibited growth of fibroblasts at all atmospheric pressures compared with control. By day 7, cell proliferation was significantly enhanced only in cells treated with 2.0-atm HBO compared with controls. Secretion of bFGF was significantly increased by HBO-treated fibroblasts on day 1; VEGF levels slightly increased with HBO treatment on day 1, but this effect was not statistically significant; TGF-beta1 levels were detectable on day 1 only for control and HBO-treated cells at 1.0 atm, and not detectable for any cell groups after day 1. CONCLUSIONS: These results suggest that daily HBO treatment enhances the growth of fibroblasts when administered to a critical degree. Also, HBO appears to directly effect fibroblast production of autocrine growth factors on initial exposure. We postulate that fibroblasts possess the ability to respond to hyperoxia directly, which causes changes in cell signaling pathways involved in cellular proliferation and growth factor production.

PMID: 14732642 [PubMed - indexed for MEDLINE]

66: Stroke. 2004 Feb;35(2):578-83. Epub 2004 Jan 8. Therapeutic window for use of hyperbaric oxygenation in focal transient ischemia in rats.

Lou M, Eschenfelder CC, Herdegen T, Brecht S, Deuschl G.

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BACKGROUND AND PURPOSE: Hyperbaric oxygenation (HBO) is an attractive procedure that has been used frequently in cerebral ischemia. However, depending on the model of cerebral ischemia and HBO protocol, different and conflicting results were obtained in the past. This study was undertaken to reevaluate the effects of single administration of HBO in 2 models of acute cerebral ischemia: transient or permanent focal ischemia in rats. A comparison of the 2 ischemia models was undertaken to search for a putative therapeutic window. METHODS: The intraluminal middle cerebral artery occlusion model (MCAO) was used. The effect of single HBO therapy (3 atm absolute, 60 minutes) on transient or permanent focal ischemia, when applied at different times (3, 6, or 12 hours) after MCAO, was investigated; infarct volume and neurological deficits were assessed at 24 hours and up to 7 days. RESULTS: HBO had neuroprotective effects on transient MCAO when HBO was initiated within the first 6 hours, while it aggravated the ischemic injury histologically and clinically when initiated 12 hours after MCAO. In permanent MCAO, HBO did not reduce tissue damage regardless of the timing of therapy. CONCLUSIONS: HBO is highly efficient in reducing infarct volume

and improving neurobehavioral outcome in transient MCAO within the first 6 hours. HBO at later time points ( $\geq 12$  hours) is harmful by increasing infarct volume. In permanent MCAO, HBO failed to improve infarct volume and clinical outcome.

PMID: 14715976 [PubMed - indexed for MEDLINE]

67: *Pancreas*. 2004 Jan;28(1):53-7.

The effect of combination therapy of hyperbaric oxygen, meropenem, and selective nitric oxide synthase inhibitor in experimental acute pancreatitis.

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Despite the new diagnostic and therapeutic advancements, acute pancreatitis has still high rate of morbidity and mortality. We aimed to evaluate the effects of hyperbaric oxygen (HBO) therapy alone or combined with S-methylisothiourea (SMT), and meropenem (MER) therapy in an experimental rat model of acute necrotizing pancreatitis. Rats were randomly divided into 8 groups, and acute pancreatitis was induced in all groups except group 1. Treatment protocols were saline for group 2, SMT for group 3, SMT + MER for group 4, SMT + HBO for group 5, HBO for group 6, HBO + MER for group 7, and MER for group 8. All surviving animals were killed 48 hours after the induction of pancreatitis, and specimens were collected. Oxidative stress parameters, histopathologic scores and amylase levels were better in treatment groups than in the positive control group (group 2). The most favorable results were obtained in HBO treatment groups, especially in HBO + MER group (group 7). Our results indicate that adding HBO therapy to the antibiotic therapy will decrease oxidative stress parameters, serum amylase levels, and histopathological score. We suggest that adding the HBO therapy as an adjunctive to the treatment protocol of acute necrotizing pancreatitis may yield improvement in the morbidity and mortality of the disease.

PMID: 14707730 [PubMed - indexed for MEDLINE]

68: *J Neurosci Methods*. 2004 Jan 15;132(1):45-56.

Reliability of the NeuroTrend sensor system under hyperbaric conditions.

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**OBJECTIVE:** The goal of this study was to investigate the reliability of the multi-parameter sensor NeuroTrend in a hyperbaric environment for up to 3bar absolute pressure. Measurement of brain tissue oxygenation (ptiO<sub>2</sub>) under hyperbaric conditions is supposed to elucidate whether hyperbaric oxygenation therapy has the potential to improve ptiO<sub>2</sub> to a clinically significant degree in pathological altered brain tissue after traumatic brain injury. **METHODS:** The NeuroTrend sensor hose,

filled with equilibrated plasma samples, was stored in a decompression chamber. The plasma samples were equilibrated with three different gas mixtures. After determination of the initial values for temperature, oxygen partial pressure (pO<sub>2</sub>), carbon dioxide partial pressure (pCO<sub>2</sub>) and hydrogen ion concentration (pH) in the plasma, the ambient pressure was stepwise increased from 0.1 to 3 bar. The same set-up was performed without increasing the ambient pressure. **RESULTS:** No significant difference in the mean values for all 23 measurement points and for all parameters (pO<sub>2</sub>, pCO<sub>2</sub>, pH) of all 10 NeuroTrend sensors was found, under both normobaric and hyperbaric conditions. **CONCLUSION:** The study demonstrated that an absolute ambient pressure up to 3 bar did not influence the measuring properties and the reliability of the NeuroTrend sensor.

Publication Types: Validation Studies

PMID: 14687674 [PubMed - indexed for MEDLINE]

69: *Eur J Vasc Endovasc Surg*. 2004 Jan;27(1):108.

Comment on: *Eur J Vasc Endovasc Surg*. 2003 Jun;25(6):513-8.

Re: The role of hyperbaric oxygen therapy in ischaemic diabetic lower extremity ulcers: a double-blind randomised-controlled trial.

Mills CR, Harding S.

Publication Types: Comment Letter

PMID: 14654420 [PubMed - indexed for MEDLINE]

70: *Clin Sci (Lond)*. 2004 Apr;106(4):389-95.

Haemodynamic effects of hyperbaric hyperoxia in healthy volunteers: an echocardiographic and Doppler study.

Molenat F, Boussuges A, Grandfond A, Rostain JC, Sainty JM, Robinet C, Galland F, Meliet JL.

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In the present study, we observed the haemodynamic changes, using echocardiography and Doppler, in ten healthy volunteers during 6 h of compression in a hyperbaric chamber with a protocol designed to reproduce the conditions as near as possible to a real dive. Ambient pressure varied from 1.6 to 3 atm (1 atm=101.325 kPa) and partial pressure of inspired O<sub>2</sub> from 1.2 to 2.8 atm. Subjects performed periods of exercise with breathing through a closed-circuit self-contained underwater breathing apparatus (SCUBA). Subjects did not eat or drink during the study. Examinations were performed after 15 min and 5 h. After 15 min, stroke volume (SV), left atrial (LA) diameter and left ventricular (LV) end-diastolic diameter (LVEDD) decreased. Heart rate (HR) and cardiac output (CO) did not vary, but indices of the LV systolic performance decreased by 10% and the LV meridional wall stress increased by 17%. After 5 h, although weight decreased, the serum protein concentration increased. Compared with values obtained after 15 min, SV and CO decreased, but LV systolic performance, LA diameter, LVEDD and LV meridional wall stress remained unchanged.

Compared with the reference values obtained at sea level, total arterial compliance decreased, HR remained unchanged and CO decreased. In conclusion, hyperbaric hyperoxia results in significant haemodynamic changes. Initially, hyperoxia and the SCUBA system are responsible for reducing LV preload, increasing LV afterload and decreasing LV systolic performance, although CO did not change. Prolonged exposure resulted in a further decrease in LV preload, because of dehydration, and in a further increase in LV afterload, due to systemic vasoconstriction, with the consequence of decreasing CO.

Publication Types: Clinical Trial

PMID: 14641106 [PubMed - indexed for MEDLINE]

71: Intensive Care Med. 2004 Jan;30(1):141-6. Epub 2003 Aug 2.

The role of hyperbaric oxygen in the management of subarachnoid hemorrhage.

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**OBJECTIVE:** To determine the role of hyperoxic and hyperbaric therapy following experimental subarachnoid hemorrhage (SAH). **DESIGN:** Prospective, randomized, controlled animal study. **SUBJECTS:** Thirty male Wistar rats. **INTERVENTIONS:** Thirty rats were assessed for an initial neurologic status as double-blinded by two different neurosurgeons using a neurologic severity score (NSS) and then underwent an initial angiographic examination. Two days later, 0.3 ml of homologous blood was injected into the cisterna magna to produce a SAH-induced cerebral vasospasm. The NSS and angiographic examination were then repeated. The rats having no spasm or a spasm under 50% (n=8) and 50% or over 50% (n=22) were grouped separately, as groups 1 and 2, respectively. The rats having 50% or more spasm were further divided randomly into group 2A and 2B. The rats in groups 1 and 2A (n=11) underwent a 60-min course of 100% oxygen at the atmospheric pressure 1 atmosphere absolute (ata), and group 2B (n=11) received 100% oxygen at 3 ata for 1 h. Neurologic assessment was repeated on the next day and 7 days later. **MEASUREMENTS AND MAIN RESULTS:** The animals having no spasm or less than 50% spasm had a better NSS and outcome when compared with the animals having 50% or more spasm. But the animals with 50% or more spasm which underwent hyperbaric therapy were shown to have a better outcome compared to the animals having hyperoxic therapy. **CONCLUSION:** Exposure to hyperbaric oxygen therapy seemed to accelerate the recovery of neurologic deficits secondary to experimental SAH.

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