



UNDERSEA AND HYPERBARIC MEDICAL SOCIETY

Hyperbaric Medicine  
**INDICATIONS  
MANUAL**

**15<sup>TH</sup> EDITION**

Enoch T. Huang, MD, MPH&TM  
Chair and Editor

Undersea and Hyperbaric Medical Society  
631 US Highway 1, Suite 307  
North Palm Beach, FL 33408  
USA



No responsibility is assumed by the publisher or editor for any injury and or damage to persons or property as a matter of product liability, negligence or otherwise, or from any use or operation of any methods, product, instructions, or ideas contained in the material herein. No suggested test or procedure should be carried out unless, in the reader's judgment, its risk is justified. Because of rapid advances in the medical sciences, we recommend that the independent verification of diagnoses and drug dosages be made.

All rights reserved. No part of this book may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from the publisher.

Copyright © 2023 Undersea and Hyperbaric Medical Society

ISBN: 978-1-947239-42-5

Library of Congress Catalog Number: 2023940534

Published by: Best Publishing Company

631 U.S. Highway 1, Suite 307

North Palm Beach, Florida 33408

Printed and bound in the United States of America

# Table of Contents

---

Preface . . . . .	v
Members of the Hyperbaric Medicine Committee . . . . .	vii
I. Background . . . . .	ix
II. Defining the Specialty of Undersea and Hyperbaric Medicine . . . . .	ix
III. Definition of Hyperbaric Oxygen and its Safe Delivery . . . . .	x
IV. Classification of Hyperbaric Chambers . . . . .	xii
V. Utilization Review for Hyperbaric Oxygen . . . . .	xiv
VI. Acceptance (Addition) of New Indications for Hyperbaric Oxygen . . . . .	xiv
VII. List of Abbreviations . . . . .	xv
VIII. Author Biographies . . . . .	xix

## **PART I. Indications**

1. Hyperbaric Treatment of Air or Gas Embolism: Current Recommendations . . . . .	1
2. Arterial Insufficiencies:	
A. Central Retinal Artery Occlusion . . . . .	15
B. Hyperbaric Oxygen Therapy for Selected Problem Wounds . . . . .	33
3. Carbon Monoxide Poisoning . . . . .	83
4. Clostridial Myonecrosis (Gas Gangrene) . . . . .	109
5. The Effect of Hyperbaric Oxygen on Compromised Grafts and Flaps. . . . .	117
6. Acute Traumatic Ischemias: Roles of Hyperbaric Oxygen . . . . .	137
7. Decompression Sickness. . . . .	155
8. Delayed Radiation Injuries (Soft Tissue and Bony Necrosis) and Potential for Future Research . . . . .	167
9. Sudden Sensorineural Hearing Loss . . . . .	215
10. Intracranial Abscess . . . . .	241
11. Necrotizing Soft Tissue Infections . . . . .	249
12. Refractory Osteomyelitis . . . . .	265
13. Severe Anemia . . . . .	295
14. Adjunctive Hyperbaric Oxygen in the Treatment of Thermal Burns . . . . .	305
15. Avascular Necrosis (Aseptic Osteonecrosis). . . . .	337

## **PART II. Additional Considerations**

16. Mechanisms of Action of Hyperbaric Oxygen Therapy . . . . .	347
17. Side Effects of Hyperbaric Oxygen Therapy . . . . .	357
18. Hyperbaric Oxygen Dosing . . . . .	375
19. Oxygen Pretreatment and Preconditioning. . . . .	387
20. Randomized Controlled Trials in Hyperbaric Medicine . . . . .	397
21. Emerging Indications. . . . .	429
Index . . . . .	447



# Preface

---

The application of air under pressure (hyperbaric air) dates back to 1667, when Nathaniel Henshaw proposed a hypo-hyperbaric room pressurized and depressurized with an organ bellows.<sup>1</sup> In the nineteenth century, Simpson wrote a treatise on the use of compressed air for certain respiratory diseases.<sup>2</sup> The medicinal uses of oxygen were first reported by Beddoes in 1794,<sup>3</sup> while the first article describing adjunctive uses of hyperbaric oxygen (HBO<sub>2</sub>) was written by Fontaine in 1879,<sup>4</sup> who constructed a mobile operating room that could be pressurized. He observed that pressurized patients were not as cyanotic after the use of nitrous oxide during induction of anesthesia as compared to patients anesthetized at atmospheric pressure. In addition, he noted that hernias were much easier to reduce. Around that time, the work of Paul Bert<sup>5</sup> and J. Lorrain-Smith<sup>6</sup> showed that oxygen under pressure had potentially deleterious consequences on the human body with side effects that included central nervous system and pulmonary toxicity. The efforts of Churchill-Davidson and Boerema in the 1950s and 1960s spurred the modern scientific use of clinical hyperbaric medicine.

In 1967, the Undersea Medical Society was founded by six United States Naval diving and submarine medical officers with the explicit goal of promoting diving and undersea medicine. In short order, this society expanded to include those interested in clinical hyperbaric medicine. In recognition of the dual interest by members in both diving and clinical applications of compression therapy, the society was renamed The Undersea and Hyperbaric Medical Society in 1986. It remains the leading not for profit organization dedicated to reporting scientifically and medically efficacious and relevant information pertaining to hyperbaric and undersea medicine.

In 1972, an ad hoc Medicare committee was formed to evaluate the efficacy of HBO<sub>2</sub> for specified medical conditions. The focus was to determine if this treatment modality showed therapeutic benefit and merited insurance coverage. The growth of the body of scientific evidence that had developed over the preceding years supported this endeavor and recognition for the field. In 1976, the Hyperbaric Oxygen Therapy Committee became a standing committee of what was then the UMS. The first Hyperbaric Oxygen Committee Report was published in 1977 and served as guidance for practitioners and scientists interested in HBO<sub>2</sub>. The report is usually published every three to five years and was last published in 2019. Additionally, this document continues to be used by the Centers for Medicare and Medicaid Services and other third-party insurance carriers in determining payment.

The report, currently in its 15<sup>th</sup> edition, continues to grow in size and depth to reflect the evolution of the literature. Observant readers will notice that we have changed the name of the committee and manual to recognize that the specialty of hyperbaric medicine encompasses more than just the delivery of oxygen under pressure. Hyperbaric physicians evaluate complex patients for underlying conditions that lead to ischemia and hypoxia, coordinate care with specialists to help reverse or overcome these conditions, and conduct research on the effects of action of oxygen under pressure. This year, a new indication—osteonecrosis of the femoral head—has been added to our list of recognized indications for which scientific and clinical evidence supports the use of HBO<sub>2</sub>. This edition also adds a chapter on Emerging Indications where HBO<sub>2</sub> may have some efficacy, but evidence is not robust enough for recognition by the committee, as well as a chapter discussing the rationale and evidence for choosing a specific dose of oxygen.

The Undersea and Hyperbaric Medical Society continues to maintain its reputation for its expertise on medicinal oxygen. With leading experts authoring chapters in their respective fields, this publication continues to provide the most current and up to date guidance and support for scientists and practitioners of hyperbaric medicine.

Enoch T. Huang, MD, MPH&TM  
Editor, UHMS Hyperbaric Medicine Committee Chair

## References

1. Henshaw N. Aero-Chalinos or a register for the air for the better preservation of health and cure of diseases, after a new method. London. 1677.
2. Simpson A. Compressed Air as a Therapeutic Agent in the Treatment of Consumption, Asthma, Chronic Bronchitis and Other Diseases. Edinburgh: Sutherland and Knox; 1857.
3. Beddoes T, Watt J. Considerations of the Medicinal Use of Factitious Airs, and on the Manner of Obtaining Them in Large Quantities, First Edition, part II. Bristol: Bulgin and Rossier; 1794.
4. Fontaine JA. Emploi chirurgical de l'air comprime. Union Med. 1879;28:445.
5. Bert P. Barometric Pressure [Hitchcock MS, Hitchcock FA, translation]. Bethesda, MD: Undersea Medical Society; 1978. P. 579.
6. Lorrain-Smith J. The pathological effects due to increase of oxygen tension in the air breathed. J Physiol. 1899; 24:19-35.

# Members of the Hyperbaric Medicine Committee

---

Enoch Huang, MD (Chair)

Michael Bennett, MD

Enrico Camporesi, MD

Paul Cianci, MD

Bruce Derrick, MD

William Dodson, MD

John Feldmeier, DO

Laurie Gesell, MD

Marvin Heyboer, MD

Irving Jacoby, MD

Richard Moon, MD

Heather Murphy-Lavoie, MD

Michael Strauss, MD

Stephen Thom, MD, PhD

Keith Van Meter, MD

Lindell Weaver, MD



In Memoriam:  
Dr. Michael Bennett  
(1956-2023)





# I. Background

---

The Undersea and Hyperbaric Medical Society (UHMS) is an international scientific organization that was founded in 1967 to foster exchange of data on the physiology and medicine of commercial and military diving. Over the intervening years, the interests of the Society have enlarged to include clinical hyperbaric oxygen. The society has grown to over 2,000 members and has established the largest repository of diving and hyperbaric research collected in one place. Clinical information, an extensive bibliographic database of thousands of scientific papers, books, and technical reports that represent the results of over 100 years of research by military and university laboratories around the world are contained in the UHMS Schilling Library, whose holdings are now part of the Duke University Library, Durham, NC. The results of ongoing research and clinical aspects of undersea and hyperbaric medicine are reported annually at scientific meetings and in *Undersea and Hyperbaric Medicine* published quarterly. Previously the society supported two journals, *Undersea Biomedical Research* and the *Journal of Hyperbaric Medicine*. These two journals were merged in 1993 into *Undersea and Hyperbaric Medicine*.

UHMS headquarters is located at:

631 US Highway 1, Suite 307  
North Palm Beach, FL 33408  
Phone: 561-776-6110 / 1-877-533-UHMS (8467)  
FAX: 919-490-5149  
Email: [uhms@uhms.org](mailto:uhms@uhms.org)  
Internet: [www.uhms.org](http://www.uhms.org)

## II. Defining the Specialty of Undersea and Hyperbaric Medicine

---

In the United States, the discipline of undersea & hyperbaric medicine is recognized by both the American Board of Emergency Medicine (ABEM) and the American Board of Preventive Medicine (ABPM) as warranting the status of a subspecialty under each of their specialty umbrellas. The description of this discipline in the United States and all other countries should begin with the basic scientific definition of the essential elements of hyperbaric oxygen (HBO<sub>2</sub>). However, to understand the complexities of its appropriate practice and to recognize and condemn the unfortunate proliferation of unsafe centers and unproven practices, it is necessary to append additional explanatory paragraphs that go beyond a simple physical definition.

# III. Definition of Hyperbaric Oxygen and its Safe Delivery

---

The definition of clinical HBO<sub>2</sub> is complex and often misrepresented to justify its use for unproven treatments. For this reason and to clarify misunderstandings, the UHMS Hyperbaric Medicine Committee has defined what a session of HBO<sub>2</sub> must include.

*Hyperbaric oxygen is a medical procedure requiring a physician's prescription and oversight. All patients must have their entire body placed within a hard sided hyperbaric chamber that meets the American Society of Mechanical Engineers and Pressure Vessels for Human Occupancy (ASME-PVHO-1) code, and the National Fire Protection Association (NFPA 99) code and standards for hyperbaric chambers, at a pressure of not less than 2.0 ATA (202.65 KPa) while breathing physician prescribed medical grade oxygen for an amount of time that is typically between 90-120 minutes per treatment. Medical grade oxygen (>99.0% oxygen purity) is the only acceptable gas that should be used for therapeutic delivery of hyperbaric oxygen.\**

During appropriate and acceptable clinical hyperbaric use, oxygen acts as a drug and is regulated by the FDA. Using Evidence Based Medicine (EBM) criteria, HBO<sub>2</sub> is dosed systemically by breathing medical grade oxygen under increased hyperbaric pressure, for the diagnoses described in this manual and approved by the Undersea and Hyperbaric Medical Society (UHMS)

## Proven Application of Hyperbaric Oxygen (HBO<sub>2</sub>)

The most common and acceptable clinical hyperbaric treatment pressures range between 2.0 ATA (202.65 KPa) and 3.0 ATA (303.975 KPa). The pressures used per treatment vary and are determined based on the acceptable guidelines for HBO<sub>2</sub> treatment found in this manual. These pressure requirements are supported by numerous publications and years of clinical practice. These standards are under constant review by the Hyperbaric Medicine Committee of the UHMS. Additionally, the UHMS Accreditation Council has established criteria for the safe and clinically appropriate delivery of HBO<sub>2</sub>. The FDA has advised patients to preferentially seek HBO<sub>2</sub> at hyperbaric facilities that have achieved accreditation by the UHMS Accreditation Council. Most appropriate disorders require a series of elective HBO<sub>2</sub> treatments delivered daily over a period of four to eight weeks. Certain emergency conditions are treated once or over a period of a few days depending on the diagnosis. A few emergency indications will require more than one treatment per day. In certain circumstances HBO<sub>2</sub> represents the primary treatment modality while in others it is an adjunct to surgical or pharmacologic interventions. All patients referred for HBO<sub>2</sub> should be evaluated and supervised by qualified physicians with appropriate undersea and hyperbaric medicine (UHM) training that includes both evaluation and treatment. Operational staff must be properly trained and ideally certified as a hyperbaric technologist (CHT) or as a hyperbaric nurse (CHRN).

## Hyperbaric Pressure

The term hyperbaric pressure is redundant. Hyper in medical terms signifies “above normal” or “increased”. Baric is a term coined around 1880 that pertains to weight or pressure of the atmosphere. So hyperbaric pressure can be simply stated as “hyperbaric.” Hyperbaric is defined as any atmospheric pressure above the normal pressure at sea level. Average pressure at sea level is 760 mmHg or 1 ATA (101.325 KPa). Atmospheric pressure fluctuates

---

\* Medical grade oxygen should meet United States Pharmacopeia (USP) or national equivalent standard for purity

(higher or lower) depending on the weather and the altitude where the pressure is measured. This measure of pressure has a number of other equivalent values including: 0 feet of seawater (fsw), 14.7 pounds per square inch (psi), 1 atmosphere absolute (1 ATA), 1.013 Bars, 101.325 KPa, and usually 0 when using a gauge that measures pressure at sea level.

### **Hyperbaric Air and its Potential Unsafe Delivery**

Hyperbaric air involves increasing the barometric pressure above normal atmospheric pressure while breathing air. This type of treatment was defined in the medical literature as early as 1662 and has no medical rationale when using pressures less than 2.0 ATA. The chambers delivered hyperbaric air for use as a “medical spa” as one would use a spa today; however, in the 1800s it was being used to support certain medical and surgical conditions without credible research at a time when Evidence Based Medicine (EBM) had not been developed. EBM did not become a standard until 1992 when introduced by Dr. David Sackett. The use of hyperbaric air in history was described by some physicians as having a physiologic basis, mainly when used above 2.0 ATA. Unfortunately, the use of hyperbaric air became a mainstay of many subjective treatments including the Spanish Flu, hypertension, diabetes mellitus, syphilis, and various cancer treatments that patients paid for without sound scientific proof of its efficacy. Those treatments had the added risk of patients suffering adverse effects of breathing hyperbaric air for long exposures.

### **Unproven Hyperbaric Treatment Often Termed Mild Hyperbaric Oxygen**

Mild hyperbaric facilities have proliferated in wellness centers, spas, and even shopping center store fronts. These centers use untested and uncertified chambers that present significant fire risks as well as potential loss of life due to explosive decompressions. Mild hyperbaric facilities are now employing oxygen concentrators to enrich the breathing gas mix in the subtherapeutic chamber pressures they employ. These concentrators are mated to delivery systems (simple oronasal masks or nasal prongs) that are subject to leaks, and the intrusion of ambient gasses results in a breathing mix that is well less than 100% oxygen. Both hyperbaric chambers and oxygen concentrators are Class II medical devices. The FDA requires that both be cleared individually and together for them to be marketed in the United States. Furthermore, these mild hyperbaric centers are using chambers not meeting the standards of the ASME PVHO-1 or the NFPA. As oxygen escapes into the chamber, it creates a significantly enriched oxygen atmosphere, and when it approaches a concentration of 23.5% or higher, it may have potential catastrophic results. The presence of oxygen enhances both the intensity and rapidity of the spread of fire. Many patients purchase these chambers for their home and have no guidance to the potential catastrophic occurrences.

Mild hyperbaric facilities typically deliver sessions for an hour or less, for a spectrum of medical disorders or complaints. When the proven and accepted indications for hyperbaric oxygen are treated in these mild hyperbaric chambers, this treatment is inadequate and ineffective. Moreover, these mild hyperbaric centers treat diagnoses for which HBO<sub>2</sub> has not been found to be clinically effective or listed in this manual’s accepted diagnoses. There is no credible evidence to support the use of mild hyperbaric oxygen for any EBM indication for hyperbaric oxygen as reported in this manual. The application of mild hyperbaric therapy for the treatment of acceptable indications can lead to severe disability or death of the patient or occupant because of inadequate treatment. Mild hyperbaric sessions are offered for many experimental indications for which there is no evidence based scientific support and usually against the healthcare advertising practices of both the Federal Trade Commission (FTC) and Federal Drug Administration (FDA). The target group for these treatments may include children with disorders such as autism, cerebral palsy, post concussive/traumatic brain injury syndromes, and near drowning with cerebral anoxia. Also targeted for treatment in mild hyperbaric centers are the elderly patients having suffered

cerebrovascular accidents (strokes) or those with cognitive decline. Since medical insurers do not reimburse for these experimental indications, patients are provided with a substantial out of pocket expense.

### **Hyperbaric oxygen IS**

- Treatment of the entire body
- Treatment at 2.0 to 3.0 ATA
  - Inhalation of 100% oxygen at pressure
  - Treatments usually 90 to 120 minutes
- A treatment prescribed and managed by a licensed physician

### **Hyperbaric oxygen is NOT**

- Topical application of oxygen
- Treatment at mild pressures less than 2.0 ATA
- Treatment in hyperbaric air
- Delivered by untrained and unlicensed personnel

## **IV. Classification of Hyperbaric Chambers**

The NFPA classifies chambers according to occupancy for the purposes of establishing minimum construction and operation requirements.<sup>1</sup>

1. Class A – Human, multiple occupancy
2. Class B – Human, single occupancy
3. Class C – Animal, no human occupancy

Clinical treatments can be carried out in either a Class A (multi) or B (mono) chamber system. In a Class B system, the entire chamber is pressurized with near 100% oxygen, and the patient breathes the ambient chamber oxygen directly. A Class A system holds two or more people (patients, observers, and/or support personnel); the chamber is pressurized with compressed air while the patients breathe near 100% oxygen via masks, head hoods, or endotracheal tubes. It is important to note that Class B systems can and are pressurized with compressed air while the patients breathe near 100% oxygen via masks, head hoods, or endotracheal tubes.

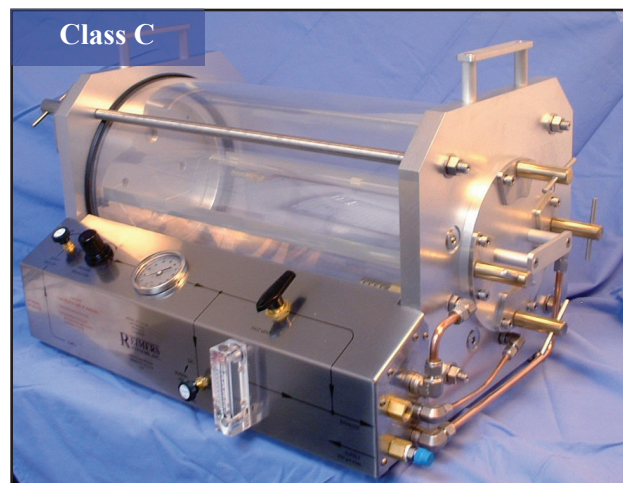


**Figure 1.** Multiplace Chamber

Photograph courtesy of Lindell Weaver MD, of Intermountain Medical Center, Murray, Utah. Fink DL8 multiplace chamber, Fink Engineering, Melbourne, Australia.



**Figure 2. Monoplace Chamber**  
Photograph courtesy of Sechrist Industries.



**Figure 3. Animal Chamber**  
Photograph courtesy of Reimers Systems.

According to the UHMS definition and the determination of The Centers for Medicare and Medicaid Services (CMS) and other third-party carriers, breathing medical grade near-100% oxygen at 1 atmosphere of pressure or exposing isolated parts of the body to 100% oxygen does not constitute HBO<sub>2</sub> therapy. The patient must receive the oxygen by inhalation within a pressurized chamber. Current information indicates that pressurization should be to 1.4 ATA or higher.

The literature of HBO<sub>2</sub> began to appear during the 1930s as navies and universities around the world began studies in oxygen breathing at elevated pressures as a way to more safely decompress divers and to treat decompression sickness and arterial gas embolism. During the 1960s, HBO<sub>2</sub> was incorporated in standard treatment tables of the U.S. Navy. Extensive research on oxygen toxicity was undertaken to establish safe limits, overall safety, and medical and physiologic aspects of the compressed gas environment. These efforts led to a vast body of literature that underpins modern hyperbaric medicine.

In 1976, recognizing the need for meticulous scrutiny of emerging clinical applications of HBO<sub>2</sub>, the Executive Committee of the UHMS established the Hyperbaric Oxygen Therapy (now Hyperbaric Medicine) Committee. The Committee was charged with the responsibility of continuously reviewing research and clinical data and rendering recommendations regarding clinical efficacy and safety of HBO<sub>2</sub>. To achieve this goal, the multi-specialty committee is comprised of practitioners and scientific investigators in the fields of internal medicine, infectious diseases, pharmacology, emergency medicine, general surgery, orthopedic surgery, trauma surgery, thoracic surgery, otolaryngology, oral and maxillofacial surgery, anesthesiology, pulmonology, critical care, radiation oncology and aerospace medicine.

Since 1976, the Committee has met annually to review research and clinical data. From the 28 indications for which third-party reimbursement was recommended in the 1976 and 1979 reports, the number of recognized indications has been refined to 15 in the current report. These indications are those for which in vitro and in vivo pre-clinical research data as well as extensive positive clinical experience and study have become convincing.

Evidence considered by the Committee includes sound physiologic rationale; in vivo or in vitro studies that demonstrate effectiveness; controlled animal studies, prospective controlled clinical studies; and extensive clinical experience from multiple, recognized hyperbaric medicine centers.

The Committee requires that experimental and clinical evidence submitted for the efficacy of HBO<sub>2</sub> treatment for a disorder be at least as convincing as that for any other currently accepted treatment modality for that disorder. Studies in progress will continue to clarify mechanisms of action, optimal oxygen dosage, duration of exposure times, frequency of treatments, and patient selection criteria. The Committee recommends third party reimbursement of HBO<sub>2</sub> for the disorders included in the accepted conditions category. Currently, most insurance carriers have established HBO<sub>2</sub> reimbursement policies.

The Committee also reviews cost effectiveness and has established guidelines for each entity. Results show that, in addition to its clinical efficacy, HBO<sub>2</sub> yields direct cost savings by successfully resolving a high percentage of difficult and expensive disorders, thereby minimizing prolonged hospitalization. However, the Committee recommends that each individual hyperbaric facility, whether monoplac or multiplace, establish its own charges consistent with the actual local costs of providing such service.

## V. Utilization Review for Hyperbaric Oxygen

---

A utilization review section is presented for each recognized HBO<sub>2</sub> indication. It is recommended that utilization review be obtained if the number of HBO<sub>2</sub> treatments is to exceed the recommended number of treatments for that indication. Such review should involve discussion of the clinical case with another qualified hyperbaric medicine physician from an outside institution. If that individual agrees that additional HBO<sub>2</sub> is warranted, treatment may exceed the usually prescribed number of treatments.

## VI. Acceptance (Addition) of New Indications for Hyperbaric Oxygen

---

New indications for HBO<sub>2</sub> are considered for acceptance at the meeting of the Hyperbaric Medicine Committee during the annual meeting of the Undersea and Hyperbaric Medical Society. This consideration can be initiated from within the Committee itself or may result in response to a written request by a non-Committee member. When a new indication is considered for acceptance, an application is completed that summarizes the in vitro, in vivo, and clinical aspects of the new indication for HBO<sub>2</sub> therapy. The application is presented to the committee, and a member is selected to present counter arguments to accepting each new indication. At the Annual Scientific Meeting of the UHMS, the petitioner's and opposition's arguments are presented to the Hyperbaric Medicine Committee. A consensus of the Hyperbaric Medicine Committee is required to recommend that the indication be moved into the Accepted category. If the Committee determines that a new condition merits acceptance, it makes this recommendation to the Executive Committee of the Society, which ultimately votes whether or not to recognize the new indication.

## VII. List of Abbreviations

---

ABI	ankle-brachial index	CO	carbon monoxide
ACGIH	American Conference of Governmental Industrial Hygienists	CONSORT	Consolidated Standards of Reporting Trials
AGE	arterial gas embolism	CPA	O <sub>2</sub> stable lecithinase-C alpha toxin
AHA	American Heart Association	CPB	cardiopulmonary bypass
AKA	above knee amputation	CPG	clinical practical guidelines
ANAM	automated neuropsychological assessment metric	CRA	central retinal artery
ARDS	acute respiratory distress syndrome	CRAO	central retinal artery occlusion
ATA	atmospheres absolute	CSF	cerebrospinal fluid
ATM	atmosphere	CT	computed tomography
ATP	adenosine triphosphate	cTnI	troponin I
AVNFB	avascular necrosis of the femoral head	CV	cardiovascular
BCBS	Blue Cross Blue Shield	CVA	cerebrovascular accident
BCVA	baseline best corrected visual acuity	CvO <sub>2</sub>	venous content of oxygen in blood
bFGF	basic fibroblast growth factor	DAI	diffuse axonal injury
BID	two times a day	dB	decibel
BKA	below knee amputation	DCI	decompression illness
BMJ	<i>British Medical Journal</i>	DCS	decompression sickness
BP	blood pressure	DFU	diabetic foot ulcer
BRAO	branch retinal artery occlusion	dL	deciliter
BSA	body surface area	DM	diabetes
CABG	coronary artery bypass graft	DO <sub>2</sub>	oxygen delivery
CAGE	cerebral arterial gas embolism	EBI	evidence-based indications
CaO <sub>2</sub>	arterial content of oxygen in blood	EBM	evidence-based medicine
CAT	catalase	ECHM	European Committee for Hyperbaric Medicine
CBC	complete blood count	EKG	electrocardiogram
CDER	Center for Drug Evaluation and Research	EMS	emergency medical services
CDRH	Center for Devices and Radiological Health	ENT	ear, nose, and throat
CDSR	Cochrane Database of Systematic Reviews	eNOS	endothelial nitric oxide synthase
CEBM	Oxford Centre for Evidence-Based Medicine	EPC	endothelial progenitor cells
CGA	Compressed Gas Association	ESR	erythrocyte sedimentation rate
cGy	centigray	ESTRO	European Society of Therapeutic Radiology and Oncology
CI	cardiac index	EVA	extravehicular activities
CMS	Centers for Medicare and Medicaid Services	FBF	fibroblast growth factors
CNS	central nervous system	FDA	Food and Drug Administration
CO <sub>2</sub>	carbon dioxide	FiO <sub>2</sub>	fraction of inspired oxygen
COHb	carboxyhemoglobin	FMD	flow-mediated dilation

## VII. List of Abbreviations (continued)

fsw	feet of sea water	IT	intra-tympanic
g	gram	ITT	intention to treat
GAS	group A <i>streptococcus</i>	ITS	intratympanic steroid
GCP	good clinical practice	IU	international unit
GCS	Glasgow Coma Scale	IV	intravenous therapy
GI	gastrointestinal	IVFA	intravenous fluorescein angiogram
GMCSF	granulocyte-macrophage colony stimulating factor	IVIG	intravenous immunoglobulin
Gy	gray	IVS	intravenous steroid
H <sub>2</sub> O <sub>2</sub>	hydrogen peroxide	KD	ketogenic diet
HBO <sub>2</sub>	hyperbaric oxygen	kg	kilogram
HCFA	Health Care Financing Administration	kPa	kilopascal
HCIO	hypochlorous acid	LENT-SOMA	late effects in normal tissues subjective, objective, management, and analytic score
HCV	hepatitis C virus	LDL	low density lipoprotein cholesterol
Hgb	hemoglobin	LR	lactated Ringer's solution
HIF	hypoxia-inducible factor	LRINEC	Laboratory Risk Indicator for Necrotizing Fasciitis
HIV	human immunodeficiency virus	MACE	Military Acute Concussion Evaluation
HODFU	hyperbaric oxygen therapy in diabetics with chronic foot ulcers	MBC	minimum bactericidal concentration
HOPPS	Hospital Outpatient Prospective Payment System	MEB	middle ear barotrauma
HTN	hypertension	MESS	mangled extremity severity score
Hz	hertz	mg	milligram
IB	investigator's brochure	MI	myocardial infarction
IBDQ	inflammatory bowel disease questionnaire	MIC	minimum inhibitory concentration
ICA	intracranial abscess	mL	milliliter
ICAM	intracellular adhesion molecule	mmHg	millimeters of mercury
ICG	indocyanine green fluorescence	MMP	matrix metalloproteinase
ICGA	indocyanine green fluorescence angiography	MOF	multiorgan failure
ICU	intensive care unit	MoHC	monoplace hyperbaric chamber
IDE	investigational device exemption	MPa	megapascal
IL	interleukin	MR	magnetic resonance
IM	internal medicine	MRI	magnetic resonance imaging
IMRT	intensity-modulated radiation	mRNA	messenger ribonucleic acid
IND	investigational new drug	MRSA	methicillin-resistant <i>Staphylococcus aureus</i>
INR	in-water recompression	MSAC	Medicare Service Advisory Committee (Australia)
IR	ischemia-reperfusion	msw	meters of sea water
IRB	institutional review board	MT	medical therapy
ISSHL	idiopathic sudden sensorineural hearing loss		



mTBI	mild traumatic brain injury	PDGF	platelet derived growth factor
N <sub>2</sub>	nitrogen	PDHA	post-deployment health assessment
N <sub>2</sub> O	nitrous oxide	PDPH	post-dural procedural headache
NAC	N-acetylcysteine	PFO	perfringolysin
NAT	nucleic acid testing	PET	positron emission tomography
NATO	North Atlantic Treaty Organization	PG	pyoderma gangrenosum
NBA	normobaric air	PM	progressive myopia
NBO <sub>2</sub>	normobaric oxygen	PML	polymorphonuclear leukocytes
NCI-PDQ	National Cancer Institute Patient Data Query	PMN	polymorphonuclear neutrophils
NF	nuclear factor	PMNL	polymorphonuclear leukocytes
NFPA	National Fire Protection Association	PO <sub>2</sub>	partial pressure of oxygen
NFST	national fire select test	POS	oral steroid
NIH	National Institute of Health	ppm	parts per million
NIOSH	National Institute for Occupational Safety and Health (U.S.)	PTA	pure tone average
NLR	neutrophil-lymphocyte ratio	PtcO <sub>2</sub>	transcutaneous partial pressure oxygen measurement
NNT	number needed to treat	PTCI	percutaneous transluminal coronary intervention
NO	nitric oxide	PT	prothrombin time
NOS	nitric oxide synthase	PTSD	post-traumatic stress disorder
NRC	National Research Council of the National Academies	PTT	partial prothrombin time
NSAID	nonsteroidal anti-inflammatory drug	PVR	pulse volume recordings
NSF	National Science Foundation	QALY	quality adjusted life years
NSTI	necrotizing soft-tissue infection	QH	every hour
NSE	neuron-specific enolase	RANKL	receptor activator of nuclear factor-kappa B
O <sub>2</sub>	oxygen	RBC	red blood cell
ON	osteonecrosis	RCT	randomized controlled trial
OOC	organ of Corti	RF	retrolental fibroplasia
OPG	osteoprotegerin	RNS	reactive nitrogen species
ORN	osteoradionecrosis	ROS	reactive oxygen species
OR	odds ratio	SARS	severe acute respiratory syndrome
OSHA	Occupational Safety and Health Administration	SCD	sickle cell disease
PAD	Peripheral arterial disease	SEK	Swedish kroner currency
PAR	percent area reduction	SD	standard deviation
paO <sub>2</sub>	arterial oxygen tension	SGB	stellate ganglion block
PAOD	peripheral arterial occlusive disease	SMCS	skeletal muscle compartment syndrome
PBMC	peripheral blood monocytes	SPC	stem progenitor cell
PCL-M	PTSD checklist – military version	SpCO	carboxyhemoglobin saturation
PCS	post-concussion syndrome	SPECT	single-photon emission computed tomography

## VII. List of Abbreviations (continued)

SPP	skin perfusion pressure
SSc	systemic scleroderma
SSHL	sudden sensorineural hearing loss
ST	standard therapy
TACO	transfusion associated circulatory overload
TAD	transfusion associated dyspnea
TBSA	total body surface area
TBI	traumatic brain injury
TCOM	transcutaneous oxygen measurement
TcPO <sub>2</sub>	transcutaneous oxygen partial pressure
TEN	toxic epidermal necrolysis
TGF	transforming growth factor
TIMP	tissue inhibitor of metalloproteinase
TNF	tumor necrosis factor
TRALI	transfusion related acute lung injury
TRAM	transverse rectus abdominis myocutaneous
TRPV	transient receptor potential vanilloid
TTI	transfusion-transmitted infection
TWA	time weighted average
Tx	treatment
UHMS	Undersea and Hyperbaric Medical Society
UMS	Undersea Medical Society
USAF	United States Air Force
USN	United States Navy
USP	United States Pharmacopoeia
VD	vasodilator
VEGF	vascular endothelial growth factor
VGE	venous gas embolism
VLU	venous leg ulcer
VO <sub>2</sub>	oxygen consumption
WHO	World Health Organization
WRS	word recognition score
XD	xanthine dehydrogenase
XO	xanthine oxidase

## VIII. Author Biographies

---

### *Caesar A. Anderson MD, MPH, CWS*

Dr. Anderson specializes in hyperbaric medicine and limb salvaging with board certification in internal medicine, undersea and hyperbaric medicine and the practice of advanced wound care. He has surgical expertise in the use of bioengineered skin substitutes and advanced wound management and serves as medical director of UC San Diego Health's hyperbaric and wound care program in Encinitas. He completed a fellowship in diving and hyperbaric medicine at the University of Pennsylvania Hospital in Philadelphia and a combined residency training program in internal and preventive medicine at Yale-New Haven Hospital and Griffin Hospital in Connecticut. Dr. Anderson did his general surgery residency at the University of Connecticut and earned his medical degree from Howard University College of Medicine in Washington DC, and his master's degree in public health from Yale University School of Medicine.

### *Richard C. Baynosa MD, FACS*

Tenured Professor & Founding Chair, Department of Plastic & Reconstructive Surgery, Kirk Kerkorian School of Medicine at UNLV  
Chief of Surgery at University Medical Center of Southern Nevada, President at Mountain West Society of Plastic Surgeons

### *Michael H. Bennett MD, FANZCA, MM(Clin Epi), Dip Advanced DHM (ANZCA)*

Professor Bennett is the academic head of the department of anesthesia, a senior staff specialist in diving and hyperbaric medicine at Prince of Wales Hospital, and conjoint professor in the faculty of medicine, University of New South Wales in Sydney, Australia. He graduated from the University of New South Wales in 1979 and spent his early post-graduate training at the Prince Henry/Prince of Wales Hospitals before undertaking training in anesthesia in the UK. He was medical director of the Department of Diving and Hyperbaric Medicine at POWH from 1993 to 2007.

In 2002 he was the recipient of the Behnke Award for outstanding scientific achievement from the Undersea and Hyperbaric Medical Society. He is the author of over 140 peer-reviewed publications including 15 Cochrane reviews of the evidence in diving and hyperbaric medicine. He is an executive member of the Australia and New Zealand College of Anesthetists (ANZCA) special interest group in diving and hyperbaric medicine and chair of the ANZCA DHM subcommittee responsible for the ANZCA Diploma of Advanced DHM. He is a past vice-president of the UHMS and currently the past president of SPUMS. Conjoint Professor, UNSW Medicine, University of NSW. He is also Academic Director, Wales Anesthesia, Prince of Wales Hospital, Randwick, NSW Australia.

### *Gerardo Bosco MD, PhD*

Associate Professor, Department of Biomedical Sciences, University of Padova, Italy  
Director: Master II level in Diving and Hyperbaric Medicine Course in Technical and Health Management in the Hyperbaric Chamber Department of Biomedical Sciences, University of Padova, Italy

## VIII. Author Biographies (continued)

### *Jay C. Buckey, M.D.*

Professor of Medicine, Geisel School of Medicine at Dartmouth  
Medical Director, Center for Hyperbaric Medicine at Dartmouth-Hitchcock Medical Center

Dr. Buckey is the Medical Director of the Center for Hyperbaric Medicine at Dartmouth and has had long-standing involvement in research on the effects and uses of hyperbaric oxygen. The Dartmouth center was part of a phase I trial of hyperbaric oxygen as a radiation sensitizer for head and neck cancer, and participated in a randomized, sham-controlled trial of hyperbaric oxygen for moderately severe ulcerative colitis. The center has also completed two other clinical trials—a dose ranging trial of hyperbaric oxygen for severe ulcerative colitis, and a phase 1 trial of hyperbaric oxygen for radiosensitization of isolated brain metastases prior to stereotactic radiosurgery. Dr. Buckey also initiated and currently directs the International Multicenter Registry for Hyperbaric Oxygen Therapy, which is a consortium of hyperbaric centers that collect consistent outcome data on all patients treated with hyperbaric oxygen therapy.

### *Frank Butler Jr. MD, Capt, MC, USN (Ret)*

Dr. Butler is a former U.S. Navy SEAL platoon commander and a pioneer in the field of ophthalmology and diving. He has been a diving medical research officer at the U.S. Navy Experimental Diving Unit where he helped to develop many of the diving techniques and procedures used by Navy SEALs today. His landmark paper, “Diving and Hyperbaric Ophthalmology,” was the first comprehensive review of ocular disorders in diving and is now the standard on this topic. His 2008 paper in *Undersea and Hyperbaric Medicine* provided the first comprehensive overview of the use of HBO<sub>2</sub> in ocular disorders. Dr. Butler has volunteered his time as an ophthalmology consultant to UHMS and the Divers’ Alert Network since 1995, providing expert advice to divers around the world. He served for three years as a member of the Board of Directors for the Undersea and Hyperbaric Medical Society. He is the Co-Chair of the UHMS Decompression Sickness and Arterial Gas Embolism Committee and is currently spearheading the Society’s effort to develop evidence-based best practice guidelines to improve the treatment of these disorders. Dr. Butler has been awarded the U.S. Special Operations Command Medal by Admiral Bill McRaven and the Academy of Underwater Arts and Sciences NOGI Award for Distinguished Service to the diving community. He currently chairs the Department of Defense’s Committee on Tactical Combat Casualty Care.

### *Enrico M. Camporesi MD, FUHM, AB*

Enrico M. Camporesi MD (Milan, 1970), FUHM (2000), AB Anesthesiology (1978)

AB Undersea Medicine (2000 and 2009)

HBO Committee (1988, Chair, 1996)

Past President, UHMS (2000-2002)

Treasurer (2012-2014)

Editor in Chief, UHM (2016-present)

Emeritus Professor of Surgery, Department of Surgery, University of South Florida, Tampa, Florida

Attending Anesthesiologist, TeamHealth, Tampa General Hospital, Tampa, Florida

Director of Research, TeamHealth Research Institute

Hyperbaric Medicine Director, Memorial Hospital of Tampa

Research interest in anesthesia, respiration and exercise in extreme environments, diving medicine and hyperbaric oxygen biology

***Benjamin Cherng, MBBS, MBBS (National University of Singapore), MRCP (UK)***

Consultant, Department of Infectious Diseases, Singapore General Hospital  
Program Director, Singhealth Infectious Diseases Residency, Singapore

***Paul Cianci MD, FACS, FUHM, FACP***

Director, Hyperbaric Medicine Department, Doctors Medical Center, San Pablo, CA  
Director Emeritus, Department of Hyperbaric Medicine, John Muir Medical Center, Walnut Creek, CA  
Director Emeritus, Department of Hyperbaric Medicine, Saint Francis Memorial Hospital, San Francisco, CA  
Diplomate, American Board of Internal Medicine  
Fellow, American College of Physicians  
Certified by the American Board of Preventative Medicine in the subspecialty of subsea and hyperbaric medicine  
Fellow, Undersea and Hyperbaric Medicine  
Professor Emeritus of Internal Medicine, University of California, Davis  
Past President, Undersea and Hyperbaric Medical Society  
Current member of the UHMS Hyperbaric Oxygen Committee  
Consultant to the DOD, NOAA, and State of California  
Visiting distinguished professor, University of Texas, Houston  
Director, Department of Hyperbaric Medicine, Health Science Center, University of Texas, Houston (1998–1990)

***Julia Faulkner***

Julia Faulkner has been the executive assistant in the Department of Hyperbaric Medicine at Doctors Medical Center, San Pablo, CA, for over 30 years. During that time, she has been an integral part of the preparation and the publishing aspects of many of the peer review papers from this group of doctors.

***John J. Feldmeier DO, FACRO, FUHM***

Professor Emeritus and Past Chairman, Radiation Oncology, University of Toledo Medical Center

Dr. Feldmeier is Professor Emeritus of Radiation Oncology at the University of Toledo from which he has just retired as the long-term chairman. He has been recognized as a “Best Doctor” since 2007. He is a past president of the Undersea and Hyperbaric Medical Society and recognized as an expert in applying hyperbaric oxygen to the management of radiation injuries. He is board certified in both radiation oncology and hyperbaric medicine.

***Laurie Beth Gesell MD, FACEP, FUHM***

System Director, Hyperbaric Medicine and Wound Care, Aurora Health Care Medical Group  
Section Chair, Undersea and Hyperbaric Medicine, Aurora St. Luke’s Medical Center, Milwaukee, Wisconsin

Dr. Gesell is the system director for hyperbaric medicine and wound care with Aurora Health Care Medical Group and section chair for undersea and hyperbaric medicine. She is board certified in emergency medicine and undersea and hyperbaric medicine. Dr. Gesell is a Fellow of the American College of Emergency Physicians, as well as the Undersea and Hyperbaric Medical Society. Dr. Gesell is a past president of the Undersea and Hyperbaric Medical Society, past chair of the UHMS Board of Directors, and former chair of the UHMS Hyperbaric Oxygen Therapy Committee. She currently serves as the UHMS Treasurer. Dr. Gesell also represents the medical specialty as the UHMS Delegate in the AMA House of Delegates.

## VIII. Author Biographies (continued)

### ***Dr. Georgios F. Giannakopoulos MD, PhD, FEBTS, FACS***

Georgios Giannakopoulos is a consultant Traumasurgeon and Helicopter Emergency Medical Services (HEMS) physician at Amsterdam University Medical Centre and the 'Lifeline 1' HEMS in Amsterdam, The Netherlands. He has special interest in the early prehospital and in-hospital management and treatment of the severely injured patient, the operative treatment of spinal injuries, limb reconstruction after severe injury and fracture healing disorders (non-union) with special interest in fracture related infections. As a fellow of the European board of Trauma Surgery and fellow of the American College of Surgeons he is interested in surgical education and scientific research. He participates in several national and international projects and his publication list counts more than 70 peer-reviewed articles.

### ***Catherine E. Hagan MD, MS, CDR MC (UMO) USN***

Chief Medical Officer, Staff Ophthalmologist, Anterior Segment & Corneal Refractive Surgeon, Naval Hospital Jacksonville, Florida

Dr. Hagan obtained her undergraduate degree in zoology from the University of Florida and attended medical school at the University of Louisville, KY. In 2007, she became the 11<sup>th</sup> woman in U.S. history to earn the Submarine Medical Officer Qualification. Upon completion of ophthalmology residency in 2008 at the Naval Medical Center San Diego, CA, she was awarded the department's only Excellence in Research award for her support with the publication, proposal and ultimate approval of Central Retinal Artery Occlusion (CRAO) as an accepted indication for HBO<sub>2</sub> Therapy by the UHMS. Since residency, she has been stationed at Naval Hospital Camp LeJeune, NC, from 2008-2011 and Naval Hospital Jacksonville since 2011, where she has held multiple leadership roles such as Department Head of Ophthalmology and Refractive Surgery, Chair of Credentials Committee, Surgical Physician Advisor of Process Improvement, and Chair of the Medical Executive Committee. She is currently serving as the Chief Medical Officer of Naval Hospital Jacksonville and its five branch health clinics spanning from Key West, FL to Albany, GA. CDR Hagan continues to serve as a consultant on ocular disorders for the U.S. Navy Dive School and is an invited guest lecturer twice a year on the topic of treating CRAO with HBO<sub>2</sub>.

### ***Brett B. Hart MD, FUHM***

Dr. Hart earned his MD from the Uniformed Services University of the Health Sciences. He completed hyperbaric medicine fellowship training at Duke University and is dual board certified in anesthesiology and undersea and hyperbaric medicine. A former U.S. Navy Undersea Medical Officer, Dr. Hart now serves as a Pharmacovigilance Medical Monitor at Emmes in Rockville, Maryland.

### ***Marvin Heyboer III, MD, FUHM***

Professor, Emergency Medicine  
Division Chief, Hyperbaric Medicine & Wound Care  
State University of New York, Upstate Medical University, Syracuse, NY

Marvin Heyboer III, MD is a Professor of Emergency Medicine, Division of Hyperbaric Medicine and Wound Care at SUNY Upstate Medical University in Syracuse, NY. He is Medical Director of the Hyperbaric Medicine and Wound Care Center. In addition, he is the Program Director of the Fellowship in Undersea and Hyperbaric Medicine. He graduated from Case Western Reserve University School of Medicine. He completed residency in Emergency Medicine with Michigan State University at Spectrum Health in Grand Rapids, Michigan and completed a fellowship in Undersea and Hyperbaric Medicine at Hospital of the University of Pennsylvania. Dr.

Heyboer is board certified in Emergency Medicine and Undersea and Hyperbaric Medicine by the American Board of Emergency Medicine.

***Enoch T. Huang MD, MPH&TM, FUHM, FACEP, FACCWS***

Dr. Huang is the program medical director for hyperbaric medicine and chronic wound care at Legacy Emanuel Medical Center in Portland, OR. He graduated from Princeton University with a degree in chemistry. He attended medical school at Tulane University School of Medicine where he also obtained a master's degree in public health and tropical medicine. He completed a residency in emergency medicine at the University of California, Irvine and went on to complete a fellowship in undersea and hyperbaric medicine at the University of Pennsylvania. He is board-certified in emergency medicine as well as undersea and hyperbaric medicine. He is the founder and past-president of the Columbia Wound Care Community—a multidisciplinary, multihospital group of wound care providers in the greater Portland metropolitan area. He is the past-president of the Undersea and Hyperbaric Medical Society.

***Irving "Jake" Jacoby MD, FACP, FACEP, FAAEM, FUHM***

Dr. Jacoby is Clinical Professor of Emergency Medicine, Emeritus, at the University of California San Diego School of Medicine, La Jolla, CA. He graduated from the University of Miami with a degree in Chemistry. He attended medical school at the Johns Hopkins University School of Medicine. He completed an Internal Medicine Residency at the Boston City Hospital and Peter Bent Brigham Hospital in Boston, and was Chief Resident in Medicine at the Boston City Hospital. He went on to complete a Fellowship in Infectious Diseases at the Peter Bent Brigham Hospital. He is Board certified in Internal Medicine, Infectious Diseases, Emergency Medicine and Undersea and Hyperbaric Medicine. He has a particular interest in the intersection of infectious diseases and hyperbaric medicine. Additionally he founded and continues to serve as Commander of the San Diego-based Disaster Medical Assistance Team (DMAT CA-4), a response team of the National Disaster Medical System, U.S. Dept of Health & Human Services.

***Shawna Kleban MD***

Chief Resident, Department of Plastic Surgery, University of Nevada Las Vegas School of Medicine

***Tracy Leigh LeGros MD, PhD, FAAEM, FACEP, FUHM***

Tracy Leigh LeGros is a Professor of Emergency Medicine and the Director of Faculty Development at the University of Tennessee Health Sciences Center, Regional One Physicians Level 1 Trauma Center in Memphis Tennessee. Prior to this, Tracy was a Clinical Professor in Emergency Medicine and the Program Director of the LSU Undersea and Hyperbaric Medicine Fellowship at University Medical Center in New Orleans, Louisiana. Dr. LeGros obtained her Doctorate in Physiology from LSU School of Graduate Studies and her Medical Doctorate from LSU School of Medicine. She matched her first choice in residency—the Charity Hospital Emergency Medicine Residency. Tracy graduated as a chief resident and the Lauro Award winner at graduation. Dr. LeGros then completed a fellowship in Undersea and Hyperbaric Medicine with Dr. Keith Van Meter. She has been a clinical and academic attending in both emergency medicine and undersea and hyperbaric medicine for the last 20 years.

## VIII. Author Biographies (continued)

**Simon J. Mitchell MB ChB, PhD, DipAdvDHM (ANZCA), DipOccMed, FUHM, FANZCA**

Professor of Anesthesiology, School of Medicine, University of Auckland

Dr. Mitchell is a physician and scientist with specialist training in diving medicine and anesthesiology. His diving career has included more than 6,000 dives spanning sport, scientific, commercial, and military diving. He was elected to Fellowship of the Explorers' Club of New York in 2006 and was the DAN Rolex Diver of the Year in 2015. He is widely published with over 150 papers or book chapters. He has twice been vice president of the Undersea and Hyperbaric Medicine Society (USA) and in 2010 received the society's Behnke Award for contributions to the science of diving and hyperbaric medicine. In the past, Simon was a naval diving medical officer and medical director of the Wesley Centre for Hyperbaric Medicine in Brisbane. He now works as a consultant anesthetist at Auckland City Hospital and Professor of Anesthesiology at the University of Auckland.

**Richard E. Moon MD, FRCPC, FACP, FCCP, FUHM**

Professor of Anesthesiology and Medicine, Medical Director, Center for Hyperbaric Medicine and Environmental Physiology, Duke University Medical Center, Durham, NC

Dr. Moon has served as president of the UHMS. His publications include diving physiology and medicine, hyperbaric oxygen, and monitoring of patients under anesthesia. His research interests include the study of cardiorespiratory function during diving and high-altitude exposure, decompression procedures, swimming-induced pulmonary edema, hyperbaric oxygen therapy and opioid-induced respiratory depression.

**Heather Murphy-Lavoie MD, UHM, FACEP, FAAEM**

Clinical Professor of Emergency Medicine, LSU Health Sciences Center  
University Medical Center, Emergency Department  
Emergency Medicine Residency  
Undersea and Hyperbaric Medicine Fellowship, New Orleans, Louisiana

Heather Murphy-Lavoie MD, UHM, FACEP, FAAEM is a clinical professor of medicine at the Louisiana State University School of Medicine. She received her undergraduate degree, with honors, in biomedical engineering from Tulane University. She matriculated in the top third of her class from Tulane School of Medicine. She graduated as a chief resident from Charity Hospital's Emergency Medicine residency and completed her Undersea and Hyperbaric Medicine Fellowship under Dr. Keith Van Meter. She is board certified in emergency medicine and in the subspecialty of Undersea and Hyperbaric Medicine. She is a Fellow in the American College of Emergency Physicians (FACEP) and a Fellow in American Academy of Emergency Medicine (FAAEM). She serves on the Education Committee of the American Academy of Emergency Medicine. She has been on the UHMS Education Committee for 13 years, serving as chair for the last six years, and has been on the HBO<sub>2</sub> Therapy Committee since 2009. In 2006, she brought forth Central Retinal Artery Occlusion (CRAO) as a proposed new indication before the HBO<sub>2</sub> Therapy Committee. It is because of her efforts that CRAO is now an accepted indication. In 2011, she again proposed two new indications before this same august body and coordinated her fellowship team to successfully advocate for the addition of acute idiopathic sensorineural hearing loss as the latest accepted indication. She is a nationally recognized lecturer and advocate for the UHM specialty.

Her awards include the following: FUHM status (2014); Paul James Sheffield Education Award for Lifetime Achievement (2012); Caroline Sue Ray Lifetime Achievement Award (2012); Outstanding Lecturer Award for Excellence in Graduate Medical Education; and Hyperbaric Medicine Fellowship (2007 and 2010). She has been instrumental in training 41 UHM fellows to date.



Dr. Murphy-Lavoie has authored numerous scientific publications in emergency medicine and hyperbaric medicine, including over 20 book chapters. She has published extensively on the use of hyperbaric oxygen therapy for ophthalmologic diseases.

***Matteo Paganini MD***

Emergency Medicine Chief Resident, University of Padova, Italy  
Research interests on undersea and hyperbaric medicine, wilderness, prehospital and disaster medicine  
Former Italian Navy Cadet, Navy Military School in Venice

***Alex Rizzato PhD, MSc***

Research fellow, Department of Biomedical Sciences, University of Padova, Italy

***William Santiago, MD***

Associate Professor, Emergency Medicine  
Associate Medical Director, Hyperbaric Medicine & Wound Care  
State University of New York, Upstate Medical University, Syracuse, NY  
Education: BS (Biology), Wright State University; MD, University of Cincinnati College of Medicine;  
Emergency Medicine Residency, SUNY Upstate, Syracuse, NY; Undersea and Hyperbaric Medicine  
Fellowship, SUNY Upstate, Syracuse, NY  
Board certified in Emergency Medicine and Undersea & Hyperbaric Medicine Certified in Wound Medicine  
by American Board of Wound Medicine and Surgery.

***Ronald Sato MD***

Dr. Sato, a native of Hawaii, received his medical degree from Yale University Medical School and trained as a resident at Stanford University. He has participated as a burn fellow at the University of Texas Health Science Center and has taught at Stanford University. In addition to his work on numerous publications related to burn care and plastic reconstructive surgery, he has served on the advisory board of the American Burn Association and as a member of the editorial staff for the *Journal of Burn Care and Rehabilitation*. Dr. Sato has been the director of the Burn Center at Doctors Medical Center for over 19 years, where he has dedicated a large part of his medical career to the treatment of severely burned patients and those with severely infected and chronic wounds.

***Davut J. Savaser MD, MPH, FAAEM, FACEP***

Hyperbaric Medicine and Chronic Wound Clinic, Legacy Emanuel Medical Center, Portland, Oregon

Dr. Savaser is a board-certified physician in both emergency medicine and undersea & hyperbaric medicine. He practices emergency medicine at multiple locations throughout the Pacific Rim, including practice locations at Legacy Good Samaritan Medical Center and undersea & hyperbaric medicine/wound care at Legacy Emanuel Medical Center, in Portland, Oregon. He has been an active leader in both fields and their societies, having held leadership roles within the American College of Emergency Physicians (ACEP) and the Undersea and Hyperbaric Medical Society (UHMS). He was honored in 2021 with the Excellence in Hyperbaric Medicine Award by the UHMS.

## VIII. Author Biographies (continued)

### ***Chai Rick Soh MD***

Head, Department of Anaesthesiology, Singapore General Hospital (SGH)  
Senior Consultant, Hyperbaric and Diving Medicine Centre, SGH  
Senior Consultant, Department of Surgical Intensive Care, SGH  
Associate Professor, Duke-NUS Medical School.  
Deputy Vice Chair, Education, Anaesthesiology Academic Clinical Program  
Co-director, Human Structure and Function Course, Duke-NUS Medical School, Singapore

### ***Michael B. Strauss MD***

Dr. Strauss has over a 40-year association with hyperbaric medicine focusing on orthopedic, wound care and diving applications of this discipline. He is a board-certified orthopedic surgeon with over 20 years' service as the orthopedic surgeon coordinator for his medical center's Class 2 (no 24/7 onsite neurosurgeon) trauma center. During this time he served as the medical director for his medical center's nationally recognized hyperbaric medicine program. He has over 200 citations in the medical literature on subjects related to his hyperbaric medicine experiences including those on crush injuries and compartment syndromes. Dr. Strauss generated the crush injury section for the first *Hyperbaric Oxygen Therapy Committee Report* and has updated the information with each succeeding report up to and including the present edition.

### ***William Tettelbach, MD, FACP, FIDSA, FUHM, MAPWCA, CWSP***

Dr. William Tettelbach is actively board-certified in Undersea & Hyperbaric Medicine, Infectious Diseases, and Internal Medicine while retaining academic appointments at Duke University School of Medicine and Western University of Health Sciences, College of Podiatric Medicine. His past and current leadership rolls include Program Director of the Duke University Undersea and Hyperbaric Medicine Fellowship satellite site program in Utah, Executive System Medical Director of the Intermountain Health Wound and Hyperbaric Medicine Service line, Executive Medical Director of the Hyperbaric Medicine & Wound Care Service line for the Mountain Division (Alaska, Idaho & Utah) of HCA Healthcare and CMO of Restorix Health. He is a participating member of the CMS advisory panel on Hospital Outpatient Payment as well as a committee member for The Alliance of Wound Care Stakeholders, which acts as one of the voices for Undersea and Hyperbaric Medicine in the Government Affairs health policy arena. His career has been dedicated to teaching providers and improving patients' lives requiring the services of Hyperbaric Medicine, Advanced Wound Care and Infectious Diseases.

### ***Edward O. Tomoye DO, MA***

Director, North Central Texas Infectious Disease Group, Richland Hills, Texas  
Adjunct Associate Professor of Medicine, University of North Texas, Fort worth, Texas  
Fellowship in Infectious disease & Immunology, University of Massachusetts  
Fellowship in Undersea & Hyperbaric Medicine, Duke University

Research interests: Effects of hyperbaric oxygen in adults with sickle cell crisis  
Efficacy of antimicrobial products in chronic wounds  
Carbon monoxide levels in mouth smoke: comparing tobacco brands  
Analysis of blood pressure elevation during hyperbaric oxygen treatments

***Robert A. van Hulst MD, PhD, FUHM, Capt Navy (ret)***

Professor of Hyperbaric and Diving Medicine  
Captain Royal Dutch Navy (retired)  
Director of Diving and Submarine Medicine, Royal Netherlands Navy

Robert van Hulst is a former navy senior undersea medical officer, with his last position as Director Diving and Submarine Medical Center until 2014. Since 2014 he is a full professor in hyperbaric and diving medicine in the Amsterdam University Medical Center, The Netherlands, and head of the hyperbaric department (Boerema chamber). He is a consultant for the Navy for occupational medicine in submarines and escape and rescue. His PhD thesis (2003) is, "Cerebral air embolism and brain metabolism: effects of ventilation and hyperbaric oxygen in healthy and brain traumatized animals." His research interests include cerebral air embolism, pulmonary oxygen toxicity, pre-conditioning, ventilation/gas exchange during diving and HBO<sub>2</sub> treatment for wound healing and Crohn's disease.

***Keith W. Van Meter MD, FUHM, FAAEM, FACP***

Keith Van Meter is currently board certified in Undersea and Hyperbaric Medicine, Pediatric Emergency Medicine, Medical Toxicology and Emergency Medicine. He is an ACS ATLS instructor and Clinical Professor of Medicine at LSU HSC/NOLA and an Adjunctive Professor of Surgery at Tulane School of Medicine. He is the Section Head of Emergency Medicine at LSU HSC/NOLA and the Medical Director of the Baromedical Research Institute in New Orleans, LA. His awards include the Craig Hoffman Memorial Award (1999), the Charles Shilling Award (2007), the Albert Behnke Award (2009), the Jefferson Davis Award (2010), the UHMS Commercial Diving award (2016), and the ADCI Commercial Diving Hall of Fame Election (2014). He is the Treasurer and Board member of NBDHMT.

***Lindell K. Weaver MD, FACP, FCCP, FCCM, FUHM***

Hyperbaric Medicine Division, Intermountain LDS Hospital, Salt Lake City, Utah Hyperbaric Medicine, Intermountain Medical Center, Murray, Utah  
University of Utah School of Medicine, Salt Lake City, Utah  
Medical Director and Division Chief, Hyperbaric Medicine, LDS Hospital, Salt Lake City, UT and Intermountain Medical Center, Murray, UT  
Professor of Medicine, University of Utah School of Medicine.  
Training: BS in engineering science, Arizona State University; internship, Naval Hospital San Diego; military, undersea and diving medical officer training followed by undersea medical officer, U.S. Navy; residency in internal medicine, LDS Hospital, Salt Lake City, UT; fellowship in pulmonary/critical care, University of Utah  
Undersea and Hyperbaric Medical Society past president,  
Chair, UHMS Hyperbaric Oxygen Therapy Committee

***Robert P. Weenink, MD, PhD, Captain (Navy)***

Consultant, department of Anesthesiology, Amsterdam University Medical Centers, The Netherlands  
Consultant, department of Hyperbaric Medicine, Amsterdam University Medical Centers, The Netherlands  
Flight surgeon

Robert Weenink is a military anesthesiologist, working as a clinical anesthesiologist and Helicopter Emergency Medical Service physician in the Amsterdam University Medical Centers. He is a Navy diving medical officer and flight surgeon, and is involved in acute hyperbaric medicine, both clinically and scientifically. His special interests within this field are management of ICU patients in the hyperbaric chamber, and cerebral arterial gas embolism.

## References

1. Benton PJ, Woodfine JD, Westwook PR. Arterial gas embolism following a 1-meter ascent during helicopter escape training: a case report. *Aviat Space Environ Med.* 1996;67:63-4.
2. Hampson NB, Moon RE. Arterial gas embolism breathing compressed air in 1.2 metres of water. *Diving Hyperb Med.* 2020;50(3):292-4.
3. Lindblom U, Tosterud C. Pulmonary barotrauma with cerebral arterial gas embolism from a depth of 0.75-1.2 metres of fresh water or less: A case report. *Diving Hyperb Med.* 2021;51(2):224-6.
4. Mellem H, Emhjellen S, Horgen O. Pulmonary barotrauma and arterial gas embolism caused by an emphysematous bulla in a SCUBA diver. *Aviat Space Environ Med.* 1990;61:559-62.
5. Weiss LD, Van Meter KW. Cerebral air embolism in asthmatic scuba divers in a swimming pool. *Chest.* 1995;107:1653-4.
6. Goffinet CM, Simpson G. Cerebral arterial gas embolism in a scuba diver with a primary lung bulla. *Diving Hyperb Med.* 2019;49(2):141-4.
7. Mason WH, Damon TG, Dickinson AR, Nevison TO, Jr. Arterial gas emboli after blast injury. *Proc Soc Exp Biol Med.* 1971;136(4):1253-5.
8. Freund U, Kopolovic J, Durst AL. Compressed air emboli of the aorta and renal artery in blast injury. *Injury.* 1980;12(1):37-8.
9. Guy RJ, Glover MA, Cripps NP. Primary blast injury: pathophysiology and implications for treatment. Part III: Injury to the central nervous system and the limbs. *J R Nav Med Serv.* 2000;86(1):27-31.
10. Ence TJ, Gong H, Jr. Adult respiratory distress syndrome after venous air embolism. *Am Rev Respir Dis.* 1979;119:1033-7.
11. Frim DM, Wollman L, Evans AB, Ojemann RG. Acute pulmonary edema after low-level air embolism during craniotomy. Case report. *J Neurosurg.* 1996;85(5):937-40.
12. Verstappen FT, Bernards JA, Kreuzer F. Effects of pulmonary gas embolism on circulation and respiration in the dog. I. Effects on circulation. *Pflugers Arch.* 1977;368(1-2):89-96.
13. Butler BD, Hills BA. Transpulmonary passage of venous air emboli. *J Appl Physiol* (1985). 1985;59:543-7.
14. Vik A, Brubakk AO, Hennessy TR, Jenssen BM, Ekker M, Slordahl SA. Venous air embolism in swine: transport of gas bubbles through the pulmonary circulation. *J Appl Physiol* (1985). 1990;69(1):237-44.
15. Messina AG, Leslie J, Gold J, Topkins MJ, Devereux RB. Passage of microbubbles associated with intravenous infusion into the systemic circulation in cyanotic congenital heart disease: documentation by transesophageal echocardiography. *Am J Cardiol.* 1987;59(9):1013-4.
16. Vik A, Jenssen BM, Brubakk AO. Paradoxical air embolism in pigs with a patent foramen ovale. *Undersea Biomed Res.* 1992;19(5):361-74.
17. Vik A, Jenssen BM, Brubakk AO. Arterial gas bubbles after decompression in pigs with patent foramen ovale. *Undersea Hyperb Med.* 1993;20(2):121-31.
18. Ries S, Knauth M, Kern R, Klingmann C, Daffertshofer M, Sartor K, Hennerici M. Arterial gas embolism after decompression: correlation with right-to-left shunting. *Neurology.* 1999;52(2):401-4.
19. Spencer MP. Decompression limits for compressed air determined by ultrasonically detected bubbles. *J Appl Physiol* (1985). 1976;40:229-35.
20. Gardette B. Correlation between decompression sickness and circulating bubbles in 232 divers. *Undersea Biomed Res.* 1979;6(1):99-107.
21. Balldin UI, Pilmanis AA, Webb JT. Central nervous system decompression sickness and venous gas emboli in hypobaric conditions. *Aviat Space Environ Med.* 2004;75(11):969-72.
22. Majendie F. Sur l'entree accidentelle de l'air dans les veins. *J Physiol Exp (Paris).* 1821;1:190.
23. King A, Fee M, McGlynn E, Marshall B, Akers KG, Hatten B. Timing of embolic phenomena after hydrogen peroxide exposure - a systematic review. *Clin Toxicol (Phila).* 2023;61(1):12-21.
24. Moore RM, Braselton CW. Injections of air and carbon dioxide into a pulmonary vein. *Ann Surg.* 1940;112:212-8.
25. Tunncliffe FW, Stebbing GF. Intravenous injection of oxygen gas as therapeutic measure. *Lancet.* 1916;2:321-3.
26. Yeakel A. Lethal air embolism from plastic blood storage container. *JAMA.* 1968;204:267-8.
27. Gorman DF, Browning DM, Parsons DW, Traugott FM. The distribution of arterial gas emboli in the pial circulation. *SPUMS J.* 1987;17:101-15.
28. Helps SC, Parsons DW, Reilly PL, Gorman DF. The effect of gas emboli on rabbit cerebral blood flow. *Stroke.* 1990;21:94-9.
29. Helps SC, Meyer-Witting M, Riley PL, Gorman DF. Increasing doses of intracarotid air and cerebral blood flow in rabbits. *Stroke.* 1990;21:1340-5.

30. Helps SC, Gorman DF. Air embolism of the brain in rabbits pre-treated with mechlorethamine. *Stroke*. 1991;22:351-4.
31. Levin LL, Stewart GJ, Lynch PR, Bove AA. Blood and blood vessel wall changes induced by decompression sickness in dogs. *J Appl Physiol* (1985). 1981;50:944-9.
32. Nossum V, Koteng S, Brubakk AO. Endothelial damage by bubbles in the pulmonary artery of the pig. *Undersea Hyperb Med*. 1999;26(1):1-8.
33. Nossum V, Hjelde A, Brubakk AO. Small amounts of venous gas embolism cause delayed impairment of endothelial function and increase polymorphonuclear neutrophil infiltration. *Eur J Appl Physiol*. 2002;86:209-14.
34. van Hulst RA, Lameris TW, Hasan D, Klein J, Lachmann B. Effects of cerebral air embolism on brain metabolism in pigs. *Acta Neurol Scand*. 2003;108(2):118-24.
35. van Hulst RA, Drenthen J, Haitsma JJ, Lameris TW, Visser GH, Klein J, Lachmann B. Effects of hyperbaric treatment in cerebral air embolism on intracranial pressure, brain oxygenation and brain glucose metabolism in the pig. *Crit Care Med*. 2005.
36. Klinger AL, Pichette B, Sobolewski P, Eckmann DM. Mechanotransductional basis of endothelial cell response to intravascular bubbles. *Integrative biology : quantitative biosciences from nano to macro*. 2011;3(10):1033-42.
37. Sobolewski P, Kandel J, Klinger AL, Eckmann DM. Air bubble contact with endothelial cells in vitro induces calcium influx and IP<sub>3</sub>-dependent release of calcium stores. *Am J Physiol Cell Physiol*. 2011;301(3):C679-86.
38. Sobolewski P, Kandel J, Eckmann DM. Air bubble contact with endothelial cells causes a calcium-independent loss in mitochondrial membrane potential. *PLoS ONE*. 2012;7(10):e47254.
39. Pearson RR, Goad RF. Delayed cerebral edema complicating cerebral arterial gas embolism: Case histories. *Undersea Biomed Res*. 1982;9:283-96.
40. Jabur GN, Merry AF, McGeorge A, Cavadino A, Donnelly J, Mitchell SJ. A prospective observational study on the effect of emboli exposure on cerebral autoregulation in cardiac surgery requiring cardiopulmonary bypass. *Perfusion*. 2022;2676591221094696.
41. Elliott DH, Harrison JAB, Barnard EEP. Clinical and radiological features of 88 cases of decompression barotrauma. In: Shilling CW, Beckett MW, editors. *Underwater Physiology VI Proceedings of the Sixth Symposium on Underwater Physiology*. Bethesda, MD: FASEB; 1978. p. 527-35.
42. Elliott DH, Moon RE. Manifestations of the decompression disorders. In: Bennett PB, Elliott DH, editors. *The Physiology and Medicine of Diving*. Philadelphia, PA: WB Saunders; 1993. p. 481-505.
43. Lam KK, Hutchinson RC, Gin T. Severe pulmonary oedema after venous air embolism. *Can J Anaesth*. 1993;40(10):964-7.
44. Fitchet A, Fitzpatrick AP. Central venous air embolism causing pulmonary oedema mimicking left ventricular failure. *Bmj*. 1998;316(7131):604-6.
45. Blanc P, Boussuges A, Henriette K, Sainty JM, Deleflie M. Iatrogenic cerebral air embolism: importance of an early hyperbaric oxygenation. *Intensive Care Med*. 2002;28(5):559-63.
46. Francis TJR, Mitchell SJ. Manifestations of decompression disorders. In: Brubakk AO, Neuman TS, editors. *Bennett & Elliott's Physiology and Medicine of Diving*. New York, NY: Elsevier Science; 2003. p. 578-99.
47. Neuman TS, Bove AA. Combined arterial gas embolism and decompression sickness following no-stop dives. *Undersea Biomed Res*. 1990;17:429-36.
48. Warren LP, Djang WT, Moon RE, Camporesi EM, Sallee DS, Anthony DC. Neuroimaging of scuba diving injuries to the CNS. *AJNR Am J Neuroradiol*. 1988;9:933-8.
49. Catron PW, Dutka AJ, Biondi DM, Flynn ET, Hallenbeck JM. Cerebral air embolism treated by pressure and hyperbaric oxygen. *Neurology*. 1991;41(2 ( Pt 1)):314-5.
50. Reuter M, Tetzlaff K, Hutzelmann A, Fritsch G, Steffens JC, Bettinghausen E, Heller M. MR imaging of the central nervous system in diving-related decompression illness. *Acta Radiol*. 1997;38(6):940-4.
51. Sayama T, Mitani M, Inamura T, Yagi H, Fukui M. Normal diffusion-weighted imaging in cerebral air embolism complicating angiography. *Neuroradiology*. 2000;42(3):192-4.
52. Benson J, Adkinson C, Collier R. Hyperbaric oxygen therapy of iatrogenic cerebral arterial gas embolism. *Undersea Hyperb Med*. 2003;30(2):117-26.
53. Leitch DR, Green RD. Pulmonary barotrauma in divers and the treatment of cerebral arterial gas embolism. *Aviat Space Environ Med*. 1986;57:931-8.
54. van Hulst RA, Klein J, Lachmann B. Gas embolism: pathophysiology and treatment. *Clin Physiol Funct Imaging*. 2003;23(5):237-46.
55. Krivonyak GS, Warren SG. Cerebral arterial air embolism treated by a vertical head-down maneuver. *Catheter Cardiovasc Interv*. 2000;49(2):185-7.

56. Butler BD, Laine GA, Leiman BC, Warters D, Kurusz M, Sutton T, Katz J. Effects of Trendelenburg position on the distribution of arterial air emboli in dogs. *Ann Thorac Surg.* 1988;45:198-202.
57. Mehlhorn U, Burke EJ, Butler BD, Davis KL, Katz J, Melamed E, Morris WP, Allen SJ. Body position does not affect the hemodynamic response to venous air embolism in dogs. *Anesth Analg.* 1994;79:734-9.
58. Dutka AJ. Therapy for dysbaric central nervous system ischemia: adjuncts to recompression. In: Bennett PB, Moon RE, editors. *Diving Accident Management.* Bethesda, MD: Undersea and Hyperbaric Medical Society; 1990. p. 222-34.
59. Mitchell SJ, Bennett MH, Bryson P, Butler FK, Doolette DJ, Holm JR, Kot J, Lafere P. Pre-hospital management of decompression illness: expert review of key principles and controversies. *Diving Hyperb Med.* 2018;48(1):45-55.
60. Mitchell SJ, Bennett MH, Bryson P, Butler FK, Doolette DJ, Holm JR, Kot J, Lafere P. Consensus guideline: Pre-hospital management of decompression illness: expert review of key principles and controversies. *Undersea Hyperb Med.* 2018;45(3):273-86.
61. Mitchell SJ, Bennett MH, Moon RE. Decompression sickness and arterial gas embolism. *N Engl J Med.* 2022;386(13):1254-64.
62. Banham ND, Saw J, Hankey GJ, Ghia D. Cerebral arterial gas embolism proven by computed tomography following transthoracic echocardiography using bubble contrast. *Diving Hyperb Med.* 2020;50(3):300-2.
63. Huber S, Rigler B, Machler HE, Metzler H, Smolle-Juttner FM. Successful treatment of massive arterial air embolism during open heart surgery. *Ann Thorac Surg.* 2000;69(3):931-3.
64. Clarke D, Gerard W, Norris T. Pulmonary barotrauma-induced cerebral arterial gas embolism with spontaneous recovery: commentary on the rationale for therapeutic compression. *Aviat Space Environ Med.* 2002;73(2):139-46.
65. Navy Department. *US Navy Diving Manual. Revision 7, Change A. Vol 5 : Diving Medicine & Recompression Chamber Operations.* NAVSEA 0910-LP-115-1921. Washington, DC: Naval Sea Systems Command; 2018.
66. Zamboni WA, Roth AC, Russell RC, Graham B, Suchy H, Kucan JO. Morphological analysis of the microcirculation during reperfusion of ischemic skeletal muscle and the effect of hyperbaric oxygen. *Plast Reconstr Surg.* 1993;91:1110-23.
67. Martin JD, Thom SR. Vascular leukocyte sequestration in decompression sickness and prophylactic hyperbaric oxygen therapy in rats. *Aviat Space Environ Med.* 2002;73(6):565-9.
68. Ericsson JA, Gottlieb JD, Sweet RB. Closed-chest cardiac massage in the treatment of venous air embolism. *N Engl J Med.* 1964;270:1353-4.
69. Moses HL. *Casualties in Individual Submarine Escape 1928-1957.* Groton, CT: US Naval Submarine Medical Center; 1964. Report No.: Report No. 438.
70. Van Genderen L. *Study of Air Embolism and Extra-aveolar Accidents Associated with Submarine Escape Training.* Groton, CT: US Naval Submarine Medical Center; 1967. Report No.: 500.
71. Ingvar DH, Adolfson J, Lindemark C. Cerebral air embolism during training of submarine personnel in free escape: an electroencephalographic study. *Aerosp Med.* 1973;44(6):628-35.
72. Hart GB. Treatment of decompression illness and air embolism with hyperbaric oxygen. *Aerosp Med.* 1974;45:1190-3.
73. Ah-See AK. Review of arterial air embolism in submarine escape. In: Smith G, editor. *Proceedings of the Sixth International Congress on Hyperbaric Medicine.* Aberdeen, Scotland: Aberdeen University Press; 1977. p. 349-51.
74. Bray P, Myers RA, Cowley RA. Orogenital sex as a cause of nonfatal air embolism in pregnancy. *Obstet Gynecol.* 1983;61(5):653-7.
75. Murphy BP, Harford FJ, Cramer FS. Cerebral air embolism resulting from invasive medical procedures. Treatment with hyperbaric oxygen. *Ann Surg.* 1985;201(2):242-5.
76. Dutka AJ. Air or gas embolism. In: Camporesi EM, Barker AC, editors. *Hyperbaric Oxygen Therapy: A Critical Review.* Bethesda, MD: Undersea and Hyperbaric Medical Society; 1991. p. 1-10.
77. Ziser A, Adir Y, Lavon H, Shupak A. Hyperbaric oxygen therapy for massive arterial air embolism during cardiac operations. *J Thorac Cardiovasc Surg.* 1999;117(4):818-21.
78. Massey EW, Moon RE, Shelton D, Camporesi EM. Hyperbaric oxygen therapy of iatrogenic air embolism. *J Hyperb Med.* 1990;5:15-21.
79. Zwirewich CV, Müller NL, Abboud RT, Lepawsky M. Noncardiogenic pulmonary edema caused by decompression sickness: rapid resolution following hyperbaric therapy. *Radiology.* 1987;163:81-2.
80. Dexter F, Hindman BJ. Recommendations for hyperbaric oxygen therapy of cerebral air embolism based on a mathematical model of bubble absorption. *Anesth Analg.* 1997;84:1203-7.
81. Leitch DR, Greenbaum LJ, Jr, Hallenbeck JM. Cerebral arterial air embolism: III. Cerebral blood flow after decompression from various pressure treatments. *Undersea Biomed Res.* 1984;11:249-63.

82. Howsare CR, Rocca AF, Morrison LJ, Jackson RL. Comparison of USN TT-6 vs TT-6A for the treatment of AGE in the US Navy. A retrospective study. *Undersea Hyperb Med.* 1997;24(Suppl):33.
83. Moon RE, Sheffield PJ. Guidelines for treatment of decompression illness. *Aviat Space Environ Med.* 1997;68:234-43.
84. Vann RD, Butler FK, Mitchell SJ, Moon RE. Decompression illness. *Lancet.* 2011;377(9760):153-64.
85. Cianci P, Slade JB, Jr. Delayed treatment of decompression sickness with short, no-air-break tables: review of 140 cases. *Aviat Space Environ Med.* 2006;77(10):1003-8.
86. Undersea & Hyperbaric Medical Society. UHMS Best Practice Guidelines: Prevention and Treatment of Decompression Sickness and Arterial Gas Embolism. Durham, NC2011.
87. Wolf HK, Moon RE, Mitchell PR, Burger PC. Barotrauma and air embolism in hyperbaric oxygen therapy. *Am J Forensic Med Pathol.* 1990;11:149-53.
88. Rivalland G, Mitchell SJ, van Schalkwyk JM. Pulmonary barotrauma and cerebral arterial gas embolism during hyperbaric oxygen therapy. *Aviat Space Environ Med.* 2010;81(9):888-90.
89. Mitchell SJ. Lidocaine in the treatment of decompression illness: a review of the literature. *Undersea Hyperb Med.* 2001;28(3):165-74.
90. Bennett M, Mitchell S, Dominguez A. Adjunctive treatment of decompression illness with a non-steroidal anti-inflammatory drug (tenoxicam) reduces compression requirement. *Undersea Hyperb Med.* 2003;30(3):195-205.
91. Moon RE, editor. *Adjunctive Therapy for Decompression Illness.* Kensington, MD: Undersea and Hyperbaric Medical Society; 2003.
92. Chang M, Marshall J. Therapeutic hypothermia for acute air embolic stroke. *West J Emerg Med.* 2012;13(1):111-3.
93. Oh SH, Kang HD, Jung SK, Choi S. Implementation of targeted temperature management in a patient with cerebral arterial gas embolism. *Ther Hypothermia Temp Manag.* 2018.
94. Dutka AJ, Hallenbeck JM, Kochanek P. A brief episode of severe arterial hypertension induces delayed deterioration of brain function and worsens blood flow after transient multifocal cerebral ischemia. *Stroke.* 1987;18(2):386-95.
95. van Hulst RA, Haitsma JJ, Lameris TW, Klein J, Lachmann B. Hyperventilation impairs brain function in acute cerebral air embolism in pigs. *Intensive Care Med.* 2004;30(5):944-50.
96. Beevor H, Frawley G. Iatrogenic cerebral gas embolism: analysis of the presentation, management and outcomes of patients referred to The Alfred Hospital Hyperbaric Unit. *Diving Hyperb Med.* 2016;46(1):15-21.
97. Takita H, Olszewski W, Schimert G, Lanphier EH. Hyperbaric treatment of cerebral air embolism as a result of open-heart surgery. Report of a case. *J Thorac Cardiovasc Surg.* 1968;55(5):682-5.
98. Mader JT, Hulet WH. Delayed hyperbaric treatment of cerebral air embolism: report of a case. *Arch Neurol.* 1979;36(8):504-5.
99. Perez MF, Ongkeko Perez JV, Serrano AR, Andal MP, Aldover MC. Delayed hyperbaric intervention in life-threatening decompression illness. *Diving Hyperb Med.* 2017;47(4):257-9.
100. Trytko BE, Bennett MH. Arterial gas embolism: a review of cases at Prince of Wales Hospital, Sydney, 1996 to 2006. *Anaesth Intensive Care.* 2008;36(1):60-4.
101. Weaver LK, Morris A. Venous and arterial gas embolism associated with positive pressure ventilation. *Chest.* 1998;113(4):1132-4.
102. Yadav S, Jain S, Aggarwal P, Gupta R. Systemic arterial air embolism: positive pressure ventilation can be fatal in a patient with blunt trauma. *BMJ Case Rep.* 2013;2013.
103. Berlot G, Rinaldi A, Moscheni M, Ferluga M, Rossini P. Uncommon occurrences of air embolism: description of cases and review of the literature. *Case Rep Crit Care.* 2018;2018:5808390.
104. Rehwald R, Loizides A, Wiedermann FJ, Grams AE, Djurdjevic T, Glodny B. Systemic air embolism causing acute stroke and myocardial infarction after percutaneous transthoracic lung biopsy - a case report. *J Cardiothorac Surg.* 2016;11(1):80.
105. Wherrett CG, Mehran RJ, Beaulieu MA. Cerebral arterial gas embolism following diagnostic bronchoscopy: delayed treatment with hyperbaric oxygen. *Can J Anaesth.* 2002;49(1):96-9.
106. Malik N, Claus PL, Illman JE, Kligerman SJ, Moynagh MR, Levin DL, Woodrum DA, Arani A, Arunachalam SP, Araoz PA. Air embolism: diagnosis and management. *Future Cardiol.* 2017;13(4):365-78.
107. Mohamed S, Patel AJ, El-Zeki A, Oliemy A, Habib A. Triplegic stroke after air embolism from bronchogenic cyst secondary to barotrauma. *Ann Thorac Surg.* 2022;113(1):e45-e7.
108. Dube L, Soltner C, Daenen S, Lemaricé J, Asfar P, Alquier P. Gas embolism: an exceptional complication of radial arterial catheterization. *Acta Anaesthesiol Scand.* 2004;48(9):1208-10.
109. Ceponis PJ, Fox W, Taylor TD, Hurwitz LM, Amrhein TJ, Moon RE. Non-dysbaric arterial gas embolism associated with chronic necrotizing pneumonia, bullae and coughing: a case report. *Undersea Hyperb Med.* 2017;44(1):73-7.
110. Abernathy CM, Dickinson TC. Massive air emboli from intravenous infusion pump: etiology and prevention. *Am J Surg.* 1979;137(2):274-5.

111. Khan M, Schmidt DH, Bajwa T, Shalev Y. Coronary air embolism: incidence, severity, and suggested approaches to treatment. *Catheterization & Cardiovascular Diagnosis*. 1995;36(4):313-8.
112. Baskin SE, Wozniak RF. Hyperbaric oxygenation in the treatment of hemodialysis-associated air embolism. *N Engl J Med*. 1975;293(4):184-5.
113. Ordway CB. Air embolus via CVP catheter without positive pressure: presentation of case and review. *Ann Surg*. 1974;179(4):479-81.
114. Vesely TM. Air embolism during insertion of central venous catheters. *J Vasc Interv Radiol*. 2001;12(11):1291-5.
115. Raju GS, Bendixen BH, Khan J, Summers RW. Cerebrovascular accident during endoscopy - consider cerebral air embolism, a rapidly reversible event with hyperbaric oxygen therapy. *Gastrointest Endosc*. 1998;47(1):70-3.
116. Eoh EJ, Derrick B, Moon R. Cerebral arterial gas embolism during upper endoscopy. *A A Case Rep*. 2015;5(6):93-4.
117. Park S, Ahn JY, Ahn YE, Jeon SB, Lee SS, Jung HY, Kim JH. Two cases of cerebral air embolism that occurred during esophageal ballooning and endoscopic retrograde cholangiopancreatography. *Clin Endosc*. 2016;49(2):191-6.
118. Bassan MM, Dudai M, Shalev O. Near-fatal systemic oxygen embolism due to wound irrigation with hydrogen peroxide. *Postgrad Med J*. 1982;58(681):448-50.
119. Tsai SK, Lee TY, Mok MS. Gas embolism produced by hydrogen peroxide irrigation of an anal fistula during anesthesia. *Anesthesiology*. 1985;63(3):316-7.
120. Rackoff WR, Merton DF. Gas embolism after ingestion of hydrogen peroxide. *Pediatrics*. 1990;85(4):593-4.
121. Christensen DW, Faught WE, Black RE, Woodward GA, Timmons OD. Fatal oxygen embolization after hydrogen peroxide ingestion. *Crit Care Med*. 1992;20(4):543-4.
122. Mullins ME, Beltran JT. Acute cerebral gas embolism from hydrogen peroxide ingestion successfully treated with hyperbaric oxygen. *J Toxicol Clin Toxicol*. 1998;36(3):253-6.
123. Jones PM, Segal SH, Gelb AW. Venous oxygen embolism produced by injection of hydrogen peroxide into an enterocutaneous fistula. *Anesth Analg*. 2004;99(6):1861-3.
124. Smedley BL, Gault A, Gawthrope IC. Cerebral arterial gas embolism after pre-flight ingestion of hydrogen peroxide. *Diving Hyperb Med*. 2016;46(2):117-9.
125. Habegger R, Siebenmann R, Kieser C. Lethal air embolism during arthroscopy. A case report. *J Bone Joint Surg Br*. 1989;71(2):314-6.
126. Faure EAM, Cook RI, Miles D. Air embolism during anesthesia for shoulder arthroscopy. *Anesthesiology*. 1998;89(3):805-6.
127. Hwang SL, Lieu AS, Lin CL, Liu GC, Howng SL, Kuo TH. Massive cerebral air embolism after cardiopulmonary resuscitation. *J Clin Neurosci*. 2005;12(4):468-9.
128. Helmlberger TK, Roth U, Empen K. Massive air embolism during interventional laser therapy of the liver: successful resuscitation without chest compression. *Cardiovasc Intervent Radiol*. 2002;25(4):335-6.
129. Kaufman BS, Kaminsky SJ, Rackow EC, Weil MH. Adult respiratory distress syndrome following orogenital sex during pregnancy. *Crit Care Med*. 1987;15:703-4.
130. Bernhardt TL, Goldmann RW, Thombs PA, Kindwall EP. Hyperbaric oxygen treatment of cerebral air embolism from orogenital sex during pregnancy. *Crit Care Med*. 1988;16(7):729-30.
131. Batman PA, Thomlinson J, Moore VC, Sykes R. Death due to air embolism during sexual intercourse in the puerperium. *Postgrad Med J*. 1998;74:612-3.
132. Sadler DW, Pounder DJ. Fatal air embolism occurring during consensual intercourse in a non-pregnant female. *J Clin Forensic Med*. 1998;5(2):77-9.
133. Gariel C, Delwarde B, Beroud S, Soldner R, Floccard B, Rimmele T. Is decompression illness possible during hyperbaric therapy? a case report. *Undersea Hyperb Med*. 2017;44(3):283-5.
134. Raja S, Rice TW, Mason DP, Rodriguez C, Tan C, Rodriguez ER, Manno E, Videtic GM, Murthy SC. Fatal cerebral air embolus complicating multimodality treatment of esophageal cancer. *Ann Thorac Surg*. 2011;92(5):1901-3.
135. Miyamoto S, Mashimo Y, Horimatsu T, Ezoe Y, Morita S, Muto M, Chiba T. Cerebral air embolism caused by chemoradiotherapy for esophageal cancer. *J Clin Oncol*. 2012;30(25):e237-8.
136. Shim CY, Lee SY, Pak HN. Coronary air embolism associated with atrioesophageal fistula after ablation of atrial fibrillation. *Can J Cardiol*. 2013;29(10):Pages 1329 e17- e19.
137. Kapur S, Barbhaiya C, Deneke T, Michaud GF. Esophageal injury and atrioesophageal fistula caused by ablation for atrial fibrillation. *Circulation*. 2017;136(13):1247-55.
138. Thomson M, El Sakr F. Gas in the left atrium and ventricle. *N Engl J Med*. 2017;376(7):683.
139. Peterson C, Elswick C, Diaz V, Tubbs RS, Moisi M. Delayed presentation of cerebral air embolism from a left atrial-esophageal fistula: a case report and review of the literature. *Cureus*. 2017;9(11):e1850.
140. Clark CC, Weeks DB, Gusdon JP. Venous carbon dioxide embolism during laparoscopy. *Anesth Analg*. 1977;56:650-2.



141. Lantz PE, Smith JD. Fatal carbon dioxide embolism complicating attempted laparoscopic cholecystectomy--case report and literature review. *J Forensic Sci.* 1994;39(6):1468-80.
142. Moskop RJ, Jr, Lubarsky DA. Carbon dioxide embolism during laparoscopic cholecystectomy. *South Med J.* 1994;87:414-5.
143. Gillart T, Bazin JE, Bonnard M, Schoeffler P. Pulmonary interstitial edema after probable carbon dioxide embolism during laparoscopy. *Surg Laparosc Endosc.* 1995;5(4):327-9.
144. Cottin V, Delafosse B, Viale JP. Gas embolism during laparoscopy: a report of seven cases in patients with previous abdominal surgical history. *Surg Endosc.* 1996;10(2):166-9.
145. Vacanti CA, Lodhia KL. Fatal massive air embolism during transurethral resection of the prostate. *Anesthesiology.* 1991;74(1):186-7.
146. Tsou MY, Teng YH, Chow LH, Ho CM, Tsai SK. Fatal gas embolism during transurethral incision of the bladder neck under spinal anesthesia. *Anesth Analg.* 2003;97(6):1833-4.
147. Ledowski T, Kiese F, Jeglin S, Scholz J. Possible air embolism during eye surgery. *Anesth Analg.* 2005;100(6):1651-2.
148. Lin SM, Chang WK, Tsao CM, Ou CH, Chan KH, Tsai SK. Carbon dioxide embolism diagnosed by transesophageal echocardiography during endoscopic vein harvesting for coronary artery bypass grafting. *Anesth Analg.* 2003;96(3):683-5, table of contents.
149. Sherlock S, Shearer WA, Buist M, Rasiah R, Edwards A. Carbon dioxide embolism following diagnostic hysteroscopy. *Anaesth Intensive Care.* 1998;26(6):674-6.
150. Imasogie N, Crago R, Leyland NA, Chung F. Probable gas embolism during operative hysteroscopy caused by products of combustion. *Can J Anaesth.* 2002;49(10):1044-7.
151. Michenfelder JD, Martin JT, Altenburg BM, Rehder K. Air embolism during neurosurgery. An evaluation of right-atrial catheters for diagnosis and treatment. *JAMA.* 1969;208:1353-8.
152. Fong J, Gadalla F, Gimbel AA. Precordial Doppler diagnosis of haemodynamically compromising air embolism during caesarean section. *Can J Anaesth.* 1990;37(2):262-4.
153. Jolliffe MP, Lyew MA, Berger IH, Grimaldi T. Venous air embolism during radical perineal prostatectomy. *J Clin Anesth.* 1996;8(8):659-61.
154. Albin MS, Ritter RR, Reinhart R, Erickson D, Rockwood A. Venous air embolism during radical retropubic prostatectomy. *Anesth Analg.* 1992;74(1):151-3.
155. Razvi HA, Chin JL, Bhandari R. Fatal air embolism during radical retropubic prostatectomy. *J Urol.* 1994;151(2):433-4.
156. Lang SA, Duncan PG, Dupuis PR. Fatal air embolism in an adolescent with Duchenne muscular dystrophy during Harrington instrumentation. *Anesth Analg.* 1989;69(1):132-4.
157. Wills J, Schwend RM, Paterson A, Albin MS. Intraoperative visible bubbling of air may be the first sign of venous air embolism during posterior surgery for scoliosis. *Spine.* 2005;30(20):E629-35.
158. Baptiste L, Kamar Z, Mazaud A, Balanca B. Air embolism during lumbar surgery in the prone position. *Diving Hyperb Med.* 2021;51(3):303-5.
159. Andersen KH. Air aspirated from the venous system during total hip replacement. *Anaesthesia.* 1983;38(12):1175-8.
160. Lee SY, Choi BI, Kim JS, Park KS. Paradoxical air embolism during hepatic resection. *Br J Anaesth.* 2002;88(1):136-8.
161. Olmedilla L, Garutti I, Perez-Pena J, Sanz J, Teigell E, Avellanal M. Fatal paradoxical air embolism during liver transplantation. *Br J Anaesth.* 2000;84(1):112-4.
162. Davies JM, Campbell LA. Fatal air embolism during dental implant surgery: a report of three cases. *Can J Anaesth.* 1990;37(1):112-21.
163. Burrowes P, Wallace C, Davies JM, Campbell L. Pulmonary edema as a radiologic manifestation of venous air embolism secondary to dental implant surgery. *Chest.* 1992;101(2):561-2.

## References

1. Cibis GW, Beaver HA, Johns K, et al. Fundamentals and principles of ophthalmology (basic and clinical science course). San Francisco, CA: American Academy of Ophthalmology; 2006. P. 38-40.
2. Patz A. Oxygen inhalation in retinal arterial occlusion. *Am J Ophthalmol.* 1955;40:789-795.
3. Li HK, Dejean BJ, Tang RA. Reversal of visual loss with hyperbaric oxygen treatment in a patient with Susac Syndrome. *Ophthalmology* 1996;103(12):2091-2098.
4. Stone R, Zink H, Klingele T, Burde R. Visual recovery after central retinal artery occlusion: two cases. *Ann Ophthalmol.* 1977;9:445-450.
5. Hayreh SS, Zimmerman MB. Central retinal artery occlusion: visual outcome. *Am J Ophthalmol.* 2005;140:376-391.
6. David NJ, Norton EWD, Gass JD, Beauchamp J. Fluorescein angiography in central retinal artery occlusion. *Arch Ophthalmol.* 1967;77:619-629.
7. Duker JS, Brown GC. Recovery following acute obstruction of the retinal and choroidal circulations. *Retina.* 1988;8(4):257-260.
8. Hertzog LM, Meyer GW, Carson S, Strauss MB, Hart GB. Central retinal artery occlusion treated with hyperbaric oxygen. *J Hyperbaric Medicine.* 1992;7:33-42.
9. Jain KK, editor. Textbook of hyperbaric medicine. 4th ed. Cambridge, MA: Hogrefe & Huber Publishers; 2004. P. 383-392.
10. Murphy-Lavoie H, Harch P, VanMeter K. Effect of hyperbaric oxygen on central retinal artery occlusion (abstract). UHMS Scientific Assembly, Australia; 2004.
11. Anderson B, Saltzman H, Heyman A. The effects of hyperbaric oxygenation on retinal arterial occlusion. *Arch Ophthalmol.* 1965;73:315-319.
12. Augsburger JJ, Magargal LE. Visual prognosis following treatment of acute central retinal artery obstruction. *Br J Ophthalmol.* 1980;64:913-917.
13. Miyake Y, Horiguchi M, Matsuura M, et al. Hyperbaric oxygen therapy in 72 eyes with retinal arterial occlusion. In: The 9th international symposium on underwater and hyperbaric physiology. Bethesda, MD: Undersea and Hyperbaric Medical Society; 1987. P. 949-953.
14. Yotsukura J, Adachi-Usami E. Correlation of electro-retinographic changes with visual prognosis in central retinal artery occlusion. *Ophthalmologica.* 1993;207:13-18.
15. Roy M, Bartow W, Ambrus J, Fauci A, Collier B, Titus J. Retinal leakage in retinal vein occlusion: reduction after hyperbaric oxygen. *Ophthalmologica.* 1989;198:78-83.
16. Miyake Y, Awaya S, Takahashi H, et al. Hyperbaric oxygen and acetazolamide improve visual acuity in patients with cystoid macular edema by different mechanisms. *Arch Ophthalmol.* 1993;111:1605-1606.
17. Schmidt D. Ocular massage in a case of central retinal artery occlusion the successful treatment of a hitherto undescribed type of embolism. *Eur J Med Res.* 2000 Apr 19;5(4):157-164.
18. Beard T, Warriner RA, Pascer P, et al. Adverse events during hyperbaric oxygen therapy (HBOT), a retrospective analysis from 25 centers (abstract). Undersea Hyperbaric Medical Society Annual Scientific Meeting, Las Vegas, NV; 2005.
19. Telander G, Hielweil G, Schwartz S, Butler F. Diagnostic and therapeutic challenges. *Retina.* 2011;31(8):1726-1731.
20. Gaydar V, Ezraichi D, Dratviman-Storobinsky O, et al. *Invest Ophthalmol Vis Sci.* 2011;52:7514-7522.
21. Neubauer AS, Mueller AJ, Schriever S, Gruterich M, Ulbig M, Kampik A. Minimally invasive therapy for clinically complete central retinal artery occlusion-results and meta-analysis of literature. *Klin Monatsbl Augenheilkd.* 2000 Jul;217(1):30-36.
22. Hayreh SS, Podhajsky P. Ocular neovascularization with retinal vascular occlusion: II. Occurrence in central retinal and branch retinal artery occlusion. *Arch Ophthalmol.* 1982;100:1581-1596.
23. Weber J, Remonda L, Mattle HP, et al. Selective intra-arterial fibrinolysis of acute central retinal artery occlusion. *Stroke.* 1998;29:2076-2079.
24. Rumelt S, Dorenboim Y, Rehany U. Aggressive systematic treatment for central retinal artery occlusion. *Am J Ophthalmol.* 1999;128:733-738.
25. Petterson JA, Hill MD, Demchuk AM, et al. Intra-arterial thrombolysis for retinal artery occlusion: The Calgary experience. *Can J Neurol Sci.* 2005;32:507-511.
26. Garcia-Arumi J, Martinez-Castillo V, Boixadera A, Fonollosa A, Corcostgui B. Surgical embolus removal in retinal artery occlusion. *Br J Ophthalmol.* 2006;90:1252-1255.
27. Tang WM, Han DP. A study of surgical approaches to retinal vascular occlusions. *Arch Ophthalmol.* 2000;118:138-143.
28. Mangat HS. Retinal artery occlusion. *Surv Ophthalmol.* 1995;40:145-156.
29. Butler FK. The eye in the wilderness. In: Auerbach PS, editor. *Wilderness medicine.* 5th ed. St Louis:MO, Mosby; 2007.

30. Saltzman HA, Hart L, Sieker HO, Duffy EJ. Retinal vascular response to hyperbaric oxygenation. *JAMA*. 1965;191(4):114-116.
31. Haddad HM, Leopold IH. Effect of hyperbaric oxygenation on microcirculation: Use in therapy of retinal vascular disorders. *Invest Ophthalmol*. 1965;4:1141-1151.
32. Yu DY, Cringle SJ. Retinal degeneration and local oxygen metabolism. *Exp Eye Res*. 2005;80:745-751.
33. Phillips D, Diaz C, Atwell G, Chimiak J, Ullman S, et al. Care of sudden blindness: a case report of acute central retinal artery occlusion reversed with hyperbaric oxygen therapy (abstract). *Undersea Hyperb Med*. 1999;26(suppl):23-24.
34. Hayreh SS, Kolder HE, Weingeist TA. Central retinal artery occlusion and retinal tolerance time. *Ophthalmology*. 1980;87(1):75-78.
35. Zhang XZ, Cao JQ. Observations on therapeutic results in 80 cases of central serous retinopathy treated with hyperbaric oxygenation. Presented at the 5th Chinese conference on hyperbaric medicine, Fuzhow, China; 1986 Sept 26-29.
36. Matsuo T. Multiple occlusive retinal arteritis in both eyes of a patient with rheumatoid arthritis. *Jpn J Ophthalmol*. 2001;45:662-664.
37. Beiran I, Reissman P, Scharf J, Nahum Z, Miller B. Hyperbaric oxygenation combined with nifedipine treatment for recent-onset retinal artery occlusion. *Eur J Ophthalmol*. 1993;3(2):89-94.
38. Perkins SA, Magargal LE, Augsburg JJ, Sanborn GE. The idling retina: reversible visual loss in central retinal artery obstruction. *Ann Ophthalmol*. 1987;19:3-6.
39. Beiran I, Goldenberg I, Adir Y, Tamir A, Shupak A, Miller B. Early hyperbaric oxygen therapy for retinal artery occlusion. *Eur J Ophthalmol*. 2001 Oct-Dec;11(4):345-350.
40. Gool VJ, De Jong H. Hyperbaric oxygen treatment in vascular insufficiency of the retina and optic nerve. In: Ledingham IM, editor. *Proceedings of the second international congress on clinical and applied hyperbaric medicine*. Edinburgh: Churchill Livingstone; 1964. P. 447-460.
41. Takahashi K, Shima T, Yamamuro M. Hyperbaric oxygenation following stellate ganglion block in patients with retinal artery occlusion. In: Smith G, editor. *Proceedings of the sixth international congress on hyperbaric medicine*. Aberdeen: University of Aberdeen Press; 1977. P. 211-215.
42. Pallotta R, Anceschi S, Costagliola N, et al. Recovery from blindness through hyperbaric oxygen in a case of thrombosis on the central retinal artery. *Ann Med Nav*. 1978;83:591-592.
43. Sasaki K, Fukuda M, Otani S, et al. High pressure oxygen therapy in ocular diseases: With special reference to the effect of concomitantly used stellate ganglion block. *Jpn J Anesth*. 1978;27:170-176.
44. Suzuki H, Irie J, Horiuchi T, Fukada J, Matsuzaki H. Hyperbaric oxygenation therapy in ophthalmology. Part 1: Incipient insufficiency of the retinal circulation. *Jpn Clin Ophthalmol*. 1980;34:335-343.
45. Krasnov MM, Kharlap SI, Pereverzina OK, et al. Hyperbaric oxygen in the treatment of vascular disease of the retina. In: Yefunny SN, editor. *Abstracts of the seventh international congress on hyperbaric medicine*. Moscow: USSR Academy of Sciences; 1981. P. 301-302.
46. Desola J. Hyperbaric oxygen therapy in acute occlusive retinopathies. In: Schmutz J, editor. *Proceedings of the first Swiss symposium on hyperbaric medicine*. Foundation for Hyperbaric Medicine. Basel; 1987. P. 333.
47. Kindwall EP, Goldmann RW. *Hyperbaric medicine procedures*. Milwaukee, WI: St. Luke's Medical Center; 1988.
48. Hirayama Y, Matsunaga N, Tashiro J, et al. Bifemelane in the treatment of central retinal artery or vein obstruction. *Clin Ther*. 1990;12:230-235.
49. Aisenbrey S, Krott R, Heller R, et al. Hyperbaric oxygen therapy in retinal artery occlusion. *Ophthalmologe*. 2000;97:461-467.
50. Weinberger AWA, Siekmann UPE, Wolf S, et al. Treatment of acute central retinal artery occlusion (CRAO) by hyperbaric oxygenation therapy (HBO) - a pilot study with 21 patients. *Klin Monatsbl Augenheilkd*. 2002;219:728-734.
51. Imai E, Kunikata H, Udono T, et al. Branch artery occlusion: A complication of iron-deficiency anemia in a young adult with a rectal carcinoid. *Tohoku J Exp Med*. 2004; 203:141-144.
52. Swaby K, Valderrama O, Schiffman J (2005) Treatment Of Disc Edema And Retinal Artery Occlusion With Hbo During The Third Trimester Of Pregnancy. UHMS Annual Scientific Assembly, Las Vegas, 2005. (Abstract)
53. Weiss JN. Hyperbaric oxygen treatment of nonacute central retinal artery occlusion. *Undersea Hyperb Med*. 2009;36(6):401-405.
54. Inoue, O; Kajiya, S; Yachimori, (2009) Treatment Of Central Retinal Artery Occlusion(Crao) And Branch Retinal Artery Occlusion (Brao) By Hyperbaric Oxygen Therapy(Hbo) - 107 Eyes Over 20 Years. UHMS Annual Scientific Assembly, Las Vegas, 2009. (Abstract)
55. Weiss JN. Hyperbaric oxygen treatment of retinal artery occlusion. *Undersea Hyperb Med*. 2010;37(3):167-172.

56. Aten, LA; Stone, JA; Poli, (2011) T. Treatment of a patient with acute central retinal artery occlusion with hyperbaric oxygen therapy. UHMS Annual Scientific Assembly, Ft Worth, 2011. (Abstract)
57. Cope A, Eggert J, O'Brien E. Retinal artery occlusion: visual outcome after treatment with hyperbaric oxygen. *Diving Hyperb Med.* 2011;40(3):135-138.
58. Menzel-Severing J, Siekmann U, Weinberger A, et al. Early hyperbaric oxygen treatment for nonarteritic central retinal artery obstruction. *Am J Ophthalmol.* 2012;153:454-459.
59. Oguz H, Sobaci G. The use of hyperbaric oxygen in ophthalmology. *Surv Ophthalmol.* 2008;53:112-120.
60. Weiss JN. Treatment of central retinal artery occlusions. *Undersea Hyperb Med.* 2010;37(1):51-53; author reply 54-55.
61. Murphy-Lavoie H, Butler FK. Response to: treatment of central retinal artery occlusions. *Undersea Hyperb Med.* 2010;37(1):54-55.
62. Gibbons RJ, Smith S, Antman E. American College of Cardiology; American Heart Association: American College of Cardiology/American Heart Association clinical practice guidelines: Part I. Where do they come from? *Circulation.* 2003;107:2979-2986.
63. Butler FK, Hagan C, Murphy-Lavoie H. Hyperbaric oxygen therapy and the eye. *Undersea Hyperb Med.* 2008;35:333-387.
64. Canan H, Ulas B, Altan-Yaycioglu R.(2014) Hyperbaric oxygen therapy in combination with systemic treatment of sickle cell disease presenting as central retinal artery occlusion: a case report. *Journal of Medical Case Reports* 2014, 8:370.
65. Hsaio S, Huang Y. (2014) Partial vision recovery after iatrogenic retinal artery occlusion. *Ophthalmology* 2014, 14:120.
66. Masters T, Westgard B, Hendrikson S (2015) Central Retinal Artery Occlusion Treated with Hyperbaric Oxygen: A Retrospective Review. UHMS Annual Scientific Assembly, perMontreal, 2015. (Abstract)
67. Desola J, Papoutsidakis E, Martos P (2015) Hyperbaric oxygenation in the treatment of Central Retinal Artery Occlusions: An analysis of 214 cases following a prospective protocol. UHMS Annual Scientific Assembly, Montreal, 2015. (Abstract)
68. Lu C, Wang J, Zhou D (2015) Central retinal artery occlusion associated with persistent truncus arteriosus and single atrium: a case report. *BMC Ophthalmology* (2015) 15:137.
69. Lemos JA, Teixeira C, Carvalho R, et al. (2015) Combined Central Retinal Artery and Vein Occlusion Associated with Factor V Leiden Mutation and Treated with Hyperbaric Oxygen. *Case Rep Ophthalmol.* 2015 Dec 19;6(3):462-8.
70. Hwang K. (2016) Hyperbaric Oxygen Therapy to Avoid Blindness From Filler Injection. *J Craniofac Surg.* 2016 Nov;27(8):2154-2155
71. Olson EA, Lentz K. (2016) Central Retinal Artery Occlusion: A Literature Review and the Rationale for Hyperbaric Oxygen Therapy. *Mo Med.* 2016 Jan-Feb;113(1):53-7.
72. Tang P, Engel K, and Parke D (2016) Early Onset of Ocular Neovascularization After Hyperbaric Oxygen Therapy in a Patient with Central Retinal Artery Occlusion. *Ophthalmol Ther.* 2016; 5:263-269.
73. Elder M, Rawstron J, Davis M. Hyperbaric oxygen in the treatment of acute retinal artery occlusion. *Diving Hyperb Med.* 2017; 47:4, 233-238.
74. Hadanny A, Maliar A, Fishlev G, et al. (2017) Reversibility of retinal ischemia due to central retinal artery occlusion by hyperbaric oxygen. *Clin Ophthalmol.* 2017; 11: 115-125.
75. Butler F, Hagan C, Van Hoesen K, et al. Management of Central Retinal Artery Occlusion following successful Hyperbaric Oxygen Therapy: A Case Report. *Undersea Hyperb Med.* 2018; 45:1. 101-107.
76. Gunay C, Altin G, Kersin B, et al. A Rare Complication after Septoplasty: Visual Loss due to Right Retinal Artery Spasm. *J Craniofac Surg* 2018; 29: 466-468.
77. Karaman S, Ozkan B, Yazir Y. Comparison of Hyperbaric Oxygen versus Iloprost Treatment in an Experimental Rat Central Retinal Artery Occlusion Model. *Graefes Arch Clin Exp Ophthalmol.* 2016. 254: 2209-2215.
78. Murphy-Lavoie H, LeGros T, Butler FK, and Jain K. "Hyperbaric Oxygen Therapy and Ophthalmology." In Jain (Ed.), K.K. Jain Textbook of Hyperbaric Medicine, 6th Ed; Springer Publishing. (2016)
79. Youn T, Lavin P, Patrylo M, et al. Current treatment of central retinal artery occlusion: a national survey. *J Neuro.* 2018; 265: 330-335.
80. Callizo J, Feltgen N, Pantenburg S. Cardiovascular Risk Factors in Central Retinal Artery Occlusion: Results of a Prospective Standardized Medical Exam. *Ophthalmology* 2015. 122:1881-1888.
81. Wagner B, Lindenbaum E, Logue C. Rethinking the Standard of Care for Patients with Central Retinal Artery Occlusion. *Ann Emer Med.* 2017. 70:4, Suppl. Pg S105.

82. Bagli BS, Cevik SG, Cevik MT. Effect of Hyperbaric Oxygen Treatment on Central Retinal Artery Occlusion. UHM 2018; 45(4): 421-425.
83. Cevik MO, Bagli BS, and Cevik SG. Hyperbaric Oxygen Treatment Results in a Group of Turkish Central Retinal Artery Occlusion Patients with Combined Presence of Thrombophilic Mutations. UHM 2020; 47(1): 65-73.
84. Johnson DR, Cooper JS. Retinal Artery and Vein Occlusions Successfully Treated with Hyperbaric Oxygen. Clin Pract Cases Emerg Med. 2019; 3(4):338-340.
85. Kim SH, Cha YS, Lee Y, et al. Successful Treatment of Central Retinal Artery Occlusion using Hyperbaric Oxygen Therapy. Clin Exp Emerg Med 2018; 5(4): 278-281.
86. KimYS, Nam MS, Park EJ, et al. The Effects of Adjunctive Hyperbaric Oxygen Therapy in Patients with Central Retinal Artery Occlusion. UHM 2020; 47(1): 57-64.
87. Lavin P, Patrylo M, Hollar M, et al. Stroke Risk and Risk Factors in Patients with Central Retinal Artery Occlusions. Am J Ophthalmol. 2018; 196: 96-100
88. Lifson N, Salloum G, Kurochin P, et al. Treatment Outcomes on Neovascularization after CRAO Treated with Hyperbaric Oxygen Therapy. UHM 2021; 48(4): 425-430.
89. Lopes AS, Basto R, Henriques S, et al. Case Series: Hyperbaric Oxygen Therapy in Retinal Artery Occlusion: Epidemiology, Clinical Approach, and Visual Outcomes. Case Reports Ophth Med. 2019; 1-5. ID 9765938.
90. Masters TC, Westgard BC, Hendriksen SM, et al. Case Series of Hyperbaric Oxygen Therapy for Central Retinal Artery Occlusion. Retinal Cases and Brief Reports. 2021; 15: 783-788.

## References

1. Hunt TK, Ellison EC, Sen CK. Oxygen: at the foundation of wound healing--introduction. *World J Surg.* 2004;28(3):291-293.
2. Janis JE, Harrison B. Wound healing: part I. Basic science. *Plast Reconstr Surg.* 2014;133(2):199e-207e.
3. Sen CK. Wound healing essentials: let there be oxygen. *Wound Repair Regen.* 2009;17(1):1-18.
4. Allen DB, Maguire JJ, Mahdavian M, et al. Wound hypoxia and acidosis limit neutrophil bacterial killing mechanisms. *Arch Surg.* 1997;132(9):991-996.
5. Hunt TK, Pai MP. The effect of varying ambient oxygen tensions on wound metabolism and collagen synthesis. *Surg Gynecol Obstet.* 1972;135(4):561-567.
6. Hopf HW, Gibson JJ, Angeles AP, et al. Hyperoxia and angiogenesis. *Wound Repair Regen.* 2005;13(6):558-564.
7. Knighton DR, Silver IA, Hunt TK. Regulation of wound-healing angiogenesis--effect of oxygen gradients and inspired oxygen concentration. *Surgery.* 1981;90(2):262-270.
8. LaVan FB, Hunt TK. Oxygen and wound healing. *Clin Plast Surg.* 1990;17(3):463-472.
9. Knighton DR, Hunt TK, Scheuenstuhl H, Halliday BJ, Werb Z, Banda MJ. Oxygen tension regulates the expression of angiogenesis factor by macrophages. *Science.* 1983;221(4617):1283-1285.
10. Knighton DR, Fiegel VD, Halverson T, Schneider S, Brown T, Wells CL. Oxygen as an antibiotic. The effect of inspired oxygen on bacterial clearance. *Arch Surg.* 1990;125(1):97-100.
11. Knighton DR, Halliday B, Hunt TK. Oxygen as an antibiotic. The effect of inspired oxygen on infection. *Arch Surg.* 1984;119(2):199-204.
12. Knighton DR, Halliday B, Hunt TK. Oxygen as an antibiotic. A comparison of the effects of inspired oxygen concentration and antibiotic administration on in vivo bacterial clearance. *Arch Surg.* 1986;121(2):191-195.
13. Ruthenborg RJ, Ban JJ, Wazir A, Takeda N, Kim JW. Regulation of wound healing and fibrosis by hypoxia and hypoxia-inducible factor-1. *Mol Cells.* 2014;37(9):637-643.
14. UHMS Position Statement: Topical Oxygen for Chronic Wounds. *Undersea Hyperb Med.* 2018;45(3):379-380.
15. Heughan C, Grislis G, Hunt TK. The effect of anemia on wound healing. *Ann Surg.* 1974;179(2):163-167.
16. Knighton DR, Fiegel VD. Macrophage-derived growth factors in wound healing: regulation of growth factor production by the oxygen microenvironment. *Am Rev Respir Dis.* 1989;140(4):1108-1111.
17. Hunt TK, Aslam RS. Oxygen 2002: wounds. *Undersea Hyperb Med.* 2004;31(1):147-153.
18. Hohn DC. Leukocyte phagocytic function and dysfunction. *Surg Gynecol Obstet.* 1977;144(1):99-104.
19. Babior BM. Oxygen-dependent microbial killing by phagocytes (first of two parts). *N Engl J Med.* 1978;298(12):659-668.
20. Babior BM. The respiratory burst of phagocytes. *J Clin Invest.* 1984;73(3):599-601.
21. Tizard J. Destruction of foreign material - the myeloid system, neutrophils. In: *Immunology: An introduction.* 3rd ed. Forth Worth, TX: Saunders College Publishing; 1992.
22. Silver IA. Tissue PO<sub>2</sub> changes in acute inflammation. *Adv Exp Med Biol.* 1978;94:769-774.
23. Hohn DC, MacKay RD, Halliday B, Hunt TK. Effect of O<sub>2</sub> tension on microbicidal function of leukocytes in wounds and in vitro. *Surg Forum.* 1976;27(62):18-20.
24. Niinikoski J. Effect of oxygen supply on wound healing and formation of experimental granulation tissue. *Acta Physiol Scand Suppl.* 1969;334:1-72.
25. Pai MP, Hunt TK. Effect of varying oxygen tensions on healing of open wounds. *Surg Gynecol Obstet.* 1972;135(5):756-758.
26. Kivisaari J, Vihersaari T, Renvall S, Niinikoski J. Energy metabolism of experimental wounds at various oxygen environments. *Ann Surg.* 1975;181(6):823-828.
27. Chang N, Goodson WH, 3rd, Gottrup F, Hunt TK. Direct measurement of wound and tissue oxygen tension in postoperative patients. *Ann Surg.* 1983;197(4):470-478.
28. Bullough WS, Johnson M. Epidermal mitotic activity and oxygen tension. *Nature.* 1957;167:488.
29. Udenfriend S. Formation of hydroxyproline in collagen. *Science.* 1966;152:1335.
30. Velazquez OC. Angiogenesis and vasculogenesis: inducing the growth of new blood vessels and wound healing by stimulation of bone marrow-derived progenitor cell mobilization and homing. *J Vasc Surg.* 2007;45 Suppl A:A39-47.
31. Thom SR, Milovanova TN, Yang M, et al. Vasculogenic stem cell mobilization and wound recruitment in diabetic patients: increased cell number and intracellular regulatory protein content associated with hyperbaric oxygen therapy. *Wound Repair Regen.* 2011;19(2):149-161.
32. Winter G, Perrins D. Effects of hyperbaric oxygen treatment on epidermal regeneration. Paper presented at: Fourth International Congress on Hyperbaric Medicine 1970; Tokyo.

33. Utkina O. Regeneration of the skin epithelium in healing wounds under normal conditions and at reduced barometric pressure. *Biol Abs.* 1964;45:78585.
34. Broughton G, 2nd, Janis JE, Attinger CE. Wound healing: an overview. *Plast Reconstr Surg.* 2006;117(7 Suppl):1e-S-32e-S.
35. Witte MB, Barbul A. General principles of wound healing. *Surg Clin North Am.* 1997;77(3):509-528.
36. Chvapil M, Hurych J, Mirejovska E. Effect of long-term hypoxia on protein synthesis in granuloma and in some organs in rats. *Proc Soc Exp Biol Med.* 1970;135(3):613-617.
37. Fife CE, Buyukcakil C, Otto G, Sheffield P, Love T, Warriner R, 3rd. Factors influencing the outcome of lower-extremity diabetic ulcers treated with hyperbaric oxygen therapy. *Wound Repair Regen.* 2007;15(3):322-331.
38. Fife CE, Buyukcakil C, Otto GH, et al. The predictive value of transcutaneous oxygen tension measurement in diabetic lower extremity ulcers treated with hyperbaric oxygen therapy: a retrospective analysis of 1,144 patients. *Wound Repair Regen.* 2002;10(4):198-207.
39. Fife CE, Smart DR, Sheffield PJ, Hopf HW, Hawkins G, Clarke D. Transcutaneous oximetry in clinical practice: consensus statements from an expert panel based on evidence. *Undersea Hyperb Med.* 2009;36(1):43-53.
40. Londahl M, Katzman P, Hammarlund C, Nilsson A, Landin-Olsson M. Relationship between ulcer healing after hyperbaric oxygen therapy and transcutaneous oximetry, toe blood pressure and ankle-brachial index in patients with diabetes and chronic foot ulcers. *Diabetologia.* 2011;54(1):65-68.
41. Londahl M. Hyperbaric oxygen therapy as adjunctive treatment of diabetic foot ulcers. *Med Clin North Am.* 2013;97(5):957-980.
42. Huang ET, Mansouri J, Murad MH, et al. A clinical practice guideline for the use of hyperbaric oxygen therapy in the treatment of diabetic foot ulcers. *Undersea Hyperb Med.* 2015;42(3):205-247.
43. Margolis DJ, Gupta J, Hoffstad O, et al. Lack of effectiveness of hyperbaric oxygen therapy for the treatment of diabetic foot ulcer and the prevention of amputation: a cohort study. *Diabetes Care.* 2013;36(7):1961-1966.
44. Moon H, Strauss MB, La SS, Miller SS. The validity of transcutaneous oxygen measurements in predicting healing of diabetic foot ulcers. *Undersea Hyperb Med.* 2016;43(6):641-648.
45. Thom SR, Bhopale VM, Velazquez OC, Goldstein LJ, Thom LH, Buerk DG. Stem cell mobilization by hyperbaric oxygen. *Am J Physiol Heart Circ Physiol.* 2006;290(4):H1378-1386.
46. Heyboer M, 3rd, Milovanova TN, Wojcik S, et al. CD34+/CD45-dim stem cell mobilization by hyperbaric oxygen - changes with oxygen dosage. *Stem Cell Res.* 2014;12(3):638-645.
47. Heyboer M, Byrne J, Pons P, Wolner E, Seargent S, Wojcik SM. Use of in-chamber transcutaneous oxygen measurement to determine optimal treatment pressure in patients undergoing hyperbaric oxygen therapy. *Undersea Hyperb Med.* 2018;45(4):389-394.
48. Wormer BA, Huntington CR, Ross SW, et al. A prospective randomized double-blinded controlled trial evaluating indocyanine green fluorescence angiography on reducing wound complications in complex abdominal wall reconstruction. *J Surg Res.* 2016;202(2):461-472.
49. Colavita PD, Wormer BA, Belyansky I, et al. Intraoperative indocyanine green fluorescence angiography to predict wound complications in complex ventral hernia repair. *Hernia.* 2016;20(1):139-149.
50. Furukawa H, Hayashi T, Oyama A, et al. Effectiveness of intraoperative indocyanine-green fluorescence angiography during inguinal lymph node dissection for skin cancer to prevent postoperative wound dehiscence. *Surg Today.* 2015;45(8):973-978.
51. Wang HD, Singh DP. The use of indocyanine green angiography to prevent wound complications in ventral hernia repair with open components separation technique. *Hernia.* 2013;17(3):397-402.
52. Kitai T, Kawashima M, Fujii H, Mashima S, Shimahara Y. Indocyanine green fluorescence monitoring of perineal wound contamination in abdominoperineal resection: a preliminary report. *Surg Today.* 2011;41(8):1037-1040.
53. Johnson-Arbor K, Falola R, Kely J, Barbour J, Attinger C. Use of indocyanine green fluorescent angiography in a hyperbaric patient with soft tissue radiation necrosis: a case report. *Undersea Hyperb Med.* 2017;44(3):273-278.
54. Arnold J, Marmolejo V. Visualization of angiogenesis and vasculogenesis in a late tissue radiation injury of the chest wall treated with adjuvant hyperbaric oxygen therapy using fluorescence angiography. *Undersea Hyperb Med.* 2019;46(1):5.
55. Kim D, Rao A, Kaplan S, et al. The use of indocyanine green fluorescence angiography to assess perfusion of chronic wounds undergoing hyperbaric oxygen therapy. *Undersea Hyperb Med.* 2018;45(6):9.
56. Huang E, Nichols T. Indocyanine green angiography results pre- and post-hyperbaric oxygen exposure. *Undersea Hyperb Med.* 2016;43(6):1.
57. Boerema I, Meyne NG, Brummelkamp WH, et al. [Life without blood]. *Ned Tijdschr Geneesk.* 1960;104:949-954.
58. Hopf HW, Rollins MD. Wounds: an overview of the role of oxygen. *Antioxid Redox Signal.* 2007;9(8):1183-1192.
59. Thom SR. Hyperbaric oxygen: its mechanisms and efficacy. *Plast Reconstr Surg.* 2011;127 Suppl 1:131S-141S.

60. Thom SR. Oxidative stress is fundamental to hyperbaric oxygen therapy. *J Appl Physiol* (1985). 2009;106(3):988-995.
61. Schafer M, Werner S. Oxidative stress in normal and impaired wound repair. *Pharmacol Res*. 2008;58(2):165-171.
62. Dennog C, Gedik C, Wood S, Speit G. Analysis of oxidative DNA damage and HPRT mutations in humans after hyperbaric oxygen treatment. *Mutat Res*. 1999;431(2):351-359.
63. Dennog C, Hartmann A, Frey G, Speit G. Detection of DNA damage after hyperbaric oxygen (HBO) therapy. *Mutagenesis*. 1996;11(6):605-609.
64. Dennog C, Radermacher P, Barnett YA, Speit G. Antioxidant status in humans after exposure to hyperbaric oxygen. *Mutat Res*. 1999;428(1-2):83-89.
65. Rothfuss A, Dennog C, Speit G. Adaptive protection against the induction of oxidative DNA damage after hyperbaric oxygen treatment. *Carcinogenesis*. 1998;19(11):1913-1917.
66. Speit G, Dennog C, Eichhorn U, Rothfuss A, Kaina B. Induction of heme oxygenase-1 and adaptive protection against the induction of DNA damage after hyperbaric oxygen treatment. *Carcinogenesis*. 2000;21(10):1795-1799.
67. Speit G, Dennog C, Lampl L. Biological significance of DNA damage induced by hyperbaric oxygen. *Mutagenesis*. 1998;13(1):85-87.
68. Speit G, Dennog C, Radermacher P, Rothfuss A. Genotoxicity of hyperbaric oxygen. *Mutat Res*. 2002;512(2-3):111-119.
69. Juttner B, Scheinichen D, Bartsch S, et al. Lack of toxic side effects in neutrophils following hyperbaric oxygen. *Undersea Hyperb Med*. 2003;30(4):305-311.
70. Thom SR, Mendiguren I, Hardy K, et al. Inhibition of human neutrophil beta2-integrin-dependent adherence by hyperbaric O<sub>2</sub>. *Am J Physiol*. 1997;272(3 Pt 1):C770-777.
71. Thom SR. Functional inhibition of leukocyte B2 integrins by hyperbaric oxygen in carbon monoxide-mediated brain injury in rats. *Toxicol Appl Pharmacol*. 1993;123(2):248-256.
72. Marx RE, Ehler WJ, Tayapongsak P, Pierce LW. Relationship of oxygen dose to angiogenesis induction in irradiated tissue. *Am J Surg*. 1990;160(5):519-524.
73. Svalestad J, Hellem S, Thorsen E, Johannessen AC. Effect of hyperbaric oxygen treatment on irradiated oral mucosa: microvessel density. *Int J Oral Maxillofac Surg*. 2015;44(3):301-307.
74. Svalestad J, Thorsen E, Vaagbo G, Hellem S. Effect of hyperbaric oxygen treatment on oxygen tension and vascular capacity in irradiated skin and mucosa. *Int J Oral Maxillofac Surg*. 2014;43(1):107-112.
75. Thom SR, Milavonova T. Hyperbaric oxygen therapy increases stem cell number and HIF-1 content in diabetics (Abstract). *Undersea Hyperb Med*. 2008;35(4):1.
76. Berra E, Roux D, Richard DE, Pouyssegur J. Hypoxia-inducible factor-1 alpha (HIF-1 alpha) escapes O<sub>2</sub>-driven proteasomal degradation irrespective of its subcellular localization: nucleus or cytoplasm. *EMBO Rep*. 2001;2(7):615-620.
77. Zhang Q, Chang Q, Cox RA, Gong X, Gould LJ. Hyperbaric oxygen attenuates apoptosis and decreases inflammation in an ischemic wound model. *J Invest Dermatol*. 2008;128(8):2102-2112.
78. Sheikh AY, Gibson JJ, Rollins MD, Hopf HW, Hussain Z, Hunt TK. Effect of hyperoxia on vascular endothelial growth factor levels in a wound model. *Arch Surg*. 2000;135(11):1293-1297.
79. Huang X, Liang P, Jiang B, et al. Hyperbaric oxygen potentiates diabetic wound healing by promoting fibroblast cell proliferation and endothelial cell angiogenesis. *Life Sci*. 2020;259:118246.
80. Kang TS, Gorti GK, Quan SY, Ho M, Koch RJ. Effect of hyperbaric oxygen on the growth factor profile of fibroblasts. *Arch Facial Plast Surg*. 2004;6(1):31-35.
81. Lin S, Shyu KG, Lee CC, et al. Hyperbaric oxygen selectively induces angiopoietin-2 in human umbilical vein endothelial cells. *Biochem Biophys Res Commun*. 2002;296(3):710-715.
82. Sander AL, Henrich D, Muth CM, Marzi I, Barker JH, Frank JM. In vivo effect of hyperbaric oxygen on wound angiogenesis and epithelialization. *Wound Repair Regen*. 2009;17(2):179-184.
83. Bonomo SR, Davidson JD, Yu Y, Xia Y, Lin X, Mustoe TA. Hyperbaric oxygen as a signal transducer: upregulation of platelet derived growth factor-beta receptor in the presence of HBO<sub>2</sub> and PDGF. *Undersea Hyperb Med*. 1998;25(4):211-216.
84. Boykin JV, Jr., Baylis C. Hyperbaric oxygen therapy mediates increased nitric oxide production associated with wound healing: a preliminary study. *Adv Skin Wound Care*. 2007;20(7):382-388.
85. Godman CA, Chheda KP, Hightower LE, Perdrizet G, Shin DG, Giardina C. Hyperbaric oxygen induces a cytoprotective and angiogenic response in human microvascular endothelial cells. *Cell Stress Chaperones*. 2010;15(4):431-442.
86. Brownlee M. The pathobiology of diabetic complications: a unifying mechanism. *Diabetes*. 2005;54(6):1615-1625.



87. Dinh TL, Veves A. A review of the mechanisms implicated in the pathogenesis of the diabetic foot. *Int J Low Extrem Wounds*. 2005;4(3):154-159.
88. Catrina SB, Okamoto K, Pereira T, Brismar K, Poellinger L. Hyperglycemia regulates hypoxia-inducible factor-1alpha protein stability and function. *Diabetes*. 2004;53(12):3226-3232.
89. Gao W, Ferguson G, Connell P, et al. High glucose concentrations alter hypoxia-induced control of vascular smooth muscle cell growth via a HIF-1alpha-dependent pathway. *J Mol Cell Cardiol*. 2007;42(3):609-619.
90. Vinik AI, Maser RE, Mitchell BD, Freeman R. Diabetic autonomic neuropathy. *Diabetes Care*. 2003;26(5):1553-1579.
91. Rollins MD, Gibson JJ, Hunt TK, Hopf HW. Wound oxygen levels during hyperbaric oxygen treatment in healing wounds. *Undersea Hyperb Med*. 2006;33(1):17-25.
92. Tibbles PM, Edelsberg JS. Hyperbaric-oxygen therapy. *N Engl J Med*. 1996;334(25):1642-1648.
93. Asano T, Kaneko E, Shinozaki S, et al. Hyperbaric oxygen induces basic fibroblast growth factor and hepatocyte growth factor expression, and enhances blood perfusion and muscle regeneration in mouse ischemic hind limbs. *Circ J*. 2007;71(3):405-411.
94. Gallagher KA, Liu ZJ, Xiao M, et al. Diabetic impairments in NO-mediated endothelial progenitor cell mobilization and homing are reversed by hyperoxia and SDF-1 alpha. *J Clin Invest*. 2007;117(5):1249-1259.
95. Goldstein LJ, Gallagher KA, Bauer SM, et al. Endothelial progenitor cell release into circulation is triggered by hyperoxia-induced increases in bone marrow nitric oxide. *Stem Cells*. 2006;24(10):2309-2318.
96. Liu ZJ, Velazquez OC. Hyperoxia, endothelial progenitor cell mobilization, and diabetic wound healing. *Antioxid Redox Signal*. 2008;10(11):1869-1882.
97. Camporesi EM, Bosco G. *Mechanisms of Action*. 2014.
98. Hart G, Strauss MB. Responses of ischaemic ulcerative conditions to OHP. Paper presented at: Sixth International Congress on Hyperbaric Medicine 1979; Aberdeen, Scotland.
99. Huang ET. Hyperbaric medicine today: an historically noble discipline challenged by loss of critical access and overutilization -- an introduction to invited commentary. *Undersea Hyperb Med*. 2017;44(1):1-3.
100. Hart G, Strauss M. Responses of ischaemic ulcerative conditions to OHP. *Proceedings of the Sixth International Congress on Hyperbaric Medicine*. 1979:312-314.
101. Davis JC. The use of adjuvant hyperbaric oxygen in treatment of the diabetic foot. *Clin Podiatr Med Surg*. 1987;4(2):429-437.
102. Baroni G, Porro T, Faglia E, et al. Hyperbaric oxygen in diabetic gangrene treatment. *Diabetes Care*. 1987;10(1):81-86.
103. Oriani G, Meazza D, Favales F, Pizzi G, Aldeghi A, Faglia E. Hyperbaric Oxygen Therapy in Diabetic Gangrene. *Journal of Hyperbaric Medicine*. 1990;5(3):171-175.
104. Oriani G, Michael M, Meazza D, et al. Diabetic Foot and Hyperbaric Oxygen Therapy: A Ten-Year Experience. *Journal of Hyperbaric Medicine*. 1992;7(4):213-221.
105. Doctor N, Pandya S, Supe A. Hyperbaric oxygen therapy in diabetic foot. *Journal of postgraduate medicine*. 1992;38(3):112-114, 111.
106. Faglia E, Favales F, Aldeghi A, et al. Adjunctive systemic hyperbaric oxygen therapy in treatment of severe prevalently ischemic diabetic foot ulcer. A randomized study. *Diabetes Care*. 1996;19(12):1338-1343.
107. Fife C. Personal Communication about CMS approval of hyperbaric oxygen therapy for diabetic foot ulcers. In:2014.
108. National Coverage Determination (NCD) for Hyperbaric Oxygen Therapy (20.29). In. Version 3 ed: Centers for Medicare and Medicaid Services; 1996.
109. Game F. Classification of diabetic foot ulcers. *Diabetes Metab Res Rev*. 2016;32 Suppl 1:186-194.
110. Wattel F, Mathieu D, Fossati P, Nevriere R, Coget JM. Hyperbaric Oxygen in the Treatment of Diabetic Foot Lesions: Search for Predictive Healing Factors. *Journal of Hyperbaric Medicine*. 1991;6(4):263-268.
111. Faglia E, Favales F, Aldeghi A, et al. Change in major amputation rate in a center dedicated to diabetic foot care during the 1980s: prognostic determinants for major amputation. *Journal of diabetes and its complications*. 1998;12(2):96-102.
112. Strauss MB, Bryant BJ, Hart GB. Transcutaneous oxygen measurements under hyperbaric oxygen conditions as a predictor for healing of problem wounds. *Foot Ankle Int*. 2002;23(10):933-937.
113. Moon H, Strauss M, La S, Miller S. The validity of transcutaneous oxygen measurements in predicting healing of diabetic foot ulcers. *Undersea Hyperb Med*. 2016;43(6).
114. Kalani M, Jorneskog G, Naderi N, Lind F, Brismar K. Hyperbaric oxygen (HBO) therapy in treatment of diabetic foot ulcers. Long-term follow-up. *Journal of diabetes and its complications*. 2002;16(2):153-158.

115. Abidia A, Laden G, Kuhan G, et al. The role of hyperbaric oxygen therapy in ischaemic diabetic lower extremity ulcers: a double-blind randomised-controlled trial. *Eur J Vasc Endovasc Surg.* 2003;25(6):513-518.
116. Kessler L, Bilbault P, Ortega F, et al. Hyperbaric oxygenation accelerates the healing rate of nonischemic chronic diabetic foot ulcers: a prospective randomized study. *Diabetes Care.* 2003;26(8):2378-2382.
117. Duzgun AP, Satir HZ, Ozozan O, Saylam B, Kulah B, Coskun F. Effect of hyperbaric oxygen therapy on healing of diabetic foot ulcers. *J Foot Ankle Surg.* 2008;47(6):515-519.
118. Londahl M, Katzman P, Nilsson A, Hammarlund C. Hyperbaric oxygen therapy facilitates healing of chronic foot ulcers in patients with diabetes. *Diabetes Care.* 2010;33(5):998-1003.
119. Londahl M, Landin-Olsson M, Katzman P. Hyperbaric oxygen therapy improves health-related quality of life in patients with diabetes and chronic foot ulcer. *Diabet Med.* 2011;28(2):186-190.
120. Ma L, Li P, Shi Z, Hou T, Chen X, Du J. A prospective, randomized, controlled study of hyperbaric oxygen therapy: effects on healing and oxidative stress of ulcer tissue in patients with a diabetic foot ulcer. *Ostomy Wound Manage.* 2013;59(3):18-24.
121. Chen CY, Wu RW, Hsu MC, Hsieh CJ, Chou MC. Adjunctive Hyperbaric Oxygen Therapy for Healing of Chronic Diabetic Foot Ulcers: A Randomized Controlled Trial. *J Wound Ostomy Continence Nurs.* 2017;44(6):536-545.
122. Salama SE, Eldeeb AE, Elbarbary AH, Abdelghany SE. Adjuvant Hyperbaric Oxygen Therapy Enhances Healing of Nonischemic Diabetic Foot Ulcers Compared With Standard Wound Care Alone. *Int J Low Extrem Wounds.* 2019;18(1):75-80.
123. Rahman N, Mohammad W, Bajuri M, Shafee R. Use of hyperbaric oxygen therapy (HBOT) in chronic diabetic wound - A randomised trial. *Medical Journal of Malaysia.* 2019;74(5):5.
124. Carter MJ, Fife CE, Bennett M. Comment on: Margolis et al. lack of Effectiveness of hyperbaric oxygen therapy for the treatment of diabetic foot ulcer and the prevention of amputation: a cohort study. *Diabetes Care* 2013;36:1961-1966. *Diabetes Care.* 2013;36(8):e131.
125. Margolis D. Discussion on Propensity Scoring. In:2013.
126. Margolis DJ, Gupta J, Hoffstad O, Papdopoulos M, Thom SR, Mitra N. Response to Comments on: Margolis et al. Lack of effectiveness of hyperbaric oxygen therapy for the treatment of diabetic foot ulcer and the prevention of amputation: a cohort study. *Diabetes Care* 2013;36:1961-1966. *Diabetes Care.* 2013;36(8):e132-133.
127. Fedorko L, Bowen JM, Jones W, et al. Hyperbaric Oxygen Therapy Does Not Reduce Indications for Amputation in Patients With Diabetes With Nonhealing Ulcers of the Lower Limb: A Prospective, Double-Blind, Randomized Controlled Clinical Trial. *Diabetes Care.* 2016.
128. Londahl M, Fagher K, Katzman P. Comment on Fedorko et al. Hyperbaric Oxygen Therapy Does Not Reduce Indications for Amputation in Patients With Diabetes With Nonhealing Ulcers of the Lower Limb: A Prospective, Double-Blind, Randomized Controlled Clinical Trial. *Diabetes Care* 2016;39:392-399. *Diabetes Care.* 2016;39(8):e131-132.
129. Murad MH. Comment on Fedorko et al. Hyperbaric Oxygen Therapy Does Not Reduce Indications for Amputation in Patients With Diabetes With Nonhealing Ulcers of the Lower Limb: A Prospective, Double-Blind, Randomized Controlled Clinical Trial. *Diabetes Care* 2016;39:392-399. *Diabetes Care.* 2016;39(8):e135.
130. Huang ET. Comment on Fedorko et al. Hyperbaric Oxygen Therapy Does Not Reduce Indications for Amputation in Patients With Diabetes With Nonhealing Ulcers of the Lower Limb: A Prospective, Double-Blind, Randomized Controlled Clinical Trial. *Diabetes Care* 2016;39:392-399. *Diabetes Care.* 2016;39(8):e133-134.
131. LeDez K. Serious concerns about the Toronto Hyperbaric Oxygen for Diabetic Foot Ulcer study. *Undersea Hyperb Med.* 2016;43(6):737-741.
132. *Fedorko Study Subject #1121 Testimonial.* <https://www.youtube.com/watch?v=1TPNBRHZe1Q2016>.
133. Santema KTB, Stoekenbroek RM, Koelemay MJW, et al. Hyperbaric Oxygen Therapy in the Treatment of Ischemic Lower-Extremity Ulcers in Patients With Diabetes: Results of the DAMO2CLES Multicenter Randomized Clinical Trial. *Diabetes Care.* 2018;41(1):112-119.
134. Huang E. Comment on Santema et al. Hyperbaric Oxygen Therapy in the Treatment of Ischemic Lower-Extremity Ulcers in Patients With Diabetes: Results of the DAMO2CLES Multicenter Randomized Clinical Trial. *Diabetes Care* 2018;41:112-119. *Diabetes Care.* 2018;41(4):e61.
135. Santema KTB, Stoekenbroek RM, Koelemay MJW, Ubbink DT, Group DCS. Response to Comments on Santema et al. Hyperbaric Oxygen Therapy in the Treatment of Ischemic Lower-Extremity Ulcers in Patients With Diabetes: Results of the DAMO2CLES Multicenter Randomized Clinical Trial. *Diabetes Care* 2018;41:112-119. *Diabetes Care.* 2018;41(4):e62-e63.
136. Wunderlich RP, Peters EJ, Lavery LA. Systemic hyperbaric oxygen therapy: lower-extremity wound healing and the diabetic foot. *Diabetes Care.* 2000;23(10):1551-1555.

137. Bishop AJ, Mudge E. Diabetic foot ulcers treated with hyperbaric oxygen therapy: a review of the literature. *Int Wound J*. 2014;11(1):28-34.
138. Goldman RJ. Hyperbaric oxygen therapy for wound healing and limb salvage: a systematic review. *PM & R: the journal of injury, function, and rehabilitation*. 2009;1(5):471-489.
139. Kranke P, Bennett MH, Martyn-St James M, Schnabel A, Debus SE. Hyperbaric oxygen therapy for chronic wounds. *Cochrane Database Syst Rev*. 2012;4:CD004123.
140. Liu R, Li L, Yang M, Boden G, Yang G. Systematic review of the effectiveness of hyperbaric oxygenation therapy in the management of chronic diabetic foot ulcers. *Mayo Clinic proceedings*. 2013;88(2):166-175.
141. Murad MH, Altayar O, Bennett M, et al. Using GRADE for evaluating the quality of evidence in hyperbaric oxygen therapy clarifies evidence limitations. *J Clin Epidemiol*. 2014;67(1):65-72.
142. O'Reilly D, Pasricha A, Campbell K, et al. Hyperbaric Oxygen Therapy for Diabetic Ulcers: Systematic Review and Meta-Analysis. *International Journal of Technology Assessment in Health Care*. 2013;29(3):269-281.
143. Roeckl-Wiedmann I, Bennett M, Kranke P. Systematic review of hyperbaric oxygen in the management of chronic wounds. *The British journal of surgery*. 2005;92(1):24-32.
144. Stoekenbroek RM, Santema TB, Legemate DA, Ubbink DT, van den Brink A, Koelemay MJ. Hyperbaric oxygen for the treatment of diabetic foot ulcers: a systematic review. *Eur J Vasc Endovasc Surg*. 2014;47(6):647-655.
145. Wang Z, Hasan R, Firwana B, et al. A systematic review and meta-analysis of tests to predict wound healing in diabetic foot. *J Vasc Surg*. 2016;63(2 Suppl):29S-36S e21-22.
146. Game FL, Hinchliffe RJ, Apelqvist J, et al. A systematic review of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes Metab Res Rev*. 2012;28 Suppl 1:119-141.
147. Brouwer RJ, Laliou RC, Hoencamp R, van Hulst RA, Ubbink DT. A systematic review and meta-analysis of hyperbaric oxygen therapy for diabetic foot ulcers with arterial insufficiency. *J Vasc Surg*. 2020;71(2):682-692 e681.
148. Laliou RC, Brouwer RJ, Ubbink DT, Hoencamp R, Bol Raap R, van Hulst RA. Hyperbaric oxygen therapy for nonischemic diabetic ulcers: A systematic review. *Wound Repair Regen*. 2020;28(2):266-275.
149. Zhang Z, Zhang W, Xu Y, Liu D. Efficacy of hyperbaric oxygen therapy for diabetic foot ulcers: An updated systematic review and meta-analysis. *Asian J Surg*. 2022;45(1):68-78.
150. Wang C, Schwaitzberg S, Berliner E, Zarin DA, Lau J. Hyperbaric oxygen for treating wounds: a systematic review of the literature. *Arch Surg*. 2003;138(3):272-279; discussion 280.
151. Clinical Practice Guidelines We Can Trust. In: Institute of Medicine of the National Academies; 2011.
152. Lipsky BA, Berendt AR, Cornia PB, et al. 2012 Infectious Diseases Society of America clinical practice guideline for the diagnosis and treatment of diabetic foot infections. *Clin Infect Dis*. 2012;54(12):e132-173.
153. In: *Diabetic Foot Problems: Prevention and Management*. London 2015.
154. Game FL, Attinger C, Hartemann A, et al. IWGDF guidance on use of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes Metab Res Rev*. 2016;32 Suppl 1:75-83.
155. Hingorani A, LaMuraglia GM, Henke P, et al. The management of diabetic foot: A clinical practice guideline by the Society for Vascular Surgery in collaboration with the American Podiatric Medical Association and the Society for Vascular Medicine. *J Vasc Surg*. 2016;63(2 Suppl):3S-21S.
156. Rayman G, Vas P, Dhatariya K, et al. Guidelines on use of interventions to enhance healing of chronic foot ulcers in diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3283.
157. !!! INVALID CITATION !!! 142-156.
158. Moffat AD, Worth ER, Weaver LK. Glycosylated hemoglobin and hyperbaric oxygen coverage denials. *Undersea Hyperb Med*. 2015;42(3):197-204.
159. Ennis W, Huang E, Gordon H. Impact of Hyperbaric Oxygen on More Advanced Wagner Grades 3 and 4 Diabetic Foot Ulcers: Matching Therapy to Specific Wound Conditions. *Advances in Wound Care*. 2018;7(12):11.
160. Cianci P, Petrone G, Drager S, Lueders H, Lee H, Shapiro R. Salvage of the problem wound and potential amputation with wound care and adjunctive hyperbaric oxygen therapy: An economic analysis. *Journal of Hyperbaric Medicine*. 1988;3(3):127-141.
161. Cianci P, Petrone G, Green B. Adjunctive hyperbaric oxygen in the salvage of the diabetic foot. *Undersea Biomed Res*. 1991;18(Suppl):109.
162. Eggert JV, Worth ER, Van Gils CC. Cost and mortality data of a regional limb salvage and hyperbaric medicine program for Wagner Grade 3 or 4 diabetic foot ulcers. *Undersea Hyperb Med*. 2016;43(1):1-8.
163. Guo S, Counte MA, Gillespie KN, Schmitz H. Cost-effectiveness of adjunctive hyperbaric oxygen in the treatment of diabetic ulcers. *Int J Technol Assess Health Care*. 2003;19(4):731-737.
164. Hailey D, Jacobs P, Perry D, Chuck A, Morrison A, Boudreau R. *Adjunctive Hyperbaric Oxygen Therapy for Diabetic Foot Ulcer: An Economic Analysis*. Canadian Agency for Drugs and Technologies in Health; March 2007.

165. Lipsky BA, Berendt AR. Hyperbaric oxygen therapy for diabetic foot wounds: has hope hurdled hype? *Diabetes Care*. 2010;33(5):1143-1145.
166. Chuck AW, Hailey D, Jacobs P, Perry DC. Cost-effectiveness and budget impact of adjunctive hyperbaric oxygen therapy for diabetic foot ulcers. *Int J Technol Assess Health Care*. 2008;24(2):178-183.
167. Santema TB, Stoekenbroek RM, van Steekelenburg KC, van Hulst RA, Koelemay MJ, Ubbink DT. Economic outcomes in clinical studies assessing hyperbaric oxygen in the treatment of acute and chronic wounds. *Diving Hyperb Med*. 2015;45(4):228-234.
168. Rosamond W, Flegal K, Furie K, et al. Heart disease and stroke statistics--2008 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*. 2008;117(4):e25-146.
169. Thomas DR. Managing peripheral arterial disease and vascular ulcers. *Clin Geriatr Med*. 2013;29(2):425-431.
170. Hopf HW, Ueno C, Aslam R, et al. Guidelines for the treatment of arterial insufficiency ulcers. *Wound Repair Regen*. 2006;14(6):693-710.
171. Tautenhahn J, Lobmann R, Koenig B, Halloul Z, Lippert H, Buerger T. The influence of polymorbidity, revascularization, and wound therapy on the healing of arterial ulceration. *Vasc Health Risk Manag*. 2008;4(3):683-689.
172. Marston WA, Davies SW, Armstrong B, et al. Natural history of limbs with arterial insufficiency and chronic ulceration treated without revascularization. *J Vasc Surg*. 2006;44(1):108-114.
173. Mlekusch W, Schillinger M, Sabeti S, Maca T, Ahmadi R, Minar E. Clinical outcome and prognostic factors for ischaemic ulcers treated with PTA in lower limbs. *Eur J Vasc Endovasc Surg*. 2002;24(2):176-181.
174. Mohapatra A, Henry JC, Avgerinos ED, et al. Heel Wounds Predict Mortality but Not Amputation after Infrapopliteal Revascularization. *Ann Vasc Surg*. 2018;51:78-85.
175. Milovanova TN, Bhopale VM, Sorokina EM, et al. Hyperbaric oxygen stimulates vasculogenic stem cell growth and differentiation in vivo. *J Appl Physiol (1985)*. 2009;106(2):711-728.
176. Capla JM, Ceradini DJ, Tepper OM, et al. Skin graft vascularization involves precisely regulated regression and replacement of endothelial cells through both angiogenesis and vasculogenesis. *Plast Reconstr Surg*. 2006;117(3):836-844.
177. Boger RH, Bode-Boger SM, Thiele W, Junker W, Alexander K, Frolich JC. Biochemical evidence for impaired nitric oxide synthesis in patients with peripheral arterial occlusive disease. *Circulation*. 1997;95(8):2068-2074.
178. Heyboer M, 3rd, Grant WD, Byrne J, et al. Hyperbaric oxygen for the treatment of nonhealing arterial insufficiency ulcers. *Wound Repair Regen*. 2014;22(3):351-355.
179. Angelis M, Wong LL, Myers SA, Wong LM. Calciphylaxis in patients on hemodialysis: a prevalence study. *Surgery*. 1997;122(6):1083-1089; discussion 1089-1090.
180. Podymow T, Wherrett C, Burns KD. Hyperbaric oxygen in the treatment of calciphylaxis: a case series. *Nephrol Dial Transplant*. 2001;16(11):2176-2180.
181. Coates T, Kirkland GS, Dymock RB, et al. Cutaneous necrosis from calcific uremic arteriolopathy. *Am J Kidney Dis*. 1998;32(3):384-391.
182. Budisavljevic MN, Cheek D, Ploth DW. Calciphylaxis in chronic renal failure. *J Am Soc Nephrol*. 1996;7(7):978-982.
183. Mazhar AR, Johnson RJ, Gillen D, et al. Risk factors and mortality associated with calciphylaxis in end-stage renal disease. *Kidney Int*. 2001;60(1):324-332.
184. McCarthy JT, El-Azhary RA, Patzelt MT, et al. Survival, Risk Factors, and Effect of Treatment in 101 Patients With Calciphylaxis. *Mayo Clinic proceedings*. 2016;91(10):1384-1394.
185. Bhambri A, Del Rosso JQ. Calciphylaxis: a review. *J Clin Aesthet Dermatol*. 2008;1(2):38-41.
186. An J, Devaney B, Ooi KY, Ford S, Frawley G, Menahem S. Hyperbaric oxygen in the treatment of calciphylaxis: A case series and literature review. *Nephrology (Carlton)*. 2015;20(7):444-450.
187. Basile C, Montanaro A, Masi M, Pati G, De Maio P, Gismondi A. Hyperbaric oxygen therapy for calcific uremic arteriolopathy: a case series. *J Nephrol*. 2002;15(6):676-680.
188. Arenas MD, Gil MT, Gutierrez MD, et al. Management of calcific uremic arteriolopathy (calciphylaxis) with a combination of treatments, including hyperbaric oxygen therapy. *Clin Nephrol*. 2008;70(3):261-264.
189. Don BR, Chin AI. A strategy for the treatment of calcific uremic arteriolopathy (calciphylaxis) employing a combination of therapies. *Clin Nephrol*. 2003;59(6):463-470.
190. Dean SM, Werman H. Calciphylaxis: a favorable outcome with hyperbaric oxygen. *Vasc Med*. 1998;3(2):115-120.
191. Vassa N, Twardowski ZJ, Campbell J. Hyperbaric oxygen therapy in calciphylaxis-induced skin necrosis in a peritoneal dialysis patient. *Am J Kidney Dis*. 1994;23(6):878-881.

192. McCulloch N, Wojcik SM, Heyboer M, 3rd. Patient Outcomes and Factors Associated with Healing in Calciphylaxis Patients Undergoing Adjunctive Hyperbaric Oxygen Therapy. *J Am Coll Clin Wound Spec.* 2015;7(1-3):8-12.
193. Baldwin C, Farah M, Leung M, et al. Multi-intervention management of calciphylaxis: a report of 7 cases. *Am J Kidney Dis.* 2011;58(6):988-991.
194. Hymes SR, Alousi AM, Cowen EW. Graft-versus-host disease: part I. Pathogenesis and clinical manifestations of graft-versus-host disease. *J Am Acad Dermatol.* 2012;66(4):515 e511-518; quiz 533-514.
195. Stussi G, Tsakiris DA. Late effects on haemostasis after haematopoietic stem cell transplantation. *Hamostaseologie.* 2012;32(1):63-66.
196. Biedermann BC, Sahner S, Gregor M, et al. Endothelial injury mediated by cytotoxic T lymphocytes and loss of microvessels in chronic graft versus host disease. *Lancet.* 2002;359(9323):2078-2083.
197. Gassas A, Wayne Evans A, Armstrong C, Doyle JJ. Open wound chronic skin graft-vs-host disease. Are these wounds ischemic? *Pediatr Transplant.* 2007;11(1):101-104.
198. Al-Waili NS, Butler GJ. Effects of hyperbaric oxygen on inflammatory response to wound and trauma: possible mechanism of action. *ScientificWorldJournal.* 2006;6:425-441.
199. Song XY, Sun LN, Zheng NN, Zhang HP. Effect of hyperbaric oxygen on acute graft-versus-host disease after allogeneic bone marrow transplantation. *Zhongguo Shi Yan Xue Ye Xue Za Zhi.* 2008;16(3):623-626.
200. Heyboer M, 3rd, Taylor J, Morgan M, Mariani P, Jennings S. The Use of Hyperbaric Oxygen Therapy in the Treatment of Non-healing Ulcers Secondary to Graft-versus-host Disease. *J Am Coll Clin Wound Spec.* 2013;5(1):14-18.
201. Takahashi PY, Kiemele LJ, Jones JP, Jr. Wound care for elderly patients: advances and clinical applications for practicing physicians. *Mayo Clinic proceedings.* 2004;79(2):260-267.
202. Valencia IC, Falabella A, Kirsner RS, Eaglstein WH. Chronic venous insufficiency and venous leg ulceration. *J Am Acad Dermatol.* 2001;44(3):401-421; quiz 422-404.
203. Amsler F, Willenberg T, Blattler W. In search of optimal compression therapy for venous leg ulcers: a meta-analysis of studies comparing diverse [corrected] bandages with specifically designed stockings. *J Vasc Surg.* 2009;50(3):668-674.
204. Callam MJ, Ruckley CV, Harper DR, Dale JJ. Chronic ulceration of the leg: extent of the problem and provision of care. *Br Med J (Clin Res Ed).* 1985;290(6485):1855-1856.
205. London NJ, Donnelly R. ABC of arterial and venous disease. Ulcerated lower limb. *BMJ.* 2000;320(7249):1589-1591.
206. Burton CS, 3rd. Management of chronic and problem lower extremity wounds. *Dermatol Clin.* 1993;11(4):767-773.
207. Hammarlund C, Sundberg T. Hyperbaric oxygen reduced size of chronic leg ulcers: a randomized double-blind study. *Plast Reconstr Surg.* 1994;93(4):829-833; discussion 834.
208. Kranke P, Bennett M, Roedel-Wiedmann I, Debus S. Hyperbaric oxygen therapy for chronic wounds. *Cochrane Database Syst Rev.* 2004(2):CD004123.
209. Andrade SM, Santos IC. Hyperbaric oxygen therapy for wound care. *Rev Gaucha Enferm.* 2016;37(2):e59257.
210. Thistlethwaite KR, Finlayson KJ, Cooper PD, et al. The effectiveness of hyperbaric oxygen therapy for healing chronic venous leg ulcers: A randomized, double-blind, placebo-controlled trial. *Wound Repair Regen.* 2018;26(4):324-331.
211. Moran ME. Scleroderma and evidence based non-pharmaceutical treatment modalities for digital ulcers: a systematic review. *J Wound Care.* 2014;23(10):510-516.
212. Dowling GB, Copeman PW, Ashfield R. Raynaud's phenomenon in scleroderma treated with hyperbaric oxygen. *Proc R Soc Med.* 1967;60(12):1268-1269.
213. Chun W, Kim S, Seong H, Chong T. Hyperbaric oxygen therapy in systemic scleroderma. *Korean J Dermatol.* 1974;12(1):4.
214. Slade B. The Effect of hyperbaric oxygen therapy (HBO) on wound healing in patients with collagen-vascular disease: a retrospective analysis. *Undersea Biomed Res.* 1991;18(Suppl):1.
215. Wallace DJ, Silverman S, Goldstein J, Hughes D. Use of hyperbaric oxygen in rheumatic diseases: case report and critical analysis. *Lupus.* 1995;4(3):172-175.
216. Hafner J, Kohler A, Enzler M, Brunner U. Successful treatment of an extended leg ulcer in systemic sclerosis. *Vasa.* 1997;26(4):302-304.
217. Markus YM, Bell MJ, Evans AW. Ischemic scleroderma wounds successfully treated with hyperbaric oxygen therapy. *J Rheumatol.* 2006;33(8):1694-1696.

218. Gerodimos C, Stefanidou S, Kotsiou M, Melekos T, Mesimeris T. Hyperbaric oxygen treatment of intractable ulcers in a systemic sclerosis patient. *Aristotle University Medical Journal*. 2013;40(3):4.
219. Li Y, Pang J, Miao L, Yu M. The long-term effect of hyperbaric oxygen therapy on systemic sclerosis. *Guide of China Medicine*. 2013.
220. Poirier E, Wind H, Cordel N. [Efficacy of hyperbaric oxygen therapy in the treatment of ischemic toe ulcer in a patient presenting systemic sclerosis]. *Ann Dermatol Venereol*. 2017;144(1):55-59.
221. Mirasoglu B, Bagli BS, Aktas S. Hyperbaric oxygen therapy for chronic ulcers in systemic sclerosis - case series. *Int J Dermatol*. 2017;56(6):636-640.
222. Kan Y, Kamiya T, Kumagai A, Hosokawa Y, Uhara H. Successful therapy for diffuse cutaneous systemic sclerosis-induced digital ulcer treated with hyperbaric oxygen therapy. *J Dermatol*. 2020;47(2):e62-e64.
223. Ahijon-Lana M, Baragano-Ordonez E, Veiga-Cabello R, de la Cruz-Tapidor C, Carreira PE. Treatment of Raynaud phenomenon and ischemic ulcers associated to systemic sclerosis with hyperbaric oxygen. *Reumatol Clin (Engl Ed)*. 2022;18(4):246-248.
224. Campton-Johnston S, Wilson J, Ramundo JM. Treatment of painful lower extremity ulcers in a patient with sickle cell disease. *J Wound Ostomy Continence Nurs*. 1999;26(2):98-104.
225. Wethers DL, Ramirez GM, Koshy M, et al. Accelerated healing of chronic sickle-cell leg ulcers treated with RGD peptide matrix. RGD Study Group. *Blood*. 1994;84(6):1775-1779.
226. Freilich DB, Seelenfreund MH. Hyperbaric oxygen, retinal detachment, and sickle cell anemia. *Arch Ophthalmol*. 1973;90(2):90-93.
227. Laszlo J, Obenour W, Jr., Saltzman HA. Effects of hyperbaric oxygenation on sickle syndromes. *South Med J*. 1969;62(4):453-456.
228. Wallyn CR, Jampol LM, Goldberg MF, Zanetti CL. The use of hyperbaric oxygen therapy in the treatment of sickle cell hyphema. *Invest Ophthalmol Vis Sci*. 1985;26(8):1155-1158.
229. Mychaskiw G, 2nd, Woodyard SA, Brunson CD, May WS, Eichhorn JH. In vitro effects of hyperbaric oxygen on sickle cell morphology. *J Clin Anesth*. 2001;13(4):255-258.
230. Desforges JF, Wang MY. Sickle cell anemia. *Med Clin North Am*. 1966;50(6):1519-1532.
231. Reynolds JD. Painful sickle cell crisis. Successful treatment with hyperbaric oxygen therapy. *JAMA*. 1971;216(12):1977-1978.
232. Stirnemann J, Letellier E, Aras N, Borne M, Brinquin L, Fain O. Hyperbaric oxygen therapy for vaso-occlusive crises in nine patients with sickle-cell disease. *Diving Hyperb Med*. 2012;42(2):82-84.
233. Azik FM, Atay A, Kurekci AE, Ay H, Kibar Y, Ozcan O. Treatment of Priapism with Automated Red Cell Exchange and Hyperbaric Oxygen in an 11-year-old Patient with Sickle Cell Disease. *Turk J Haematol*. 2012;29(3):270-273.
234. Canan H, Ulas B, Altan-Yaycioglu R. Hyperbaric oxygen therapy in combination with systemic treatment of sickle cell disease presenting as central retinal artery occlusion: a case report. *J Med Case Rep*. 2014;8:370.
235. Tutrone WD, Green K, Weinberg JM, Caglar S, Clarke D. Pyoderma gangrenosum: dermatologic application of hyperbaric oxygen therapy. *J Drugs Dermatol*. 2007;6(12):1214-1219.
236. Hickman JG, Lazarus GS. Pyoderma gangrenosum: a reappraisal of associated systemic diseases. *Br J Dermatol*. 1980;102(2):235-237.
237. Powell FC, Su WP, Perry HO. Pyoderma gangrenosum: classification and management. *J Am Acad Dermatol*. 1996;34(3):395-409; quiz 410-392.
238. Brooklyn T, Dunnill G, Probert C. Diagnosis and treatment of pyoderma gangrenosum. *BMJ*. 2006;333(7560):181-184.
239. Prystowsky JH, Kahn SN, Lazarus GS. Present status of pyoderma gangrenosum. Review of 21 cases. *Arch Dermatol*. 1989;125(1):57-64.
240. Wolff K, Stingl G. Pyoderma Gangrenosum. In: Freedberg E, ed. *Fitzpatrick's Dermatology in General Medicine*. New York, NY: McGraw-Hill, Health Professions Division; 2003:969-975.
241. Hurwitz RM, Haseman JH. The evolution of pyoderma gangrenosum. A clinicopathologic correlation. *Am J Dermatopathol*. 1993;15(1):28-33.
242. Fakhar F, Memon S, Deitz D, Abramowitz R, Alpert DR. Refractory postsurgical pyoderma gangrenosum in a patient with Beckwith Wiedemann syndrome: response to multimodal therapy. *BMJ Case Rep*. 2013;2013.
243. Niezgodna JA, Cabigas EB, Allen HK, Simanonok JP, Kindwall EP, Krumenauer J. Managing pyoderma gangrenosum: a synergistic approach combining surgical debridement, vacuum-assisted closure, and hyperbaric oxygen therapy. *Plast Reconstr Surg*. 2006;117(2):24e-28e.
244. Thomas CY, Jr., Crouch JA, Guastello J. Hyperbaric oxygen therapy for pyoderma gangrenosum. *Arch Dermatol*. 1974;110(3):445-446.
245. Fuhrman DL. Letter: Hyperbaric oxygen therapy. *Arch Dermatol*. 1975;111(5):657.

246. Wyrick WJ, Mader JT, Butler ME, Hulet WH. Hyperbaric oxygen treatment of pyoderma gangrenosum. *Arch Dermatol.* 1978;114(8):1232-1233.
247. Davis JC, Landeen JM, Levine RA. Pyoderma gangrenosum: skin grafting after preparation with hyperbaric oxygen. *Plast Reconstr Surg.* 1987;79(2):200-207.
248. Wasserteil V, Bruce S, Sessoms SL, Guntupalli KK. Pyoderma gangrenosum treated with hyperbaric oxygen therapy. *Int J Dermatol.* 1992;31(8):594-596.
249. Fitzpatrick D. Primary treatment of pyoderma gangrenosum with hyperbaric oxygen therapy: a case report. *Wounds.* 1997;9:4.
250. Jacobs P, Wood L, Van Niekerk GD. Therapy: Hyperbaric Oxygen as the Only Effective Treatment in Mutilating and Resistant Systemic Vasculitis. *Hematology.* 2000;5(2):167-172.
251. Vieira WA, Barbosa LR, Martin LM. Hyperbaric oxygen therapy as an adjuvant treatment for pyoderma gangrenosum. *An Bras Dermatol.* 2011;86(6):1193-1196.
252. Hill DS, O'Neill JK, Toms A, Watts AM. Pyoderma gangrenosum: a report of a rare complication after knee arthroplasty requiring muscle flap cover supplemented by negative pressure therapy and hyperbaric oxygen. *J Plast Reconstr Aesthet Surg.* 2011;64(11):1528-1532.
253. Mazokopakis EE, Kofteridis DP, Pateromihelaki AT, Vytiniotis SD, Karastergiou PG. Improvement of ulcerative pyoderma gangrenosum with hyperbaric oxygen therapy. *Dermatol Ther.* 2011;24(1):134-136.
254. Altunay I, Kucukunal A, Sarikaya S, Tukenmez Demirci G. A favourable response to surgical intervention and hyperbaric oxygen therapy in pyoderma gangrenosum. *Int Wound J.* 2014;11(4):350-353.
255. Araujo FM, Kondo RN, Minelli L. Pyoderma gangrenosum: skin grafting and hyperbaric oxygen as adjuvants in the treatment of a deep and extensive ulcer. *An Bras Dermatol.* 2013;88(6 Suppl 1):176-178.
256. Ratnagobal S, Sinha S. Pyoderma gangrenosum: guideline for wound practitioners. *J Wound Care.* 2013;22(2):68-73.
257. Mowlds DS, Kim JJ, Murphy P, Wirth GA. Pyoderma gangrenosum: A case report of bilateral dorsal hand lesions and literature review of management. *Can J Plast Surg.* 2013;21(4):239-242.
258. Seo HI, Lee HJ, Han KH. Hyperbaric oxygen therapy for pyoderma gangrenosum associated with ulcerative colitis. *Intest Res.* 2018;16(1):155-157.
259. Chiang IH, Liao YS, Dai NT, et al. Hyperbaric Oxygen Therapy for the Adjunctive Treatment of Pyoderma Gangrenosum: A Case Report. *Ostomy Wound Manage.* 2016;62(5):32-36.
260. Feitosa MR, Feres Filho O, Tamaki CM, et al. Adjunctive Hyperbaric Oxygen Therapy promotes successful healing in patients with refractory Crohn's disease. *Acta Cir Bras.* 2016;31 Suppl 1:19-23.
261. de Sousa Magalhaes R, Moreira MJ, Rosa B, Cotter J. Hyperbaric oxygen therapy for refractory pyoderma gangrenosum: a salvage treatment. *BMJ Case Rep.* 2021;14(2).

## References

1. Benzon HT, Claybon L, Brunner EA. Elevated carbon monoxide levels from exposure to methylene chloride. *JAMA* 1978;239:2341.
2. Rioux JP, Myers RA. Hyperbaric oxygen for methylene chloride poisoning: report on two cases. *Ann Emerg Med* 1989;18:691-5.
3. Huff JS, Kardon E. Carbon monoxide toxicity in a man working outdoors with a gasoline-powered hydraulic machine. *N Engl J Med* 1989;320:1564.
4. DiMaio VJ, Dana SE. Deaths caused by carbon monoxide poisoning in an open environment (outdoors). *J Forensic Sci* 1987;32:1794-5.
5. Jumbelic MI. Open air carbon monoxide poisoning. *J Forensic Sci* 1998;43:228-30.
6. Easley RB. Open air carbon monoxide poisoning in a child swimming behind a boat. *South Med J* 2000;93:430-2.
7. Weaver LK, Churchill S, Deru K. Carbon monoxide poisoning from being towed behind a boat. *Undersea Hyperb Med* 2023;In press.
8. Hampson NB, Holm JR, Courtney TG. Garage carbon monoxide levels from sources commonly used in intentional poisoning. *Undersea Hyperb Med* 2017;44:11-5.
9. Winder C. Carbon monoxide-induced death and toxicity from charcoal briquettes. *Med J Aust* 2012;197:349-50.
10. Rahman MA, Rossner A, Hopke PK. Carbon Monoxide Off-Gassing From Bags of Wood Pellets. *Ann Work Expo Health* 2018;62:248-52.
11. Hampson NB, Dunn SL, UHMS CDC CO Poisoning Surveillance Group. Symptoms of carbon monoxide poisoning do not correlate with the initial carboxyhemoglobin level. *Undersea Hyperb Med* 2012;39:657-65.
12. Weaver LK, Hopkins RO, Chan KJ, et al. Hyperbaric oxygen for acute carbon monoxide poisoning. *N Engl J Med* 2002;347:1057-67.
13. Weaver LK. Clinical practice. Carbon monoxide poisoning. *N Engl J Med* 2009;360:1217-25.
14. Weaver LK, Valentine KJ, Hopkins RO. Carbon monoxide poisoning: risk factors for cognitive sequelae and the role of hyperbaric oxygen. *Am J Respir Crit Care Med* 2007;176:491-7.
15. Sethuraman KN, Douglas TM, Bostick BB, Comer AC, Myers B, Rosenthal RE. Clinical Characteristics of Pediatric Patients With Carbon Monoxide Poisoning. *Pediatr Emerg Care* 2020;36:178-81.
16. Hampson NB, Hauff NM. Carboxyhemoglobin levels in carbon monoxide poisoning: do they correlate with the clinical picture? *Am J Emerg Med* 2008;26:665-9.
17. Weaver LK, Deru K. Carboxyhemoglobin half-life is shorter in children. *Undersea Hyperb Med* 2020;47:368-9.
18. Hampson NB, Piantadosi CA, Thom SR, Weaver LK. Practice recommendations in the diagnosis, management, and prevention of carbon monoxide poisoning. *Am J Respir Crit Care Med* 2012;186:1095-101.
19. Rose JJ, Wang L, Xu Q, et al. Carbon Monoxide Poisoning: Pathogenesis, Management, and Future Directions of Therapy. *Am J Respir Crit Care Med* 2017;195:596-606.
20. Penney D, Benignus V, Kephelopoulos S, Kotzias D, Kleinman M, Verrier A. Carbon monoxide. WHO guidelines for indoor air quality: selected pollutants. Bonn, Germany: WHO Regional Office for Europe; 2010:55-102.
21. EPA. Air quality criteria for carbon monoxide. Research Triangle Park, NC: U.S. Environmental Protection Agency; 2000.
22. Hampson NB. Preventing carbon monoxide poisoning in the Hudson River Tunnel in 1921: recounting history. *Undersea Hyperb Med* 2021;48:89-96.
23. McGrath JJ. The interacting effects of altitude and carbon monoxide. In: Penney DG, ed. Carbon monoxide toxicity. Boca Raton, FL: CRC Press LLC; 2000:135-56.
24. Reh CM, Deitchman SD. Health Hazard Evaluation HETA 88-320-2176.: U.S. National Institute for Occupational Safety and Health; 1992.
25. NIOSH. Criteria for a recommended standard occupational exposure to carbon monoxide. Cincinnati, OH: National Institute for Occupational Safety and Health; 1972.
26. 29 CFR 1910.1000.
27. 1988 OSHA PEL project documentation. Carbon monoxide. 1988. at <http://www.cdc.gov/niosh/pel88/630-08.html>.)
28. ACGIH. Threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists; 2005.
29. National Research Council. Carbon monoxide. Emergency and continuous exposure guidance levels for selected submarine contaminants. Washington, D.C.: The National Academies Press; 2007:67-702.
30. Yoon SS, Macdonald SC, Parrish RG. Deaths from unintentional carbon monoxide poisoning and potential for prevention with carbon monoxide detectors. *JAMA* 1998;279:685-7.



31. Hampson NB, Courtney TG, Holm JR. Should the placement of carbon monoxide (CO) detectors be influenced by CO's weight relative to air? *J Emerg Med* 2012;42:478-82.
32. Hampson NB, Courtney TG, Holm JR. Diffusion of carbon monoxide through gypsum wallboard. *JAMA* 2013;310:745-6.
33. Hampson NB. Residential carbon monoxide poisoning from motor vehicles. *Am J Emerg Med* 2011;29:75-7.
34. Underwriters Laboratories. UL 2034. Standard for safety. Single and multiple station carbon monoxide alarms. 4 ed. Northbrook, IL: Underwriters Laboratories, Inc.; 2017.
35. Penney DG. Essential reference tables, graphs, and other data. In: Penney DG, ed. Carbon Monoxide Poisoning. Boca Raton, FL: CRC Press; 2008:753-64.
36. Kirkpatrick JN. Occult carbon monoxide poisoning. *West J Med* 1987;146:52-6.
37. Penney DG. Chronic carbon monoxide poisoning: a case series. In: Penney DG, ed. Carbon monoxide poisoning. Boca Raton, FL: CRC Press; 2008:551-67.
38. Penney DG. Chronic carbon monoxide poisoning. In: Penney DG, ed. Carbon monoxide toxicity. Boca Raton, FL: CRC Press; 2000:393-418.
39. Chambers CA, Hopkins RO, Weaver LK, Key C. Cognitive and affective outcomes of more severe compared to less severe carbon monoxide poisoning. *Brain Inj* 2008;22:387-95.
40. Peterson JE, Stewart RD. Absorption and elimination of carbon monoxide by inactive young men. *Arch Environ Health* 1970;21:165-71.
41. Weaver LK, Howe S, Hopkins R, Chan KJ. Carboxyhemoglobin half-life in carbon monoxide-poisoned patients treated with 100% oxygen at atmospheric pressure. *Chest* 2000;117:801-8.
42. Pace N, Strajman E, Walker EL. Acceleration of carbon monoxide elimination in man by high pressure oxygen. *Science* 1950;111:652-4.
43. Radford EP, Drizd TA. Blood carbon monoxide levels in persons 3-74 years of age: United States, 1976-80. *Adv Data* 1982;1-24.
44. Istvan JA, Cunningham TW. Smoking rate, carboxyhemoglobin, and body mass in the Second National Health and Nutrition Examination Survey (NHANES II). *J Behav Med* 1992;15:559-72.
45. Edel PO, Carroll JJ, Honaker RW, Beckman EL. Interval at sea-level pressure required to prevent decompression sickness in humans who fly in commercial aircraft after diving. *Aerosp Med* 1969;40:1105-10.
46. Touger M, Gallagher EJ, Tyrell J. Relationship between venous and arterial carboxyhemoglobin levels in patients with suspected carbon monoxide poisoning. *Ann Emerg Med* 1995;25:481-3.
47. Hao H, Zhou H, Liu X, Zhang Z, Yu Z. An accurate method for microanalysis of carbon monoxide in putrid postmortem blood by head-space gas chromatography-mass spectrometry (HS/GC/MS). *Forensic Sci Int* 2013;229:116-21.
48. Oliverio S, Varlet V. Carbon monoxide analysis method in human blood by Airtight Gas Syringe - Gas Chromatography - Mass Spectrometry (AGS-GC-MS): Relevance for postmortem poisoning diagnosis. *J Chromatogr B Analyt Technol Biomed Life Sci* 2018;1090:81-9.
49. Hampson NB. Pulse oximetry in severe carbon monoxide poisoning. *Chest* 1998;114:1036-41.
50. Suner S, Partridge R, Sucov A, et al. Non-invasive pulse CO-oximetry screening in the emergency department identifies occult carbon monoxide toxicity. *J Emerg Med* 2008;34:441-50.
51. Chee KJ, Nilson D, Partridge R, et al. Finding needles in a haystack: a case series of carbon monoxide poisoning detected using new technology in the emergency department. *Clin Toxicol (Phila)* 2008;46:461-9.
52. Weaver LK, Churchill SK, Deru K, Cooney D. False positive rate of carbon monoxide saturation by pulse oximetry of emergency department patients. *Respir Care* 2013;58:232-40.
53. Roughton F, Darling R. The effect of carbon monoxide on oxyhemoglobin dissociation curve. *Am J Physiol* 1944;141:17-31.
54. Thom SR, Ohnishi ST, Fisher D, Xu YA, Ischiropoulos H. Pulmonary vascular stress from carbon monoxide. *Toxicol Appl Pharmacol* 1999;154:12-9.
55. Piantadosi CA, Zhang J, Demchenko IT. Production of hydroxyl radical in the hippocampus after CO hypoxia or hypoxic hypoxia in the rat. *Free Radic Biol Med* 1997;22:725-32.
56. Zhang J, Piantadosi CA. Mitochondrial oxidative stress after carbon monoxide hypoxia in the rat brain. *J Clin Invest* 1992;90:1193-9.
57. Ishimaru H, Katoh A, Suzuki H, Fukuta T, Kameyama T, Nabeshima T. Effects of N-methyl-D-aspartate receptor antagonists on carbon monoxide-induced brain damage in mice. *J Pharmacol Exp Ther* 1992;261:349-52.
58. Thom SR. Carbon monoxide-mediated brain lipid peroxidation in the rat. *J Appl Physiol* 1990;68:997-1003.
59. Thom SR. Leukocytes in carbon monoxide-mediated brain oxidative injury. *Toxicol Appl Pharmacol* 1993;123:234-47.

60. Ischiropoulos H, Beers MF, Ohnishi ST, Fisher D, Garner SE, Thom SR. Nitric oxide production and perivascular nitration in brain after carbon monoxide poisoning in the rat. *J Clin Invest* 1996;97:2260-7.
61. Piantadosi CA, Zhang J, Levin ED, Folz RJ, Schmechel DE. Apoptosis and delayed neuronal damage after carbon monoxide poisoning in the rat. *Exp Neurol* 1997;147:103-14.
62. Meilin S, Rogatsky GG, Thom SR, Zarchin N, Guggenheimer-Furman E, Mayevsky A. Effects of carbon monoxide on the brain may be mediated by nitric oxide. *J Appl Physiol* 1996;81:1078-83.
63. Thom SR, Bhopale VM, Han ST, Clark JM, Hardy KR. Intravascular neutrophil activation due to carbon monoxide poisoning. *Am J Respir Crit Care Med* 2006;174:1239-48.
64. Thom SR, Bhopale VM, Fisher D, Zhang J, Gimotty P. Delayed neuropathology after carbon monoxide poisoning is immune-mediated. *Proc Natl Acad Sci USA* 2004;101:13660-5.
65. Gorman DF, Huang YL, Williams C. Prolonged exposure to one percent carbon monoxide causes a leucoencephalopathy in un-anaesthetised sheep. *Toxicology* 2001;165:97-107.
66. Beppu T, Fujiwara S, Nishimoto H, et al. Fractional anisotropy in the centrum semiovale as a quantitative indicator of cerebral white matter damage in the subacute phase in patients with carbon monoxide poisoning: correlation with the concentration of myelin basic protein in cerebrospinal fluid. *J Neurol* 2012;259:1698-705.
67. Huang YQ, Peng ZR, Huang FL, Yang AL. Mechanism of delayed encephalopathy after acute carbon monoxide poisoning. *Neural Regen Res* 2020;15:2286-95.
68. Xu J, Yang M, Kosterin P, et al. Carbon monoxide inhalation increases microparticles causing vascular and CNS dysfunction. *Toxicol Appl Pharmacol* 2013;273:410-7.
69. Ruhela D, Bhopale VM, Kalakonda S, Thom SR. Astrocyte-derived microparticles initiate a neuroinflammatory cycle due to carbon monoxide poisoning. *Brain Behav Immun Health* 2021;18:100398.
70. Tian X, Guan T, Guo Y, Zhang G, Kong J. Selective Susceptibility of Oligodendrocytes to Carbon Monoxide Poisoning: Implication for Delayed Neurologic Sequelae (DNS). *Front Psychiatry* 2020;11:815.
71. Angelova PR, Myers I, Abramov AY. Carbon monoxide neurotoxicity is triggered by oxidative stress induced by ROS production from three distinct cellular sources. *Redox Biol* 2023;60:102598.
72. Coburn RF. Carbon Monoxide (CO), Nitric Oxide, and Hydrogen Sulfide Signaling During Acute CO Poisoning. *Front Pharmacol* 2021;12:830241.
73. Thom SR, Bhopale VM, Milovanova TM, et al. Plasma biomarkers in carbon monoxide poisoning. *Clin Toxicol (Phila)* 2010;48:47-56.
74. Winter PM, Miller JN. Carbon monoxide poisoning. *JAMA* 1976;236:1502.
75. Choi IS. Delayed neurologic sequelae in carbon monoxide intoxication. *Arch Neurol* 1983;40:433-5.
76. Min SK. A brain syndrome associated with delayed neuropsychiatric sequelae following acute carbon monoxide intoxication. *Acta Psychiatr Scand* 1986;73:80-6.
77. Smith G, Sharp GR. Treatment of carbon-monoxide poisoning with oxygen under pressure. *Lancet* 1960;276:905-6.
78. Goulon M, Barrios A, Rapin M, Nouailhat F, Grosbuis S, Labrousse J. Carbon monoxide poisoning and acute anoxia due to breathing coal gas and hydrocarbons. *J Hyperb Med* 1986;1:23-41.
79. Myers RA, Snyder SK, Emhoff TA. Subacute sequelae of carbon monoxide poisoning. *Ann Emerg Med* 1985;14:1163-7.
80. Mathieu D, Wattel F, Mathieu-Nolf M, et al. Randomized prospective study comparing the effect of HBO versus 12 hours NBO in non comatose CO poisoned patients: results of the interim analysis. *Undersea Hyperb Med* 1996;23:7.
81. Rose JJ, Nouraie M, Gauthier MC, et al. Clinical Outcomes and Mortality Impact of Hyperbaric Oxygen Therapy in Patients With Carbon Monoxide Poisoning. *Crit Care Med* 2018;46:e649-e55.
82. Ginsberg MD, Myers RE. Experimental carbon monoxide encephalopathy in the primate I. Physiologic and metabolic aspects. *Arch Neurol* 1974;30:202-8.
83. Brown SD, Piantadosi CA. Recovery of energy metabolism in rat brain after carbon monoxide hypoxia. *J Clin Invest* 1992;89:666-72.
84. Okeda R, Funata N, Song SJ, Higashino F, Takano T, Yokoyama K. Comparative study on pathogenesis of selective cerebral lesions in carbon monoxide poisoning and nitrogen hypoxia in cats. *Acta Neuropathol* 1982;56:265-72.
85. Mayevsky A, Meilin S, Rogatsky GG, Zarchin N, Thom SR. Multiparametric monitoring of the awake brain exposed to carbon monoxide. *J Appl Physiol* 1995;78:1188-96.
86. Hopkins RO, Weaver LK, Larson LV, Howe S. Loss of consciousness (LOC) is not required for neurological sequelae due to CO poisoning. *Undersea Hyperb Med* 1995;22:14.
87. Thom SR, Fisher D, Xu YA, Garner S, Ischiropoulos H. Role of nitric oxide-derived oxidants in vascular injury from carbon monoxide in the rat. *Am J Physiol* 1999;276:H984-92.
88. Thom SR, Garner S, Fisher D, Ischiropoulos H. Vascular nitrosative stress from CO exposure. *Undersea Hyperb Med* 1998;25:47.

89. Preziosi TJ, Lindenberg R, Levy D, Christenson M. An experimental investigation in animals of the functional and morphologic effects of single and repeated exposures to high and low concentrations of carbon monoxide. *Ann NY Acad Sci* 1970;174:369-84.
90. Cramlet SH, Erickson HH, Gorman HA. Ventricular function following acute carbon monoxide exposure. *J Appl Physiol* 1975;39:482-6.
91. Anderson EW, Andelman RJ, Strauch JM, Fortuin NJ, Knelson JH. Effect of low-level carbon monoxide exposure on onset and duration of angina pectoris. A study in ten patients with ischemic heart disease. *Ann Intern Med* 1973;79:46-50.
92. Henry CR, Satran D, Lindgren B, Adkinson C, Nicholson CI, Henry TD. Myocardial injury and long-term mortality following moderate to severe carbon monoxide poisoning. *JAMA* 2006;295:398-402.
93. Hampson NB, Rudd RA, Hauff NM. Increased long-term mortality among survivors of acute carbon monoxide poisoning. *Crit Care Med* 2009;37:1941-7.
94. Alvarez Villeda M, Wever-Pinzon O, Parikh M, et al. Patterns of cardiac dysfunction after carbon monoxide poisoning. *Undersea Hyperb Med* 2020;47:477-85.
95. Cho DH, Ko SM, Son JW, Park EJ, Cha YS. Myocardial Injury and Fibrosis From Acute Carbon Monoxide Poisoning: A Prospective Observational Study. *JACC Cardiovasc Imaging* 2021;14:1758-70.
96. Henry TD, Lesser JR, Satran D. Myocardial fibrosis from severe carbon monoxide poisoning detected by cardiac magnetic resonance imaging. *Circulation* 2008;118:792.
97. Henry TD, Satran D. Acute Carbon Monoxide Poisoning and Cardiac Magnetic Resonance: The Future Is Now. *JACC Cardiovasc Imaging* 2021;14:1771-3.
98. Hsiao IT, Chang YT, Weng YH, et al. Comparisons of vesicular monoamine transporter type 2 signals in Parkinson's disease and parkinsonism secondary to carbon monoxide poisoning. *Neurotoxicology* 2022;88:178-86.
99. Gorman DF, Clayton D, Gilligan JE, Webb RK. A longitudinal study of 100 consecutive admissions for carbon monoxide poisoning to the Royal Adelaide Hospital. *Anaesth Intensive Care* 1992;20:311-6.
100. Hardy KR, Thom SR. Pathophysiology and treatment of carbon monoxide poisoning. *J Toxicol Clin Toxicol* 1994;32:613-29.
101. Thom SR, Taber RL, Mendiguren, II, Clark JM, Hardy KR, Fisher AB. Delayed neuropsychologic sequelae after carbon monoxide poisoning: prevention by treatment with hyperbaric oxygen. *Ann Emerg Med* 1995;25:474-80.
102. Wang T, Zhang Y, Gu Y, Chen J, Lei J, Guo S. Neurological sequelae in acute carbon monoxide poisoning: A prospective observational study with MRI data. *Acta Neurol Scand* 2022;145:590-8.
103. Abdel Salam ME, Elawady EH, Khater AS, Eweda SA, Abd El Moneam MH. Neuropsychiatric sequelae of acute carbon monoxide poisoning: The predictive role of neuron specific enolase and glial fibrillary acidic protein. *Neurotoxicology* 2021;85:115-20.
104. Jasper BW, Hopkins RO, Duker HV, Weaver LK. Affective outcome following carbon monoxide poisoning: a prospective longitudinal study. *Cogn Behav Neurol* 2005;18:127-34.
105. Meng YH, Hsieh MS, Chi YC, How CK, Chen PC, Chang CM. Effect of Carbon Monoxide Poisoning on Epilepsy Development: A Nationwide Population-Based Cohort Study. *Ann Emerg Med* 2023.
106. Huang CC, Ho CH, Chen YC, et al. Increased risk for diabetes mellitus in patients with carbon monoxide poisoning. *Oncotarget* 2017;8:63680-90.
107. Deru K, Weaver LK, Churchill S, Calderone P. Retrospective case-control study of long-term health outcomes after carbon monoxide poisonin. *Undersea Hyperb Med* 2021;48:330.
108. Huang CC, Ho CH, Chen YC, et al. Increased risk for hypothyroidism associated with carbon monoxide poisoning: a nationwide population-based cohort study. *Sci Rep* 2019;9:16512.
109. Weaver LK, Deru K, Churchill S, Calderone P, Perez AC, Schneider M. Retrospective cohort study of thyroid, bowel, and autoimmune diseases after carbon monoxide poisoning. *Undersea Hyperb Med* 2022;49:98-9.
110. Lai CY, Huang YW, Tseng CH, Lin CL, Sung FC, Kao CH. Patients With Carbon Monoxide Poisoning and Subsequent Dementia: A Population-Based Cohort Study. *Medicine (Baltimore)* 2016;95:e2418.
111. Wong CS, Lin YC, Hong LY, et al. Increased Long-Term Risk of Dementia in Patients With Carbon Monoxide Poisoning: A Population-Based Study. *Medicine (Baltimore)* 2016;95:e2549.
112. Mimura K, Harada M, Sumiyoshi S, et al. [Long-term follow-up study on sequelae of carbon monoxide poisoning; serial investigation 33 years after poisoning]. *Seishin Shinkeigaku Zasshi* 1999;101:592-618.
113. Mimura K, Harada M, Sumiyoshi S, et al. Long-term effects of carbon monoxide poisoning at Miike coal mine: a 33-year follow-up study. *Undersea Hyperb Med* 2023;50:111-43.
114. Chung WS, Lin CL, Kao CH. Carbon monoxide poisoning and risk of deep vein thrombosis and pulmonary embolism: a nationwide retrospective cohort study. *J Epidemiol Community Health* 2015;69:557-62.

115. Cho Y, Kang H, Oh J, Lim TH, Ryu J, Ko BS. Risk of Venous Thromboembolism After Carbon Monoxide Poisoning: A Nationwide Population-Based Study. *Ann Emerg Med* 2020;75:587-96.
116. Feng SY, Li Y. Incidence, timing, location, risk factors, and nomogram of lower extremity deep venous thrombosis after acute carbon monoxide poisoning. *Ir J Med Sci* 2023;192:417-22.
117. Chen YG, Lin TY, Dai MS, et al. Risk of Peripheral Artery Disease in Patients With Carbon Monoxide Poisoning: A Population-Based Retrospective Cohort Study. *Medicine (Baltimore)* 2015;94:e1608.
118. Wong CS, Lin YC, Sung LC, et al. Increased long-term risk of major adverse cardiovascular events in patients with carbon monoxide poisoning: A population-based study in Taiwan. *PLoS One* 2017;12:e0176465.
119. Lee FY, Chen WK, Lin CL, Kao CH. Carbon monoxide poisoning and subsequent cardiovascular disease risk: a nationwide population-based cohort study. *Medicine (Baltimore)* 2015;94:e624.
120. Huang CC, Chen TH, Ho CH, et al. Increased Risk of Congestive Heart Failure Following Carbon Monoxide Poisoning. *Circ Heart Fail* 2021;14:e007267.
121. Lin CW, Chen WK, Hung DZ, et al. Association between ischemic stroke and carbon monoxide poisoning: A population-based retrospective cohort analysis. *Eur J Intern Med* 2016;29:65-70.
122. Kim HH, Choi S, Jung YS, Min YG, Yoon D, Lee SE. Stroke Incidence in Survivors of Carbon Monoxide Poisoning in South Korea: A Population-Based Longitudinal Study. *Med Sci Monit* 2020;26:e926116.
123. Huang CC, Ho CH, Chen YC, et al. Association between carbon monoxide poisoning and adrenal insufficiency: a nationwide cohort study. *Sci Rep* 2022;12:16219.
124. Rhee B, Kim HH, Choi S, Min YG. Incidence patterns of nervous system diseases after carbon monoxide poisoning: a retrospective longitudinal study in South Korea from 2012 to 2018. *Clin Exp Emerg Med* 2021;8:111-9.
125. Huang TL, Tung MC, Lin CL, Chang KH. Risk of acute kidney injury among patients with carbon monoxide poisoning. *Medicine (Baltimore)* 2021;100:e27239.
126. Wei KY, Liao CY, Chung CH, et al. Carbon Monoxide Poisoning and Chronic Kidney Disease Risk: A Nationwide, Population-Based Study. *Am J Nephrol* 2021;52:292-303.
127. Shimazu T, Ikeuchi H, Sugimoto H, Goodwin CW, Mason AD, Jr., Pruitt BA, Jr. Half-life of blood carboxyhemoglobin after short-term and long-term exposure to carbon monoxide. *J Trauma* 2000;49:126-31.
128. Sasaki T. On half-clearance time of carbon monoxide hemoglobin in blood during hyperbaric oxygen therapy (OHP). *Bull Tokyo Med Dent Univ* 1975;22:63-77.
129. Ozturan IU, Yaka E, Suner S, et al. Determination of carboxyhemoglobin half-life in patients with carbon monoxide toxicity treated with high flow nasal cannula oxygen therapy. *Clin Toxicol (Phila)* 2019;57:617-23.
130. Yesiloglu O, Gulen M, Satar S, Avci A, Acehan S, Akoglu H. Treatment of carbon monoxide poisoning: high-flow nasal cannula versus non-rebreather face mask. *Clin Toxicol (Phila)* 2021;59:386-91.
131. End E, Long CW. Oxygen under pressure in carbon monoxide poisoning. *J Ind Hyg Toxicol* 1942;20:302-6.
132. Britten JS, Myers RA. Effects of hyperbaric treatment on carbon monoxide elimination in humans. *Undersea Biomed Res* 1985;12:431-8.
133. Myers RAM, Jones DW, Britten JS. Carbon monoxide half life study. Flagstaff, AZ: Best Publishing Company Co.; 1987.
134. Cardellach F, Miro O, Casademont J. Hyperbaric oxygen for acute carbon monoxide poisoning. *N Engl J Med* 2003;348:557-60; author reply -60.
135. Thom SR. Antagonism of carbon monoxide-mediated brain lipid peroxidation by hyperbaric oxygen. *Toxicol Appl Pharmacol* 1990;105:340-4.
136. Thom SR. Functional inhibition of leukocyte B2 integrins by hyperbaric oxygen in carbon monoxide-mediated brain injury in rats. *Toxicol Appl Pharmacol* 1993;123:248-56.
137. Thom SR, Bhopale VM, Fisher D. Hyperbaric oxygen reduces delayed immune-mediated neuropathology in experimental carbon monoxide toxicity. *Toxicol Appl Pharmacol* 2006;213:152-9.
138. Steenebruggen F, Jacobs D, Delporte C, et al. Hyperbaric oxygenation improve red blood cell deformability in patients with acute or chronic inflammation. *Microvasc Res* 2023;148:104534.
139. Peirce EC, 2nd, Zacharias A, Alday JM, Jr., Hoffman BA, Jacobson JH, 2nd. Carbon monoxide poisoning: experimental hypothermic and hyperbaric studies. *Surgery* 1972;72:229-37.
140. Tomaszewski CA, Rudy J, Wathen J, Brent J, Rosenberg N, Kulig K. Prevention of neurologic sequelae from carbon monoxide by hyperbaric oxygen in rats. *Ann Emerg Med* 1992;21:631-2.
141. Sethuraman K, Thom SR. Hyperbaric oxygen should be used for carbon monoxide poisoning. *Br J Clin Pharmacol* 2023;89:939-41.
142. Haldane J. The relation of the action of carbonic oxide to oxygen tension. *J Physiol* 1895;18:201-17.
143. Douglas CG, Haldane JS, Haldane JB. The laws of combination of haemoglobin with carbon monoxide and oxygen. *J Physiol* 1912;44:275-304.

144. Haldane JB. Carbon monoxide as a tissue poison. *Biochem J* 1927;21:1068-75.
145. Haldane JS. Respiration. New Haven: Yale University Press; 1922.
146. Boerema I, Meyne NG, Brummelkamp WK, et al. Life without blood (a study of the influence of high atmospheric pressure and hypothermia on dilution of the blood). *J Cardiovasc Surg* 1960;13:133-46.
147. Weaver LK. Technique of Swan-Ganz catheter monitoring in patients treated in the monoplace hyperbaric chamber. *J Hyperb Med* 1992;7:1-18.
148. Weaver LK, Howe S, Snow GL, Deru K. Arterial and pulmonary arterial hemodynamics and oxygen delivery/ extraction in normal humans exposed to hyperbaric air and oxygen. *J Appl Physiol* 2009;107:336-45.
149. Koehler RC, Jones MD, Jr., Traystman RJ. Cerebral circulatory response to carbon monoxide and hypoxic hypoxia in the lamb. *Am J Physiol* 1982;243:H27-32.
150. Koehler RC, Traystman RJ, Jones MD, Jr. Regional blood flow and O<sub>2</sub> transport during hypoxic and CO hypoxia in neonatal and adult sheep. *Am J Physiol* 1985;248:H118-24.
151. Koehler RC, Traystman RJ, Rosenberg AA, Hudak ML, Jones MD, Jr. Role of O<sub>2</sub>-hemoglobin affinity on cerebrovascular response to carbon monoxide hypoxia. *Am J Physiol* 1983;245:H1019-23.
152. Barker SJ, Tremper KK. The effect of carbon monoxide inhalation on pulse oximetry and transcutaneous PO<sub>2</sub>. *Anesthesiology* 1987;66:677-9.
153. Fuson RL, Saltzman HA, Boineau JP, Smith WW, Spach MS, Brown IW, Jr. Oxygenation and carbonic acidosis in cyanotic dogs exposed to hyperbaric oxygenation. *Surg Gynecol Obstet* 1966;122:340-52.
154. Keilin D, Hartree EF. Cytochrome and cytochrome oxidase. *Proc R Soc Lond B* 1939;127:167-91.
155. Ball EG, Strittmatter CF, Cooper O. The reaction of cytochrome oxidase with carbon monoxide. *J Biol Chem* 1951;193:635-47.
156. Chance B, Erecinska M, Wagner M. Mitochondrial responses to carbon monoxide toxicity. *Ann N Y Acad Sci* 1970;174:193-204.
157. Caughey WS. Carbon monoxide bonding in hemoproteins. *Ann N Y Acad Sci* 1970;174:148-53.
158. Wald G, Allen DW. The equilibrium between cytochrome oxidase and carbon monoxide. *J Gen Physiol* 1957;40:593-608.
159. Penney DG, Zak R, Aschenbrenner V. Carbon monoxide inhalation: effect on heart cytochrome c in the neonatal and adult rat. *J Toxicol Environ Health* 1983;12:395-406.
160. Piantadosi CA. Carbon monoxide, oxygen transport, and oxygen metabolism. *J Hyperb Med* 1987;2:27-44.
161. Coburn RF, Mayers LB. Myoglobin O<sub>2</sub> tension determined from measurement of carboxymyoglobin in skeletal muscle. *Am J Physiol* 1971;220:66-74.
162. Brown SD, Piantadosi CA. In vivo binding of carbon monoxide to cytochrome c oxidase in rat brain. *J Appl Physiol* 1990;68:604-10.
163. Thom SR, Ohnishi ST, Ischiropoulos H. Nitric oxide released by platelets inhibits neutrophil B2 integrin function following acute carbon monoxide poisoning. *Toxicol Appl Pharmacol* 1994;128:105-10.
164. Thom SR, Ischiropoulos H. Mechanism of oxidative stress from low levels of carbon monoxide. *Res Rep Health Eff Inst* 1997;1-19; discussion 21-7.
165. Thom SR, Xu YA, Ischiropoulos H. Vascular endothelial cells generate peroxynitrite in response to carbon monoxide exposure. *Chem Res Toxicol* 1997;10:1023-31.
166. Brown SD, Piantadosi CA. Reversal of carbon monoxide-cytochrome c oxidase binding by hyperbaric oxygen in vivo. *Adv Exp Med Biol* 1989;248:747-54.
167. D'Amico G, Lam F, Hagen T, Moncada S. Inhibition of cellular respiration by endogenously produced carbon monoxide. *J Cell Sci* 2006;119:2291-8.
168. Chance B, Williams GR. The respiratory chain and oxidative phosphorylation. *Adv Enzymol Relat Subj Biochem* 1956;17:65-134.
169. Alonso JR, Cardellach F, Lopez S, Casademont J, Miro O. Carbon monoxide specifically inhibits cytochrome c oxidase of human mitochondrial respiratory chain. *Pharmacol Toxicol* 2003;93:142-6.
170. Daugherty WP, Lévassieur JE, Sun D, Rockswold GL, Bullock MR. Effects of hyperbaric oxygen therapy on cerebral oxygenation and mitochondrial function following moderate lateral fluid-percussion injury in rats. *J Neurosurg* 2004;101:499-504.
171. Lou M, Chen Y, Ding M, Eschenfelder CC, Deuschl G. Involvement of the mitochondrial ATP-sensitive potassium channel in the neuroprotective effect of hyperbaric oxygenation after cerebral ischemia. *Brain Res Bull* 2006;69:109-16.
172. Stewart RJ, Yamaguchi KT, Mason SW, Roshdieh BB, Dabassi NI, Ness NT. Tissue ATP levels in burn injured skin treated with hyperbaric oxygen. *Undersea Biomed Res* 1989;16:53.

173. Piantadosi CA, Tatro L, Zhang J. Hydroxyl radical production in the brain after CO hypoxia in rats. *Free Radic Biol Med* 1995;18:603-9.
174. Cronje FJ, Carraway MS, Freiburger JJ, Suliman HB, Piantadosi CA. Carbon monoxide actuates O(2)-limited heme degradation in the rat brain. *Free Radic Biol Med* 2004;37:1802-12.
175. Rothfuss A, Radermacher P, Speit G. Involvement of heme oxygenase-1 (HO-1) in the adaptive protection of human lymphocytes after hyperbaric oxygen (HBO) treatment. *Carcinogenesis* 2001;22:1979-85.
176. Speit G, Dennog C, Eichhorn U, Rothfuss A, Kaina B. Induction of heme oxygenase-1 and adaptive protection against the induction of DNA damage after hyperbaric oxygen treatment. *Carcinogenesis* 2000;21:1795-9.
177. Gregorevic P, Lynch GS, Williams DA. Hyperbaric oxygen modulates antioxidant enzyme activity in rat skeletal muscles. *Eur J Appl Physiol* 2001;86:24-7.
178. Kim CH, Choi H, Chun YS, Kim GT, Park JW, Kim MS. Hyperbaric oxygenation pretreatment induces catalase and reduces infarct size in ischemic rat myocardium. *Pflugers Arch* 2001;442:519-25.
179. Ayvaz S, Kanter M, Aksu B, et al. The effects of hyperbaric oxygen application against cholestatic oxidative stress and hepatic damage after bile duct ligation in rats. *J Surg Res* 2013;183:146-55.
180. Bosco G, Yang ZJ, Nandi J, Wang J, Chen C, Camporesi EM. Effects of hyperbaric oxygen on glucose, lactate, glycerol and anti-oxidant enzymes in the skeletal muscle of rats during ischaemia and reperfusion. *Clin Exp Pharmacol Physiol* 2007;34:70-6.
181. Godman CA, Joshi R, Giardina C, Perdrizet G, Hightower LE. Hyperbaric oxygen treatment induces antioxidant gene expression. *Ann NY Acad Sci* 2010;1197:178-83.
182. Ozden TA, Uzun H, Bohlooli M, et al. The effects of hyperbaric oxygen treatment on oxidant and antioxidants levels during liver regeneration in rats. *Tohoku J Exp Med* 2004;203:253-65.
183. Yasar M, Yildiz S, Mas R, et al. The effect of hyperbaric oxygen treatment on oxidative stress in experimental acute necrotizing pancreatitis. *Physiol Res* 2003;52:111-6.
184. Dennog C, Radermacher P, Barnett YA, Speit G. Antioxidant status in humans after exposure to hyperbaric oxygen. *Mutat Res* 1999;428:83-9.
185. Shyu WC, Lin SZ, Saeki K, et al. Hyperbaric oxygen enhances the expression of prion protein and heat shock protein 70 in a mouse neuroblastoma cell line. *Cell Mol Neurobiol* 2004;24:257-68.
186. Wang W, Xue L, Li Y, et al. RNA sequencing analysis reveals new findings of hyperbaric oxygen treatment on rats with acute carbon monoxide poisoning. *Undersea Hyperb Med* 2016;43:759-70.
187. Park EJ, Min YG, Kim GW, Cho JP, Maeng WJ, Choi SC. Pathophysiology of brain injuries in acute carbon monoxide poisoning: a novel hypothesis. *Med Hypotheses* 2014;83:186-9.
188. Juric DM, Finderle Z, Suput D, Brvar M. The effectiveness of oxygen therapy in carbon monoxide poisoning is pressure- and time-dependent: a study on cultured astrocytes. *Toxicol Lett* 2015;233:16-23.
189. Juric DM, Suput D, Brvar M. Hyperbaric oxygen preserves neurotrophic activity of carbon monoxide-exposed astrocytes. *Toxicol Lett* 2016;253:1-6.
190. Zhang Y, Lv Y, Liu YJ, et al. Hyperbaric oxygen therapy in rats attenuates ischemia-reperfusion testicular injury through blockade of oxidative stress, suppression of inflammation, and reduction of nitric oxide formation. *Urology* 2013;82:489 e9- e15.
191. Miljkovic-Lolic M, Silbergleit R, Fiskum G, Rosenthal RE. Neuroprotective effects of hyperbaric oxygen treatment in experimental focal cerebral ischemia are associated with reduced brain leukocyte myeloperoxidase activity. *Brain Res* 2003;971:90-4.
192. Thom SR, Fisher D, Manevich Y. Roles for platelet-activating factor and \*NO-derived oxidants causing neutrophil adherence after CO poisoning. *Am J Physiol Heart Circ Physiol* 2001;281:H923-30.
193. Thom SR. Dehydrogenase conversion to oxidase and lipid peroxidation in brain after carbon monoxide poisoning. *J Appl Physiol* 1992;73:1584-9.
194. Thom SR. Effects of hyperoxia on neutrophil adhesion. *Undersea Hyperb Med* 2004;31:123-31.
195. Zamboni WA, Roth AC, Russell RC, Graham B, Suchy H, Kucan JO. Morphologic analysis of the microcirculation during reperfusion of ischemic skeletal muscle and the effect of hyperbaric oxygen. *Plast Reconstr Surg* 1993;91:1110-23.
196. Vlodavsky E, Palzur E, Soustiel JF. Hyperbaric oxygen therapy reduces neuroinflammation and expression of matrix metalloproteinase-9 in the rat model of traumatic brain injury. *Neuropathol Appl Neurobiol* 2006;32:40-50.
197. Hara S, Mukai T, Kurosaki K, Kuriwa F, Endo T. Characterization of hydroxyl radical generation in the striatum of free-moving rats due to carbon monoxide poisoning, as determined by in vivo microdialysis. *Brain Res* 2004;1016:281-4.

198. Hiramatsu M, Yokoyama S, Nabeshima T, Kameyama T. Changes in concentrations of dopamine, serotonin, and their metabolites induced by carbon monoxide (CO) in the rat striatum as determined by in vivo microdialysis. *Pharmacol Biochem Behav* 1994;48:9-15.
199. Newby MB, Roberts RJ, Bhatnagar RK. Carbon monoxide- and hypoxia-induced effects on catecholamines in the mature and developing rat brain. *J Pharmacol Exp Ther* 1978;206:61-8.
200. Thom SR, Fisher D, Zhang J, Bhopale VM, Cameron B, Buerk DG. Neuronal nitric oxide synthase and N-methyl-D-aspartate neurons in experimental carbon monoxide poisoning. *Toxicol Appl Pharmacol* 2004;194:280-95.
201. Chin BY, Jiang G, Wegiel B, et al. Hypoxia-inducible factor 1alpha stabilization by carbon monoxide results in cytoprotective preconditioning. *Proc Natl Acad Sci U S A* 2007;104:5109-14.
202. Choi YK, Kim CK, Lee H, et al. Carbon monoxide promotes VEGF expression by increasing HIF-1alpha protein level via two distinct mechanisms, translational activation and stabilization of HIF-1alpha protein. *J Biol Chem* 2010;285:32116-25.
203. Calvert JW, Cahill J, Yamaguchi-Okada M, Zhang JH. Oxygen treatment after experimental hypoxia-ischemia in neonatal rats alters the expression of HIF-1alpha and its downstream target genes. *J Appl Physiol* 2006;101:853-65.
204. Li Y, Zhou C, Calvert JW, Colohan AR, Zhang JH. Multiple effects of hyperbaric oxygen on the expression of HIF-1 alpha and apoptotic genes in a global ischemia-hypotension rat model. *Exp Neurol* 2005;191:198-210.
205. Ostrowski RP, Colohan AR, Zhang JH. Mechanisms of hyperbaric oxygen-induced neuroprotection in a rat model of subarachnoid hemorrhage. *J Cereb Blood Flow Metab* 2005;25:554-71.
206. Tofighi R, Tillmark N, Dare E, Aberg AM, Larsson JE, Ceccatelli S. Hypoxia-independent apoptosis in neural cells exposed to carbon monoxide in vitro. *Brain Res* 2006;1098:1-8.
207. Brvar M, Luzar B, FINDERLE Z, Suput D, Bunc M. The time-dependent protective effect of hyperbaric oxygen on neuronal cell apoptosis in carbon monoxide poisoning. *Inhal Toxicol* 2010;22:1026-31.
208. Calvert JW, Zhou C, Nanda A, Zhang JH. Effect of hyperbaric oxygen on apoptosis in neonatal hypoxia-ischemia rat model. *J Appl Physiol* 2003;95:2072-80.
209. Rosenthal RE, Silbergleit R, Hof PR, Haywood Y, Fiskum G. Hyperbaric oxygen reduces neuronal death and improves neurological outcome after canine cardiac arrest. *Stroke* 2003;34:1311-6.
210. Wang K, Kong W. Therapeutic study of hyperbaric oxygen on heme oxygenase-1 (HO-1) in patients with acute carbon monoxide poisoning and myocardial injury. *Cell Mol Biol (Noisy-le-grand)* 2022;68:36-9.
211. Garland H, Pearce J. Neurological complications of carbon monoxide poisoning. *Q J Med* 1967;36:445-55.
212. Thom SR. Hyperbaric-oxygen therapy for acute carbon monoxide poisoning. *N Engl J Med* 2002;347:1105-6.
213. Hampson NB, Dunford RG, Kramer CC, Norkool DM. Selection criteria utilized for hyperbaric oxygen treatment of carbon monoxide poisoning. *J Emerg Med* 1995;13:227-31.
214. Raphael JC, Elkharrat D, Jars-Guinestre MC, et al. Trial of normobaric and hyperbaric oxygen for acute carbon monoxide intoxication. *Lancet* 1989;2:414-9.
215. Ducasse JL, Celsis P, Marc-Vergnes JP. Non-comatose patients with acute carbon monoxide poisoning: hyperbaric or normobaric oxygenation? *Undersea Hyperb Med* 1995;22:9-15.
216. Schiltz KL. Failure to assess motivation, need to consider psychiatric variables, and absence of comprehensive examination: a skeptical review of neuropsychologic assessment in carbon monoxide research. *Undersea Hyperb Med* 2000;27:48-50.
217. Amitai Y, Zlotogorski Z, Golan-Katzav V, Wexler A, Gross D. Neuropsychological impairment from acute low-level exposure to carbon monoxide. *Arch Neurol* 1998;55:845-8.
218. Hampson NB, Mathieu D, Piantadosi CA, Thom SR, Weaver LK. Carbon monoxide poisoning: interpretation of randomized clinical trials and unresolved treatment issues. *Undersea Hyperb Med* 2001;28:157-64.
219. Weaver LK, Hopkins RO, Chan KJ, et al. Carbon Monoxide Research Group, LDS Hospital, Utah in reply to Scheinkestel et al. and Emerson: the role of hyperbaric oxygen in carbon monoxide poisoning. *Emerg Med Australas* 2004;16:394-9; discussion 481-2.
220. Weaver LK, Deru K, Churchill S, Russo AA. A randomized trial of one versus three hyperbaric oxygen sessions for acute carbon monoxide poisoning. *Undersea Hyperb Med* 2023;In press.
221. Jordan BD, Relkin NR, Ravdin LD, Jacobs AR, Bennett A, Gandy S. Apolipoprotein E epsilon4 associated with chronic traumatic brain injury in boxing. *JAMA* 1997;278:136-40.
222. Li L, Bao Y, He S, et al. The Association Between Apolipoprotein E and Functional Outcome After Traumatic Brain Injury: A Meta-Analysis. *Medicine (Baltimore)* 2015;94:e2028.
223. Hopkins RO, Weaver LK, Valentine KJ, Mower C, Churchill S, Carlquist J. Apolipoprotein E genotype and response of carbon monoxide poisoning to hyperbaric oxygen treatment. *Am J Respir Crit Care Med* 2007;176:1001-6.

224. Tsuang D, Kukull W, Sheppard L, et al. Impact of sample selection on APOE epsilon 4 allele frequency: a comparison of two Alzheimer's disease samples. *J Am Geriatr Soc* 1996;44:704-7.
225. Hampson NB, Dunn SL, Yip FY, Clower JH, Weaver LK. The UHMS/CDC carbon monoxide poisoning surveillance program: three-year data. *Undersea Hyperb Med* 2012;39:667-85.
226. Lee Y, Cha YS, Kim SH, Kim H. Effect of Hyperbaric Oxygen Therapy Initiation Time in Acute Carbon Monoxide Poisoning. *Crit Care Med* 2021;49:e910-e9.
227. Hampson NB, Little CE. Hyperbaric treatment of patients with carbon monoxide poisoning in the United States. *Undersea Hyperb Med* 2005;32:21-6.
228. Satran D, Henry CR, Adkinson C, Nicholson CI, Bracha Y, Henry TD. Cardiovascular manifestations of moderate to severe carbon monoxide poisoning. *J Am Coll Cardiol* 2005;45:1513-6.
229. De Reuck J, Decoo D, Lemahieu I, et al. A positron emission tomography study of patients with acute carbon monoxide poisoning treated by hyperbaric oxygen. *J Neurol* 1993;240:430-4.
230. Maeda Y, Kawasaki Y, Jibiki I, Yamaguchi N, Matsuda H, Hisada K. Effect of therapy with oxygen under high pressure on regional cerebral blood flow in the interval form of carbon monoxide poisoning: observation from subtraction of technetium-99m HMPAO SPECT brain imaging. *Eur Neurol* 1991;31:380-3.
231. Murata T, Koshino Y, Nishio M, et al. Serial proton magnetic resonance spectroscopy in a patient with acute carbon monoxide poisoning. *Biol Psychiatry* 1995;37:541-5.
232. Haberstock D, Hopkins RO, Weaver LK, Churchill S. Prospective longitudinal assessment of symptoms in acute carbon monoxide (CO) poisoning. *Undersea Hyperb Med* 1998;25:48.
233. Waisman D, Shupak A, Weisz G, Melamed Y. Hyperbaric oxygen therapy in the pediatric patient: the experience of the Israel Naval Medical Institute. *Pediatrics* 1998;102:E53.
234. Guven D, Sarici D. Clinical and Laboratory Characteristics Predicting the Severity of Carbon Monoxide Poisoning in Children: A Single-Center Retrospective Study. *Pediatr Emerg Care* 2023;39:207-15.
235. Kim JK, Coe CJ. Clinical study on carbon monoxide intoxication in children. *Yonsei Med J* 1987;28:266-73.
236. Klees M, Heremans M, Dougan S. Psychological sequelae to carbon monoxide intoxication in the child. *Sci Total Environ* 1985;44:165-76.
237. Cunningham SD, Weaver LK, Deru K, Jensen J, Petty L. Prospective neuropsychological assessment of children with carbon monoxide poisoning. *Undersea Hyperb Med* 2012;39:981-2.
238. Weaver LK, Cunningham SD, Farnsworth K, Layton B, Deru K, Petty L. Prospective vestibular outcomes of children with carbon monoxide poisoning. *Undersea Hyperb Med* 2012;39:982.
239. Koren G, Sharav T, Pastuszak A, et al. A multicenter, prospective study of fetal outcome following accidental carbon monoxide poisoning in pregnancy. *Reprod Toxicol* 1991;5:397-403.
240. Penney DG. Effects of carbon monoxide exposure on developing animals and humans. In: Penney DG, ed. Carbon monoxide. Boca Raton, FL: CRC Press, Inc.; 1996:109-44.
241. Norman CA, Halton DM. Is carbon monoxide a workplace teratogen? A review and evaluation of the literature. *Ann Occup Hyg* 1990;34:335-47.
242. Longo LD. The biological effects of carbon monoxide on the pregnant woman, fetus, and newborn infant. *Am J Obstet Gynecol* 1977;129:69-103.
243. Van Hoesen KB, Camporesi EM, Moon RE, Hage ML, Piantadosi CA. Should hyperbaric oxygen be used to treat the pregnant patient for acute carbon monoxide poisoning? A case report and literature review. *JAMA* 1989;261:1039-43.
244. Elkharrat D, Raphael JC, Korach JM, et al. Acute carbon monoxide intoxication and hyperbaric oxygen in pregnancy. *Intensive Care Med* 1991;17:289-92.
245. Arslan A. Hyperbaric oxygen therapy in carbon monoxide poisoning in pregnancy: Maternal and fetal outcome. *Am J Emerg Med* 2021;43:41-5.
246. Azarov I, Wang L, Rose JJ, et al. Five-coordinate H64Q neuroglobin as a ligand-trap antidote for carbon monoxide poisoning. *Sci Transl Med* 2016;8:368ra173.
247. Weaver LK. Engineered proteins: A carbon monoxide antidote. *Nature Biomedical Engineering* 2017;1:0030.
248. Smith JS, Brandon S. Morbidity from acute carbon monoxide poisoning at three-year follow-up. *Br Med J* 1973;1:318-21.
249. Bruno A, Wagner W, Orrison WW. Clinical outcome and brain MRI four years after carbon monoxide intoxication. *Acta Neurol Scand* 1993;87:205-9.
250. Weaver LK, Hopkins RO, Churchill S, Deru K. Neurological outcomes 6 years after acute carbon monoxide poisoning. *Undersea Hyperb Med* 2008;35:258-9.
251. Hopkins RO, Weaver LK. Cognitive outcomes 6 years after acute carbon monoxide poisoning. *Undersea Hyperb Med* 2008;35:258.



252. Lange JH, Condello III AV. Neurological impacts from carbon monoxide poisoning. *J Headache Pain Manag* 2016;1:1-3.
253. Kitamoto T, Tsuda M, Kato M, Saito F, Kamijo Y, Kinoshita T. Risk factors for the delayed onset of neuropsychologic sequelae following carbon monoxide poisoning. *Acute Med Surg* 2016;3:315-9.
254. Kuroda H, Fujihara K, Kushimoto S, Aoki M. Novel clinical grading of delayed neurologic sequelae after carbon monoxide poisoning and factors associated with outcome. *Neurotoxicology* 2015;48:35-43.
255. Lv Y, Zhang Y, Pan S. Brain stem and spinal cord demyelination due to acute carbon monoxide poisoning. *Undersea Hyperb Med* 2021;48:247-53.
256. Ruiz-Mambrilla M, Duenas-Ruiz A, Perez-Castrillon JL, Usategui-Martin I, Duenas-Laita A. Speech therapy and hyperbaric oxygen for aphasia after carbon monoxide intoxication. *Undersea Hyperb Med* 2023;50:3-7.
257. Pepe G, Castelli M, Nazerian P, et al. Delayed neuropsychological sequelae after carbon monoxide poisoning: predictive risk factors in the Emergency Department. A retrospective study. *Scand J Trauma Resusc Emerg Med* 2011;19:16.
258. Ruff RM, Iverson GL, Barth JT, et al. Recommendations for diagnosing a mild traumatic brain injury: a National Academy of Neuropsychology education paper. *Arch Clin Neuropsychol* 2009;24:3-10.
259. Alvarez VM, Parikh M, Weaver LK, Deru K. Cardiac MRI findings in patients with CO poisoning. *Undersea Hyperb Med* 2015;42:468-9.
260. Lai CY, Chou MC, Lin CL, Kao CH. Increased risk of Parkinson disease in patients with carbon monoxide intoxication: a population-based cohort study. *Medicine (Baltimore)* 2015;94:e869.
261. Huang CC, Ho CH, Chen YC, et al. Hyperbaric Oxygen Therapy Is Associated With Lower Short- and Long-Term Mortality in Patients With Carbon Monoxide Poisoning. *Chest* 2017;152:943-53.
262. Keim L, Koneru S, Ramos VFM, et al. Hyperbaric oxygen for late sequelae of carbon monoxide poisoning enhances neurological recovery: case report. *Undersea Hyperb Med* 2018;45:83-7.
263. Chang DC, Lee JT, Lo CP, et al. Hyperbaric oxygen ameliorates delayed neuropsychiatric syndrome of carbon monoxide poisoning. *Undersea Hyperb Med* 2010;37:23-33.
264. Coric V, Oren DA, Wolkenberg FA, Kravitz RE. Carbon monoxide poisoning and treatment with hyperbaric oxygen in the subacute phase. *J Neurol Neurosurg Psychiatry* 1998;65:245-7.
265. Myers RA, DeFazio A, Kelly MP. Chronic carbon monoxide exposure: a clinical syndrome detected by neuropsychological tests. *J Clin Psychol* 1998;54:555-67.
266. Spagnolo F, Costa M, Impellizzeri M, et al. Delayed hyperbaric oxygen treatment after acute carbon monoxide poisoning. *J Neurol* 2011;258:1553-4.
267. Vila JF, Meli FJ, Serqueira OE, Pisarello J, Lylyk P. Diffusion tensor magnetic resonance imaging: a promising technique to characterize and track delayed encephalopathy after acute carbon monoxide poisoning. *Undersea Hyperb Med* 2005;32:151-6.
268. Watanuki T, Matsubara T, Higuchi N, et al. [Clinical examination of 3 patients with delayed neuropsychiatric encephalopathy induced by carbon monoxide poisoning, who recovered from severe neurocognitive impairment by repetitive hyperbaric oxygen therapy]. *Seishin Shinkeigaku Zasshi* 2014;116:659-69.
269. Koita N, Mitsuhashi M, Maki T, et al. Two case reports : improvement of delayed leukoencephalopathy after carbon monoxide poisoning more than one month after onset with hyperbaric oxygen therapy. *J Neurol Sci* 2017;381:499.
270. Martani L, Giovanniello A, Bosco G, et al. Delayed Neurological Sequelae Successfully Treated with Adjuvant, Prolonged Hyperbaric Oxygen Therapy: Review and Case Report. *Int J Environ Res Public Health* 2022;19.
271. Choi S, Kim HH, Oh SB, Jung YS. Repetitive hyperbaric oxygen therapy for paroxysmal sympathetic hyperactivity after acute carbon monoxide poisoning. *Undersea Hyperb Med* 2021;48:431-41.
272. Weaver LK, Wilson SH, Lindblad AS, et al. Hyperbaric oxygen for post-concussive symptoms in United States military service members: a randomized clinical trial. *Undersea Hyperb Med* 2018;45:129-56.
273. Boussi-Gross R, Golan H, Fishlev G, et al. Hyperbaric oxygen therapy can improve post concussion syndrome years after mild traumatic brain injury - randomized prospective trial. *PLoS One* 2013;8:e79995.
274. Hampson NB, Weaver LK. Carbon monoxide poisoning: a new incidence for an old disease. *Undersea Hyperb Med* 2007;34:163-8.
275. Mathieu D, Nolf M, Durocher A, et al. Acute carbon monoxide poisoning. Risk of late sequelae and treatment by hyperbaric oxygen. *J Toxicol Clin Toxicol* 1985;23:315-24.
276. Norkool DM, Kirkpatrick JN. Treatment of acute carbon monoxide poisoning with hyperbaric oxygen: a review of 115 cases. *Ann Emerg Med* 1985;14:1168-71.
277. Huang ET, Hardy KR, Stubbs JM, Lowe RA, Thom SR. Ventriculo-peritoneal shunt performance under hyperbaric conditions. *Undersea Hyperb Med* 2000;27:191-4.

278. Scheinkestel CD, Bailey M, Myles PS, et al. Hyperbaric or normobaric oxygen for acute carbon monoxide poisoning: a randomised controlled clinical trial. *Med J Aust* 1999;170:203-10.
279. Annane D, Chadda K, Gajdos P, Jars-Guincestre MC, Chevret S, Raphael JC. Hyperbaric oxygen therapy for acute domestic carbon monoxide poisoning: two randomized controlled trials. *Intensive Care Med* 2011;37:486-92.
280. Brown SD, Piantadosi CA. Hyperbaric for carbon monoxide poisoning. *Lancet* 1989;2:1032-3.
281. Birmingham CM, Hoffman RS. Hyperbaric oxygen therapy for acute domestic carbon monoxide poisoning: two randomized controlled trials. *Intensive Care Med* 2011;37:1218; author reply 9.
282. Thom SR, Mendiguren I, Hardy K, et al. Inhibition of human neutrophil beta2-integrin-dependent adherence by hyperbaric O<sub>2</sub>. *Am J Physiol* 1997;272:C770-7.
283. Moher D, Schulz KF, Altman D, Group C. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomized trials. *JAMA* 2001;285:1987-91.
284. Moon RE. Hyperbaric oxygen treatment for decompression sickness. *Undersea Hyperb Med* 2014;41:151-7.
285. Moon RE. Hyperbaric treatment of air or gas embolism: current recommendations. *Undersea Hyperb Med* 2019;46:673-83.
286. Moon RE, Mitchell S. Hyperbaric treatment for decompression sickness: current recommendations. *Undersea Hyperb Med* 2019;46:685-93.
287. Halperin JL, Levine GN, Al-Khatib SM, et al. Further Evolution of the ACC/AHA Clinical Practice Guideline Recommendation Classification System: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2016;67:1572-4.
288. Lin CH, Su WH, Chen YC, et al. Treatment with normobaric or hyperbaric oxygen and its effect on neuropsychometric dysfunction after carbon monoxide poisoning: A systematic review and meta-analysis of randomized controlled trials. *Medicine (Baltimore)* 2018;97:e12456.
289. Jang DH, Piel S, Greenwood JC, Ehinger JK, Kilbaugh TJ. Emerging cellular-based therapies in carbon monoxide poisoning. *Am J Physiol Cell Physiol* 2021;321:C269-C75.
290. Honore PM, Djimafo P, Preseau T, et al. Hyperbaric Oxygenation Therapy Alone for Carbon Monoxide Poisoning: Time for Reinforcements? *Crit Care Med* 2022;50:e686-e7.
291. Mousavi SR, Mohammadpour AH, Moshiri M, Feizy J, Pourtaji A, Samadi S. A pilot study of neuroprotective effect of granulocyte colony-stimulating factor (G-CSF) in patients with carbon monoxide poisoning: a double-blind, randomized, placebo-controlled trial. *Naunyn Schmiedebergs Arch Pharmacol* 2023;396:1257-67.
292. Omi T. Cerebrospinal Fluid Biomarkers for Monitoring Delayed Neurologic Sequelae after Carbon Monoxide Poisoning. *Neurol India* 2022;70:1668-9.
293. Lee JS, Cha YS, Lim J. Association between number of hyperbaric oxygen therapy sessions and neurocognitive outcomes of acute carbon monoxide poisoning. *Front Med (Lausanne)* 2023;10:1127978.
294. Reisberg B, Ferris SH, de Leon MJ, Crook T. The Global Deterioration Scale for assessment of primary degenerative dementia. *Am J Psychiatry* 1982;139:1136-9.
295. Stoller KP. Hyperbaric oxygen and carbon monoxide poisoning: a critical review. *Neurol Res* 2007;29:146-55.
296. Anseeuw K, Delvau N, Burillo-Putze G, et al. Cyanide poisoning by fire smoke inhalation: a European expert consensus. *Eur J Emerg Med* 2013;20:2-9.
297. Norris JC, Moore SJ, Hume AS. Synergistic lethality induced by the combination of carbon monoxide and cyanide. *Toxicology* 1986;40:121-9.
298. Moore SJ, Ho IK, Hume AS. Severe hypoxia produced by concomitant intoxication with sublethal doses of carbon monoxide and cyanide. *Toxicol Appl Pharmacol* 1991;109:412-20.
299. Pitt BR, Radford EP, Gurtner GH, Traystman RJ. Interaction of carbon monoxide and cyanide on cerebral circulation and metabolism. *Arch Environ Health* 1979;34:345-9.
300. Baud FJ. Cyanide: critical issues in diagnosis and treatment. *Hum Exp Toxicol* 2007;26:191-201.
301. Lawson-Smith P, Jansen EC, Hyldegaard O. Cyanide intoxication as part of smoke inhalation--a review on diagnosis and treatment from the emergency perspective. *Scand J Trauma Resusc Emerg Med* 2011;19:14.
302. Beasley DM, Glass WI. Cyanide poisoning: pathophysiology and treatment recommendations. *Occup Med (Lond)* 1998;48:427-31.
303. Borron SW, Baud FJ. Antidotes for acute cyanide poisoning. *Curr Pharm Biotechnol* 2012;13:1940-8.
304. Toon MH, Maybauer MO, Greenwood JE, Maybauer DM, Fraser JF. Management of acute smoke inhalation injury. *Crit Care Resusc* 2010;12:53-61.
305. Reade MC, Davies SR, Morley PT, Dennett J, Jacobs IC, Australian Resuscitation C. Review article: management of cyanide poisoning. *Emerg Med Australas* 2012;24:225-38.
306. Thompson JP, Marrs TC. Hydroxocobalamin in cyanide poisoning. *Clin Toxicol (Phila)* 2012;50:875-85.
307. Desai SS, M. Cyanide poisoning. In: Basow DS, ed. UpToDate. Waltham, MA: UpToDate; 2013.

308. Lee J, Mukai D, Kreuter K, Mahon S, Tromberg B, Brenner M. Potential interference by hydroxocobalamin on cooximetry hemoglobin measurements during cyanide and smoke inhalation treatments. *Ann Emerg Med* 2007;49:802-5.
309. Pamidi PV, DeAbreu M, Kim D, Mansouri S. Hydroxocobalamin and cyanocobalamin interference on co-oximetry based hemoglobin measurements. *Clin Chim Acta* 2009;401:63-7.
310. Livshits Z, Lugassy DM, Shawn LK, Hoffman RS. Falsely low carboxyhemoglobin level after hydroxocobalamin therapy. *N Engl J Med* 2012;367:1270-1.
311. Trapp WG. Massive cyanide poisoning with recovery: a boxing-day story. *Can Med Assoc J* 1970;102:517.
312. Litovitz TL, Larkin RF, Myers RA. Cyanide poisoning treated with hyperbaric oxygen. *Am J Emerg Med* 1983;1:94-101.
313. Amizet L, Pruvot G, Remy S, Kfoury M. Occupational cyanide poisoning. *BMJ Case Rep* 2011;2011.
314. Borron SW, Baud FJ, Barriot P, Imbert M, Bismuth C. Prospective study of hydroxocobalamin for acute cyanide poisoning in smoke inhalation. *Ann Emerg Med* 2007;49:794-801, e1-2.
315. Pearce LL, Bominaar EL, Hill BC, Peterson J. Reversal of cyanide inhibition of cytochrome c oxidase by the auxiliary substrate nitric oxide: an endogenous antidote to cyanide poisoning? *J Biol Chem* 2003;278:52139-45.
316. Ivanov KP. The effect of elevated oxygen pressure on animals poisoned with potassium cyanide. *Farmakol Toksikol (in English translation)* 1959;22:476-9.
317. Skene WG, Norman JN, Smith G. Effect of hyperbaric oxygen in cyanide poisoning. In: Brown IW, Cox B, eds. Proceedings of the third international congress on hyperbaric medicine. Washington, DC: National Academy of Sciences - National Research Council; 1966:705-10.
318. Takano T, Miyazaki Y, Nashimoto I, Kobayashi K. Effect of hyperbaric oxygen on cyanide intoxication: in situ changes in intracellular oxidation reduction. *Undersea Biomed Res* 1980;7:191-7.
319. Way JL, End E, Sheehy MH, et al. Effect of oxygen on cyanide intoxication. IV. Hyperbaric oxygen. *Toxicol Appl Pharmacol* 1972;22:415-21.
320. Lawson-Smith P, Olsen NV, Hyldegaard O. Hyperbaric oxygen therapy or hydroxycobalamin attenuates surges in brain interstitial lactate and glucose; and hyperbaric oxygen improves respiratory status in cyanide-intoxicated rats. *Undersea Hyperb Med* 2011;38:223-37.
321. Houeto P, Borron SW, Sandouk P, Imbert M, Levillain P, Baud FJ. Pharmacokinetics of hydroxocobalamin in smoke inhalation victims. *J Toxicol Clin Toxicol* 1996;34:397-404.
322. Lawson-Smith P, Jansen EC, Hilsted L, Johnsen AH, Hyldegaard O. Effect of acute and delayed hyperbaric oxygen therapy on cyanide whole blood levels during acute cyanide intoxication. *Undersea Hyperb Med* 2011;38:17-26.
323. Lawson-Smith P, Jansen EC, Hilsted L, Hyldegaard O. Effect of hyperbaric oxygen therapy on whole blood cyanide concentrations in carbon monoxide intoxicated patients from fire accidents. *Scand J Trauma Resusc Emerg Med* 2010;18:32.
324. Mao Q, Zhao X, Kiriya A, et al. A synthetic porphyrin as an effective dual antidote against carbon monoxide and cyanide poisoning. *Proc Natl Acad Sci U S A* 2023;120:e2209924120.
325. Desola J. Hydroxycobalamin, hyperbaric oxygen and cyanide poisoning. *Undersea Hyperb Med* 2011;38:217-20.
326. Hanley ME, Murphy-Lavoie HM. Hyperbaric Evaluation and Treatment Of Cyanide Toxicity. StatPearls. Treasure Island (FL)2023.
327. Hart GB, O'Reilly RR, Broussard ND, Cave RH, Goodman DB, Yanda RL. Treatment of burns with hyperbaric oxygen. *Surg Gynecol Obstet* 1974;139:693-6.
328. Stewart RJ, Yamaguchi KT, Samadani S, et al. Effects of oxygen and pressure on extravascular lung water following smoke inhalation. *J Hyperb Med* 1988;3:173-8.
329. Ray CS, Green B, Cianci P. Hyperbaric oxygen therapy in burn patients with adult respiratory distress syndrome. *Undersea Biomed Res* 1989;16:81.
330. Thom SR, Mendiguren I, Fisher D. Smoke inhalation-induced alveolar lung injury is inhibited by hyperbaric oxygen. *Undersea Hyperb Med* 2001;28:175-9.
331. Weaver LK. Hyperbaric oxygen in the critically ill. *Crit Care Med* 2011;39:1784-91.

## References

1. Stevens, D.L., *The pathogenesis of clostridial myonecrosis*. Int J Med Microbiol, 2000. 290(4-5): p. 497-502.
2. Van Hulst, R.A. and D.J. Bakker, *Selected aerobic and anaerobic soft-tissue infections*, in *Hyperbaric medicine practice*, H.T. Whelan and E.P. Kindwall, Editors. 2017, Best Publishing Group: North Palm Beach, FL. p. 435-463.
3. Hart, G.B., R.C. Lamb, and M.B. Strauss, *Gas gangrene*. J Trauma, 1983. 23(11): p. 991-1000.
4. Lucey, B.P. and G.M. Hutchins, *William H. Welch, MD, and the discovery of Bacillus welchii*. Arch Pathol Lab Med, 2004. 128(10): p. 1193-5.
5. Weinstein, L. and M.A. Barza, *Gas gangrene*. N Engl J Med, 1973. 289(21): p. 1129-31.
6. Bakker, D.J., *Clostridial myonecrosis*, in *Hyperbaric surgery: perioperative care*, D.J. Bakker and F.S. Cramer, Editors. 2002, Best Publishing Co.: Flagstaff, AZ. p. 283-316.
7. Srivastava, I., et al., *Spontaneous C. septicum gas gangrene: A literature review*. Anaerobe, 2017. 48: p. 165-171.
8. Abella, B.S., et al., *Atraumatic Clostridial myonecrosis: case report and literature review*. J Emerg Med, 2003. 24(4): p. 401-5.
9. McLeod, J.W., *Variations in the periods of exposure of air and oxygen necessary to kill anaerobic bacteria*. Acta Pathol Microbiol Scand, 1930. 3: p. 255.
10. Heimbach, R.D., *Gas gangrene*, in *Hyperbaric medicine practice*, E.P. Kindwall, Editor. 1995, Best Publishing Company: Flagstaff, AZ. p. 373-394.
11. Kiu, R. and L.J. Hall, *An update on the human and animal enteric pathogen Clostridium perfringens*. Emerg Microbes Infect, 2018. 7(1): p. 141.
12. Navarro, M.A., B.A. McClane, and F.A. Uzal, *Mechanisms of Action and Cell Death Associated with Clostridium perfringens Toxins*. Toxins (Basel), 2018. 10(5).
13. Takehara, M., et al., *Clostridium perfringens alpha-Toxin Impairs Innate Immunity via Inhibition of Neutrophil Differentiation*. Sci Rep, 2016. 6: p. 28192.
14. Takagishi, T., et al., *Clostridium perfringens alpha-toxin impairs erythropoiesis by inhibition of erythroid differentiation*. Sci Rep, 2017. 7(1): p. 5217.
15. Stevens, D.L., et al., *Lethal effects and cardiovascular effects of purified alpha- and theta-toxins from Clostridium perfringens*. J Infect Dis, 1988. 157(2): p. 272-9.
16. Stevens, D.L., et al., *Evaluation of therapy with hyperbaric oxygen for experimental infection with Clostridium perfringens*. Clin Infect Dis, 1993. 17(2): p. 231-7.
17. Hitchcock, C.R., F.J. Demello, and J.J. Haglin, *Gangrene infection: new approaches to an old disease*. Surg Clin North Am, 1975. 55(6): p. 1403-10.
18. Titball, R.W., C.E. Naylor, and A.K. Basak, *The Clostridium perfringens alpha-toxin*. Anaerobe, 1999. 5(2): p. 51-64.
19. Sison-Martinez, J., S. Hendriksen, and J.S. Cooper, *Hyperbaric Treatment Of Clostridial Myositis And Myonecrosis*, in *StatPearls*. 2022: Treasure Island (FL).
20. Altmeier, W.A. and W.D. Fullen, *Prevention and treatment of gas gangrene*. JAMA, 1971. 217(6): p. 806-13.
21. Van Unnik, A.J.M., *Inhibition of Toxin Production in Clostridium Perfringens in Vitro by Hyperbaric Oxygen*. Antonie Van Leeuwenhoek, 1965. 31: p. 181-6.
22. Kaye, D., *Effect of hyperbaric oxygen on Clostridia in vitro and in vivo*. Proc Soc Exp Biol Med, 1967. 124(2): p. 360-6.
23. Hill, G.B. and S. Osterhout, *Experimental effects of hyperbaric oxygen on selected clostridial species. II. In-vitro studies in mice*. J Infect Dis, 1972. 125(1): p. 26-35.
24. Muhvich, K.H., L.H. Anderson, and W.J. Mehm, *Evaluation of antimicrobials combined with hyperbaric oxygen in a mouse model of clostridial myonecrosis*. J Trauma, 1994. 36(1): p. 7-10.
25. Kivisaari, J. and J. Niinikoski, *Use of silastic tube and capillary sampling technic in the measurement of tissue PO<sub>2</sub> and PCO<sub>2</sub>*. Am J Surg, 1973. 125(5): p. 623-7.
26. Schoemaker, G., *Oxygen tension measurements under hyperbaric conditions*, in *Clinical application of hyperbaric oxygen*, I. Boerema, W.H. Brummelkamp, and N.G. Meijne, Editors. 1964, Elsevier: Amsterdam, The Netherlands. p. 330-335.
27. Sheffield, P.J., *Tissue oxygen measurements*, in *Problem wounds: the role of oxygen*, J.C. Davis and T.K. Hunt, Editors. 1988, Elsevier: New York, NY. p. 17-51.
28. Maclennan, J.D., *The histotoxic clostridial infections of man*. Bacteriol Rev, 1962. 26(2 Pt 1-2): p. 177-276.
29. Nora, P.F., et al., *Brain as target organ in Clostridium perfringens exotoxin toxicity*. Arch Surg, 1966. 92(2): p. 243-6.
30. De Wolde, S.D., et al., *The Effects of Hyperbaric Oxygenation on Oxidative Stress, Inflammation and Angiogenesis*. Biomolecules, 2021. 11(8).

31. Memar, M.Y., et al., *Hyperbaric oxygen therapy: Antimicrobial mechanisms and clinical application for infections*. Biomed Pharmacother, 2019. 109: p. 440-447.
32. Hirn, M., *Hyperbaric oxygen in the treatment of gas gangrene and perineal necrotizing fasciitis. A clinical and experimental study*. Eur J Surg Suppl, 1993(570): p. 1-36.
33. Demello, F.J., J.J. Haglin, and C.R. Hitchcock, *Comparative study of experimental Clostridium perfringens infection in dogs treated with antibiotics, surgery, and hyperbaric oxygen*. Surgery, 1973. 73(6): p. 936-41.
34. Kelley, H.G., Jr. and W.G. Pace, 3rd, *Treatment of Anaerobic Infections in Mice with Hyperpressure Oxygen*. Surg Forum, 1963. 14: p. 46-7.
35. Schott, H., [*Gas gangrene (principles of treatment, results)*]. Hefte Unfallheilkd, 1979. 138: p. 179-86.
36. Nier, H. and K. Kremer, [*Gas gangrene--still a diagnostic and therapeutic problem*]. Zentralbl Chir, 1984. 109(6): p. 402-17.
37. Pailler, J.L., [*Gas gangrene - still a diagnostic and therapeutic problem*]. Acta Chir Belg, 1986. 86(2): p. 63-71.
38. Erttmann, M. and D. Havemann, [*Treatment of gas gangrene. Results of a retro- and prospective analysis of a traumatologic patient sample over 20 years*]. Unfallchirurg, 1992. 95(10): p. 471-6.
39. Brummelkamp, W.H., *Considerations on Hyperbaric Oxygen Therapy at Three Atmospheres Absolute for Clostridial Infections Type Welchii*. Ann N Y Acad Sci, 1965. 117: p. 688-99.
40. Brummelkamp, W.H., I. Boerema, and L. Hoogendyk, *Treatment of clostridial infections with hyperbaric oxygen drenching. A report on 26 cases*. Lancet, 1963. 1(7275): p. 235-8.
41. Bakker, D.J., *The use of hyperbaric oxygen in the treatment of certain infectious diseases, especially gas gangrene and acute dermal gangrene*. 1984, Wageningen, The Netherlands: Drukkerij Veenman B.V.
42. Holland, J.A., et al., *Experimental and clinical experience with hyperbaric oxygen in the treatment of clostridial myonecrosis*. Surgery, 1975. 77(1): p. 75-85.
43. Marroni, A., P. Longobardi, and R. Cali-Corleo, *Cost-effectiveness evaluation of HBO therapy*, in *Handbook on hyperbaric medicine*, D. Mathieu, Editor. 2006, Springer: Dordrecht, The Netherlands. p. 674-677.
44. Li, Y., Z. Ma, and Y. Cao, [*Effect of localized hyperbaric oxygen on gas gangrene*]. Modern Diagnostics and Treatment, 2001. 12(4): p. 229-230.
45. Yang, Z., et al., *Interventions for treating gas gangrene*. Cochrane Database Syst Rev, 2015. 2015(12): p. CD010577.
46. Kindwall, E.P., *Hyperbaric oxygen therapy committee report. UMS report number 5-23-77*. 1977. p. 4.
47. Peirce, E.C., *Gas gangrene: a critique of therapy*. Surg Rounds, 1984. 7: p. 17-25.
48. Tibbles, P.M. and J.S. Edelsberg, *Hyperbaric-oxygen therapy*. N Engl J Med, 1996. 334(25): p. 1642-8.
49. Mitton, C. and D. Hailey, *Health technology assessment and policy decisions on hyperbaric oxygen treatment*. Int J Technol Assess Health Care, 1999. 15(4): p. 661-70.
50. Mathieu, D., A. Marroni, and J. Kot, *Tenth European Consensus Conference on Hyperbaric Medicine: recommendations for accepted and non-accepted clinical indications and practice of hyperbaric oxygen treatment*. Diving Hyperb Med, 2017. 47(1): p. 24-32.

## References

1. Francis A, Baynosa RC. Hyperbaric Oxygen Therapy for the Compromised Graft or Flap. *Adv Wound Care (New Rochelle)*. 2017 Jan 1;6(1):23-32.
2. Francis A, Baynosa RC. Ischaemia-reperfusion injury and hyperbaric oxygen pathways: a review of cellular mechanisms. *Diving Hyperb Med*. 2017 Jun;47(2):110-117.
3. Kivisaari J, Niinikoski J. Effects of hyperbaric oxygen and prolonged hypoxia on the healing of open wounds. *Acta Chir Scand*. 1975;141:14-19.
4. Shulman AG, Krohn HL. Influence of hyperbaric oxygen and multiple skin allografts on the healing of skin wounds. *Surgery*. 1967;62:1051-1058.
5. Erdmann D, Roth AC, Hussmann J, et al. Skin allograft rejection and hyperbaric oxygen treatment in immunohistocompatible mice. *Undersea Hyperbaric Med*. 1995;22: 395-399.
6. Erdmann D, Roth AC, Hussman J, et al. Hyperbaric oxygen and cyclosporine as a combined treatment regimen to prevent skin allograft rejection in immunohistocompatible mice. *Ann Plast Surg*. 1996;36:304-308.
7. Renner G, McClane SD, Early E, et al. Enhancement of auricular composite graft survival with hyperbaric oxygen therapy. *Arch Facial Plast Surg*. 2002;4:102-104.
8. Rubin JS, Marzella L, Myers RA, et al. Effects of hyperbaric oxygen on the take of composite skin grafts in rabbit ears. *J Hyperbaric Med*. 1988;3:79-88.
9. Zhang F, Cheng C, Gerlach T, et al. Effect of hyperbaric oxygen on survival of the composite ear graft in rats. *Ann Plast Surg*. 1998;41:530-534.
10. Li EN, Menon NG, Rodriguez ED, et al. The effect of hyperbaric oxygen therapy on composite graft survival. *Ann Plast Surg*. 2004; 53:141-145.
11. Fodor L, Ramon Y, Meilik B, et al. Effect of hyperbaric oxygen on survival of composite grafts in rats. *Scand J Plast Reconstr Surg Hand Surg*. 2006;40:257-260.
12. Kernahan KA, Zingg W, Kay CW. The effect of hyperbaric oxygen on the survival of experimental skin flaps. *Plast Reconstr Surg*. 1965;36:19-25.
13. McFarlane RM, DeYoung G, Henry RA. Prevention of necrosis in experimental pedicle flaps with hyperbaric oxygen. *Surg Forum*. 1965;6:481-482.
14. Wald HI, Georgiade NG, Angelillo J, et al. Effect of intensive hyperbaric oxygen therapy on the survival of experimental skin flaps in rats. *Surg Forum*. 1968;19:497-499.
15. Niinikoski J. Viability of ischemic skin in hyperbaric oxygen. *Acta Chir Scand*. 1970: 136: 567-568.
16. Gruber RP, Heitkamp DH, Lawrence JB. Skin permeability to oxygen and hyperbaric oxygen. *Arch Surg*. 1970;101:69-70.
17. Pellitteri PK, Kennedy TL, Youn BA. The influence of intensive hyperbaric oxygen therapy on skin flap survival in a swine model. *Arch Otolaryngol Head Neck Surg*. 1992;118:1050-1054.
18. Arturson GG, Khanna NN. The effects of hyperbaric oxygen, dimethyl sulfoxide and complamin on survival of experimental skin flaps. *Scand J Plast Reconstr Surg*. 1970;4:8-10.
19. Esclamado RM, Larrabee WF Jr, Zel GE. Efficacy of steroids and hyperbaric oxygen on survival of dorsal skin flaps in rats. *Otolaryngol Head Neck Surg*. 1990;102:41-44.
20. Stewart RJ, Moore T, Bennett B, et al. Effect of free-radical scavengers and hyperbaric oxygen on random-pattern skin flaps. *Arch Surg*. 1994;129:982-987.
21. Da Rocha FP, Fagundes DJ, Rivoire HC, et al. Immunohistochemical expression of apoptosis and VEGF expression on random skin flaps in rats treated with hyperbaric oxygen and N-acetylcysteine. *Undersea Hyperbaric Med*. 2011;38:167-174.
22. Da Rocha FP, Fagundes DJ, Pires JA, et al. Effects of hyperbaric oxygen and N-acetylcysteine in survival of random pattern skin flaps in rats. *Indian J Plast Surg*. 2012;45:453-458.
23. Greenwood TW, Gilchrist AG. The effect of HBO on wound healing following ionizing radiation. In: Trapp WC, et al., Eds. *Proceedings of the fifth international congress on hyperbaric medicine, Vol I*. Barnaby, Canada: Simon Fraser University. 1973;253-263.
24. Nemiroff PM, Merwin GE, Brant T, et al. HBO and irradiation on experimental skin flaps in rats. *Surg Forum*. 1984;35:549-550.
25. Nemiroff PM, Merwin GE, Brant, et al. Effects of hyperbaric oxygen and irradiation on experimental flaps in rats. *Otolaryngol Head Neck Surg*. 1985;93: 485-491.
26. Zhang T, Gong W, Li Z, et al. Efficacy of hyperbaric oxygen on survival of random pattern skin flap in diabetic rats. *Undersea Hyperbaric Med*. 2007;335-339.

27. Selcuk CT, Kuvat SV, Bozkurt M, et al. The effect of hyperbaric oxygen therapy on the survival of random pattern skin flaps in nicotine-treated rats. *J Plast Reconstr Aesthet Surg.* 2012;65:489-493.
28. Demirtas A, Azbo I, Bulut M, et al. Effect of hyperbaric oxygen therapy on healing in an experimental model of degloving injury in tails of nicotine-treated rats. *J Hand Surg Eur Vol.* Epub ahead of print. 2012 Dec 7.
29. Nemiroff PM, Lungu AL. The influence of hyperbaric oxygen and irradiation on vascularity in skin flaps: a controlled study. *Surg Forum.* 1987;38:565-567.
30. Manson PN, Im MJ, Myers RA, et al. Improved capillaries by hyperbaric oxygen in skin flaps. *Surg Forum.* 1980;31:564-566.
31. Hartwig J, Kohnlein HE. The influence of hyperbaric oxygen therapy and Dextran 40 on wound healing. *Eur Surg Res.* 5(Suppl). 1973:109.
32. Meltzer T, Myers B. The effect of hyperbaric oxygen on the bursting strength and rate of vascularization of skin wounds in rats. *Am Surg.* 1986;52: 659-662.
33. Marx RE and Ames JR. The use of hyperbaric oxygen therapy in bony reconstruction of the irradiated and tissue deficient patient. *J Oral Maxillofac Surg.* 1982;40: 412-420.
34. Champion WM, McSherry CK, Goulian D. Effect of hyperbaric oxygen on survival of pedicled skin flaps. *J Surg Res.* 1967;7:583-586.
35. McFarlane RM, Wermuth RE. The use of hyperbaric oxygen to prevent necrosis in experimental pedicle flaps and composite skin grafts. *Plast Reconstr Surg.* 1966;37:422-430.
36. Jurell G, Kaijser L. The influence of varying pressure and duration of treatment with hyperbaric oxygen on the survival of skin flaps: an experimental study. *Scand J Plast Reconstr Surg.* 1973;7:25-28.
37. Tan CM, Im MJ, Myers RA, et al. Effect of hyperbaric oxygen and hyperbaric air on survival of island skin flaps. *Plast Reconstr Surg.* 1974;73:27-30.
38. Ramon Y, Abramovich A, Shupak A, et al. Effect of hyperbaric oxygen on a rat transverse rectus abdominis myocutaneous flap model. *Plast Reconstr Surg.* 1998;102:416-422.
39. Prada FS, Arrunategui G, Alves MC, et al. Effect of allopurinol, superoxide-dismutase, and hyperbaric oxygen on flap survival. *Microsurg.* 2002;22:352-360.
40. Nemiroff PM. Synergistic effects of pentoxifylline and hyperbaric oxygen on skin flaps. *Arch Otolaryngol Head Neck Surg.* 1988;114:977-981.
41. Collins TM, Caimi R, Lynch PR, et al. The effects of nicotinamide and hyperbaric oxygen on skin flap survival. *Scand J Plast Reconstr Surg Hand Surg.* 1991;25:5-7.
42. Lozano DD, Stephenson LL, Zamboni WA. Effect of hyperbaric oxygen and medicinal leeching on survival of axial skin flaps subjected to total venous occlusion. *Plast Reconstr Surg.* 1999;104:1029-1032.
43. Yucel A, Bayramicli. Effects of hyperbaric oxygen treatment and heparin on the survival of unipedicled venous flaps: and experimental study in rats. *Ann Plast Surg.* 2000;295-303.
44. Ulkur E, Yuksel F, Acikel C, et al. Effect of hyperbaric oxygen on pedicle flaps with compromised circulation. *Microsurg.* 2002;22;: 16-20.
45. Zamboni WA, Roth AC, Russell RC, et al. The effect of acute hyperbaric oxygen therapy on axial pattern skin flap survival when administered during and after total ischemia. *J Reconstr Microsurg.* 1989;5:343-347.
46. Zamboni WA, Roth AC, Russell RC, et al. The effect of hyperbaric oxygen on reperfusion of ischemic axial skin flaps: a laser Doppler analysis. *Ann Plast Surg.* 1992;28:339-341.
47. Kaelin CM, Im MJ, Myers RA, et al. The effects of hyperbaric oxygen on free flaps in rats. *Arch Surg.* 1990;125:607-609.
48. Zamboni WA, Roth AC, Russell RC, et al. Morphological analysis of the microcirculation during reperfusion of ischemic skeletal muscle and the effect of hyperbaric oxygen. *Plast Reconstr Surg.* 91. 1993;1110-1123.
49. Jones SR, Carpin KM, Woodward SM, et al. Hyperbaric oxygen inhibits ischemia-reperfusion-induced CD18 neutrophil polarization by a nitric oxide mechanism. *Plast Reconstr Surg.* 2010;126:403-411.
50. Baynosa RC, Naig AL, Murphy PS, et al. The effect of hyperbaric oxygen on nitric oxide synthase activity and expression in ischemia-reperfusion injury. *J Surg Res.* Epub ahead of print. 2013 Feb 1.
51. Francis A, Kleban SR, Stephenson LL, et al. Hyperbaric Oxygen Inhibits Reperfusion-Induced Neutrophil Polarization and Adhesion Via Plasmin-Mediated VEGF Release. *Plast Reconstr Surg Glob Open.* 2017 Sep 25;5(9):e1497.
52. Hong JP, Kwon H, Chung YK, et al. The effect of hyperbaric oxygen on ischemia-reperfusion injury: an experimental study in a rat musculocutaneous flap. *Ann Plast Surg.* 2003;51:478-487.
53. Tomur A, Etlík O, Gundogan NU. Hyperbaric oxygenation and antioxidant vitamin combination reduces ischemia-reperfusion injury in a rat epigastric island skin-flap model. *J Basic Clin Physiol Pharmacol.* 2005;16: 275-285.

54. Stevens DM, Weiss DD, Koller WA, et al. Survival of normothermic microvascular flaps after prolonged secondary ischemia: Effects of hyperbaric oxygen. *Otolaryngol Head Neck Surg.* 115: 360-364, 1996.
55. Wong HP, Zamboni WA, Stephenson LL. Effect of hyperbaric oxygen on skeletal muscle necrosis following primary and secondary ischemia in a rat model. *Surg Forum.* 1996;47:705-707.
56. Gampper TJ, Zhang F, Mofakhami NF, et al. Beneficial effect of hyperbaric oxygen on island flaps subjected to secondary venous ischemia. *Microsurg.* 2002;22:49-52.
57. Perrins DJD. Hyperbaric oxygenation of skin flaps. *Br J Plast Surg.* 1966;19:110-112.
58. Perrins DJD, Cantab MB. Influence of hyperbaric oxygen on the survival of split skin grafts. *Lancet.* 1967;1: 868- 871.
59. Roje Z, Roje Z, Eterovic D et al. Influence of adjuvant hyperbaric oxygen therapy on short-term complications during surgical reconstruction of upper and lower extremity war injuries: retrospective cohort study. *Croat Med J.* 2008;49:224-232.
60. Gonnering RS, Kindwall EP, Goldmann RW. Adjunct hyperbaric oxygen therapy in periorbital reconstruction. *Arch Ophthalmol.* 1986;104: 439-443.
61. Bowersox JC, Strauss MB, Hart GB. Clinical experience with hyperbaric oxygen therapy in salvage of ischemic skin flaps and grafts. *J Hyperbaric Med.* 1986; 141-149.
62. Friedman HI, Stonerock C, Brill A. Composite earlobe grafts to reconstruct the lateral nasal ala and sill. *Ann Plast Surg.* 2003;3:275-281.
63. Qing Y, Cen Y, Chen J, Ke S. Reconstruction of a large through-and-through defect of the nasal tip using a modified auricular composite graft. *J Craniofac Surg.* 2015;26:382-383.
64. Saber AA, Yahya KZ, Rao A, et al. A new approach in the management of chronic nonhealing leg ulcers. *J Invest Surg.* 2005;18: 321-323.
65. Assaad NN, Chong R, Tat LT, et al. Adjuvant hyperbaric oxygen therapy to support limbal conjunctival graft in the management of recurrent pterygium. *Cornea.* 2011;30:7-10.
66. Ueda M, Kaneda T, Takahashi H, et al. Hyperbaric oxygen therapy of ischemic skin flaps: clinical and experimental study. *Proceedings of 9th International Symposium on Underwater Hyperbaric Physiology.* Undersea & Hyperbaric Medical Society. 1987;823.
67. Mathieu D, Neviere R, Pellerin P, et al. Pedicle musculocutaneous flap transplantation: Prediction of final outcome by transcutaneous oxygen measurements in hyperbaric oxygen. *Plast Reconstr Surg.* 1993;91: 329-334.
68. Waterhouse MA, Zamboni WA, Brown RE, et al. The use of HBO in compromised free tissue transfer and replantation, a clinical review. *Undersea Hyperbaric Med.* 1993; 20(Suppl):64.
69. Larson JV, Steensma EA, Flikkema RM, Norman EM. The application of hyperbaric oxygen therapy in the management of compromised flaps. *Undersea Hyperb Med.* 2013;40:499-504.
70. Skeik N, Porten BR, Isaacson E, et al. Hyperbaric oxygen treatment outcome for different indications from a single center. *Ann Vasc Surg* 2015; 29:206-214.
71. Nichter LS, Morwood DT, Williams GS, et al. Expanding the limits of composite grafting: a case report of successful nose replantation assisted by hyperbaric oxygen therapy. *Plast Reconstr Surg.* 1991;87: 337-340.
72. Rapley JH, Lawrence WT, Witt PD. Composite grafting and hyperbaric oxygen therapy in pediatric nasal tip reconstruction after avulsive dog-bite injury. *Ann Plast Surg.* 2001;46: 434-438.
73. Cantarella G, Mazzola RF and Pagani D. The fate of an amputated nose after replantation. *Am J Otolaryngol.* 2005;26: 344-347.
74. Pou JD, Graham HD. Pediatric Nasal Tip Amputation Successfully Treated with Nonmicrovascular Replantation and Hyperbaric Oxygen Therapy. *Ochsner J.* 2017 Summer;17(2):204-207.
75. McCrary BF. Hyperbaric oxygen treatment for a failing facial flap. *Postgrad Med J.* 2007;83: e1-e3.
76. Khandelwal S, Wall J, Kaide C, et al. Case report: successful use of hyperbaric oxygen therapy for a complete scalp degloving injury. *Undersea Hyperbaric Med.* 2008;35: 441-445.
77. Mermans JF, Tuinder S, von Meyenfeldt ME, et al. Hyperbaric oxygen treatment for skin flap necrosis after a mastectomy: a case study. *Undersea Hyperbaric Med.* 2012;39:719-723.
78. Fredman R, Wise I, Friedman T, Heller L, Kami T. Skin-sparing mastectomy flap ischemia salvage using urgent hyperbaric chamber oxygen therapy: a case report. *Undersea Hyperb Med* 2014;41:145-147.
79. Copeland-Halperin LR, Bruce SR, Mesbahi AN. Hyperbaric oxygen following bilateral skin-sparing mastectomies: a case report. *Plast Reconstr Surg Glob Open.* 2016;4:e680.
80. Zhou YY, Liu W, Yang YJ, Lu GD. Use of hyperbaric oxygen on flaps and grafts in China: analysis of studies in the past 20 years. *Undersea Hyperb Med.* 2014;41:209-216.
81. Baynosa RC and Zamboni WA. Compromised grafts and flaps. In: TS Neuman & SR Thom, Eds. *Physiology and Medicine of Hyperbaric Oxygen Therapy.* Philadelphia, PA: Saunders/Elsevier. 2008; 373-395.



82. Friedman HI, Fitzmaurice M, Lefaivre JF, et al. An evidence-based appraisal of the use of hyperbaric oxygen on flaps and grafts. *Plast Reconstr Surg*. 2006;117 (Suppl):175S-190S.
83. Nemiroff PM, Rybak LP. Applications of hyperbaric oxygen for the otolaryngologist-head and neck surgeon. *Am J Otolaryngol*. 1988;9:52-57.
84. Reinisch JF. Pathophysiology of skin flap circulation: The delay phenomenon. *Plast Reconstr Surg*. 1974;54:585-598.
85. Reinisch JF. The role of arteriovenous anastomosis in skin flaps. In: Grabb WC, Myers MBG, Eds. *Skin Flaps*. Boston, MA: Little Brown & Co. 1975;81-92.
86. Weber R, Silver A, Williams SJ, et al. Random flap survival with hyperbaric oxygen: daily versus twice-daily treatments. *Undersea Hyperb Med*. 2018 Mar-Apr;45(2):157-164.
87. Park SK, Schank KJ, Engwall-Gill A, Clarkson JHW. Superior gluteal artery perforator flap salvaged via hyperbaric oxygen therapy. *BMJ Case Rep*. 2022 Mar 29;15(3):e248411.
88. Xu F, Zhang R, Zhang Q, Xu Z, Li D, Li Y. Hyperbaric Oxygen Therapy: An Effective and Noninvasive Therapy for Complications of Ear Reconstruction. *J Craniofac Surg*. 2019 Jun;30(4):e382-e385.
89. Neheman A, Rappaport YH, Verhovsky G, Bush N, Snodgrass W, Lang E, Zisman A, Efrati S. Hyperbaric oxygen therapy for pediatric “hypospadias cripple”-evaluating the advantages regarding graft take. *J Pediatr Urol*. 2020 Apr;16(2):163.e1-163.e7.
90. Camison L, Naran S, Lee WW, Grunwaldt LJ, Davit AJ, Goldstein JA, O’Toole KS, Losee JE, Adetayo OA. Hyperbaric Oxygen Therapy for Large Composite Grafts: An Alternative in Pediatric Facial Reconstruction. *J Plast Reconstr Aesthet Surg*. 2020 Dec;73(12):2178-2184.
91. Camargo CP, Pfann RZ, Kubrusly MS, Silva MFR, Guimarães ET, Leite MS, Saldiva PHN, Gemperli R. Study of the Effect of Hyperbaric Oxygen Therapy on the Viability of Dorsal Cutaneous Flaps in Tobacco-Exposed Rats. *Aesthetic Plast Surg*. 2020 Jun;44(3):979-985.
92. Kara S, İnci E, Gözen ED, Gülgün KC, Yener HM. Results of hyperbaric oxygen treatment in an at-risk nasal flap following trauma. *Diving Hyperb Med*. 2021 Jun 30;51(2):207-209.

## Selected References with Comments

1. Gustilo RB, Mendoza RM, Williams DN, Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma*. 1984;24(8):742-6.  
**Comment:** The “classic” reference for grading open fractures and their predicated outcomes. It was a follow-up amplification of the authors’ 1979 paper.
2. Strauss MB, Camporesci EM, Bosco G, Wilson K. Roles of oxygen and its hyperbaric oxygen mechanisms. in *Hyperbaric Medicine Practice*, 5th ed., (IN PRESS) 2023 , Ed. H Whelan & E Kindwall, Best Publishing Company, North Palm Beach, FL.  
**Comment:** A very comprehensive description of the roles of oxygen in healing and the mechanisms of hyperbaric oxygen from physics, physiology and biochemistry perspectives.
3. Strauss MB, Wilson K. The role of hyperbaric oxygen in traumatic ischemias. *Hyperbaric Medicine Practice*, 5th ed., (IN PRESS) 2023 , Ed. H Whelan & E Kindwall, Best Publishing Company, North Palm Beach FL.  
**Comment:** A more detailed and referenced—68 in total—of the traumatic ischemias with specifics about establishing the stage of the skeletal muscle-compartment syndrome.
4. Johnson LC. Kinetics of osteoarthritis, *Laboratory Investigation*, 1959;8:1223-41  
**Comment:** An old and obscure publication by an extraordinary bone pathologist. The paper mentions the high metabolic demands of the osteoclast, provides the science why stress fractures occur, and offers an explanation for the role hyperbaric oxygen has for the osteoclastic
5. Bird AD, Telfer AB. Effect of hyperbaric oxygen on limb circulation. *Lancet*.1965;1(7831)355-6.  
**Comment:** A “classic” reference confirming the hyperoxygenation effect of hyperbaric oxygen while showing that even with vasoconstriction from the hyperoxia, the net effect is increased oxygen tensions in tissues.
6. Cianci P, Sato RM, Faulkner J. Adjunctive Hyperbaric Oxygen Therapy in the Treatment of Thermal Burns. *Hyperbaric Medicine Practice*, 4th ed., 2017, ED. H Whelan & E Kindwall, Best Publishing Company, North Palm Beach, Fl, CHAP-31, pp 791-818 .  
**Comment:** A very comprehensive review of the hyperbaric oxygen burn literature with selective case presentations to attest to its benefits. The chapter is well annotated with 124 references.
7. Hart GB, O’Reilly RR, Broussard, et al. Treatment of burns with hyperbaric oxygen. *Surgery, Gynecology & Obstetrics*. 1974;139:693-6.  
**Comment:** Another “classic” paper in the hyperbaric literature and one of the first randomized trials to appear in the hyperbaric literature
8. Bouachour G, Cronier P, Gouello JP, et al. Hyperbaric oxygen therapy in the management of crush injuries; a randomized double-blinded placebo-controlled clinical trial. *Journa of Trauma*, 1996;41:333-9. Treatment of burns with hyperbaric oxygen. *Surgery, Gynecology & Obstetrics*. 1974;139:693-6.  
**Comment:** The first of two randomized control trials confirming the benefits of hyperbaric oxygen in the management of severe open fractures.
9. Millar IL, Folke GL, Karl-Ake J., et al. Hyperbaric oxygen for lower limb trauma (HOLLT): an international multi-centre randomized clinical trial. *Diving and Hyperbaric Medicine*, 2022;52(3):164-74  
**Comment:** The second of the two randomized control trials confirming the benefits of hyperbaric oxygen in the management of severe open fractures.
10. Strauss MB, Hart GB. Hyperbaric oxygen and the skeletal muscle-compartment syndrome, *Contemporary Orthopaedics*,1989; 18:167-74  
**Comment:** A prospective report that showed that no patient with a skeletal muscle-compartment syndrome in the lag phase while undergoing hyperbaric oxygen treatments progressed to the point of requiring a fasciotomy.

11. Platki C, Peters P, Almeling M, et al. Complications and side effect of hyperbaric oxygen therapy. *Aviation Space and Environmental Medicine*, 2000;71:119-124.  
**Comment:** A large series of experiences from Germany with findings in line with other reports including one oxygen seizure in every 2000-to-3000 hyperbaric oxygen treatments.
12. Schemitsch, EH, M Bhandari, MD McKee, et al., Orthopaedic surgeons: artists or scientists?, *J Bone Joint Surg*, 2009; 91:1264-73  
**Comment:** Although double-blinded randomized controlled trials and their associated meta analyses are the “gold standard” for evidence reviews, only a small percentage of orthopaedic surgery decisions are made using such information.

### Additional Citations on Traumatic Ischemias

(Included from the 15<sup>th</sup> Edition *Hyperbaric Medicine Practice*)

1. Kindwall EE. *Hyperbaric Oxygen Therapy Committee Report*. 1977, Best Publishing Company, Flagstaff AS.
2. Davis JC, Hunt TK. *Hyperbaric Oxygen Therapy* Undersea Medical Society; 1977.
3. Strauss M. Diabetic foot and leg wounds: principles, management and prevention. *Primary Care Reports*. 2001;7(22):187-197.
4. Christensen O. Mediation of cell volume regulation by Ca<sup>2+</sup> influx through stretch-activated channels. *Nature*. Nov 5-11 1987;330(6143):66-8. doi:10.1038/330066a0
5. Malinoski DJ, Slater MS, Mullins RJ. Crush injury and rhabdomyolysis. *Crit Care Clin*. Jan 2004;20(1):171-92. doi:10.1016/s0749-0704(03)00091-5
6. Guyton AC, Hall JE. *Textbook of Medical Physiology*. 10th ed. 2000.
7. Peirce E. Pathophysiology, apparatus, and methods, including the special techniques of hypothermia and hyperbaric oxygen. *Extracorporeal Circulation for Open-Heart Surgery*. 1969:84-88.
8. Strauss M. Role of hyperbaric oxygen therapy in acute ischemias and crush injuries—an orthopedic perspective. *HBO Rev* 2: 87–106. Shupak A, Gozal D, Ariel A et al.(1987) Hyperbaric oxygenation in acute peripheral posttraumatic ischemia. *J Hyperbar Med*. 1981;2:7-14.
9. Strauss MB, Hart GB. Crush injury and the role of hyperbaric oxygen. *Advanced Emergency Nursing Journal*. 1984;6(1):9-24.
10. McCord JM, Roy RS, Schaffer SW. Free radicals and myocardial ischemia. *Advances in myocardiology*. Springer; 1985:183-189.
11. Vedder NB, Fouty BW, Winn RK, Harlan JM, Rice CL. Role of neutrophils in generalized reperfusion injury associated with resuscitation from shock. *Surgery*. Sep 1989;106(3):509-16.
12. Thom SR. Functional inhibition of leukocyte B2 integrins by hyperbaric oxygen in carbon monoxide-mediated brain injury in rats. *Toxicology and applied pharmacology*. 1993;123(2):248-256.
13. Thom SR. Antagonism of carbon monoxide-mediated brain lipid peroxidation by hyperbaric oxygen. *Toxicology and applied pharmacology*. 1990;105(2):340-344.
14. Hurd TC, Dasmahapatra KS, Rush BF, Jr., Machiedo GW. Red blood cell deformability in human and experimental sepsis. *Arch Surg*. Feb 1988;123(2):217-20. doi:10.1001/archsurg.1988.01400260101012
15. Powell RJ, Machiedo GW, Rush BF, Jr. Decreased red blood cell deformability and impaired oxygen utilization during human sepsis. *Am Surg*. Jan 1993;59(1):65-8.
16. Howe CW. Experimental studies on determinants of wound infection. II. *Surgery*. Nov 1966;60(5):1072-6.
17. Tran DT, Miller SH, Buck D, Imatani J, Demuth RJ, Miller MA. Potentiation of infection by epinephrine. *Plast Reconstr Surg*. Dec 1985;76(6):933-4. doi:10.1097/00006534-198512000-00024
18. Hohn D. Oxygen and leukocyte microbial killing. *Hyperbaric oxygen therapy*. 1977;
19. Hunt TK, Linsey M, Grislis H, Sonne M, Jawetz E. The effect of differing ambient oxygen tensions on wound infection. *Ann Surg*. Jan 1975;181(1):35-9. doi:10.1097/00006558-197501000-00009
20. Hunt TK, Pai MP. The effect of varying ambient oxygen tensions on wound metabolism and collagen synthesis. *Surg Gynecol Obstet*. Oct 1972;135(4):561-7.
21. Hunt TK, Zederfeldt B, Goldstick TK. Oxygen and healing. *Am J Surg*. Oct 1969;118(4):521-5. doi:10.1016/0002-9610(69)90174-3
22. Bassett B, Bennett P. Introduction to the physical and physiological bases of hyperbaric therapy. *Hyperbaric oxygen therapy Bethesda, MD: Undersea Medical Society*. 1977;15

23. Boerama I. Life without blood (A study of the influence of high atmospheric pressure and hypothermia on dilution of blood). *J Cardiovasc Surg.* 1960;1:133-146.
24. Mathieu D, Coget J, Vinckier L, Devulder B, Wattel F. RED-BLOOD-CELL DEFORMABILITY AND HYPERBARIC-OXYGEN THERAPY. PERGAMON-ELSEVIER SCIENCE LTD THE BOULEVARD, LANGFORD LANE, KIDLINGTON ...; 1985:625-625.
25. Nemiroff PM. Synergistic effects of pentoxifylline and hyperbaric oxygen on skin flaps. *Arch Otolaryngol Head Neck Surg.* Sep 1988;114(9):977-81. doi:10.1001/archotol.1988.01860210043012
26. Bird AD, Telfer AB. Effect of Hyperbaric Oxygen on Limb Circulation. *Lancet.* Feb 13 1965;1(7381):355-6. doi:10.1016/s0140-6736(65)91783-6
27. Meijne NG. *Hyperbaric oxygen and its clinical value: with special emphasis on biochemical and cardiovascular aspects.* CC Thomas; 1970.
28. Nylander G, Lewis D, Nordström H, Larsson J. Reduction of postischemic edema with hyperbaric oxygen. *Plastic and reconstructive surgery.* 1985;76(4):596-603.
29. Schraibman I, Ledingham IM. Hyperbaric oxygen and local vasodilatation in peripheral vascular disease. *Journal of British Surgery.* 1969;56(4):295-299.
30. Skyhar MJ, Hargens AR, Strauss MB, Gershuni DH, Hart GB, Akeson WH. Hyperbaric oxygen reduces edema and necrosis of skeletal muscle in compartment syndromes associated with hemorrhagic hypotension. *J Bone Joint Surg Am.* Oct 1986;68(8):1218-24.
31. Strauss M, Hargens A, Gershuni D, et al. Reduction of skeletal muscle necrosis using intermittent hyperbaric oxygen in a model compartment syndrome. *JBJS.* 1983;65(5):656-662.
32. Strauss MB, Hargens AR, Gershuni DH, Hart GB, Akeson WH. Delayed use of hyperbaric oxygen for treatment of a model anterior compartment syndrome. *Journal of orthopaedic research.* 1986;4(1):108-111.
33. Greif R, Akca O, Horn EP, Kurz A, Sessler DI, Outcomes Research G. Supplemental perioperative oxygen to reduce the incidence of surgical-wound infection. *N Engl J Med.* Jan 20 2000;342(3):161-7. doi:10.1056/NEJM200001203420303
34. Burt J, Kapp J, Smith R. Effects of HBO on infarcts in gerbils. *Surg Neurol.* 1987;28:265-568.
35. Thomas MP, Brown LA, Sponseller DR, Williamson SE, Diaz JA, Guyton DP. Myocardial infarct size reduction by the synergistic effect of hyperbaric oxygen and recombinant tissue plasminogen activator. *Am Heart J.* Oct 1990;120(4):791-800. doi:10.1016/0002-8703(90)90194-3
36. Zamboni WA, Roth AC, Russell RC, Nemiroff PM, Casas L, Smoot EC. The effect of acute hyperbaric oxygen therapy on axial pattern skin flap survival when administered during and after total ischemia. *Journal of reconstructive microsurgery.* 1989;5(04):343-347.
37. Shandling AH, Ellestad MH, Hart GB, et al. Hyperbaric oxygen and thrombolysis in myocardial infarction: the "HOT MI" pilot study. *American heart journal.* 1997;134(3):544-550.
38. Ferrari R, Ceconi C, Curello S, et al. Oxygen-mediated myocardial damage during ischemia and reperfusion: Role of the cellular defences against oxygen toxicity. *Journal of molecular and cellular cardiology.* 1985;17(10):937-945.
39. Smith G, Stevens J, Griffiths J, Ledingham IM. Near-avulsion of foot treated by replacement and subsequent prolonged exposure of patient to oxygen at two atmospheres pressure. *The Lancet.* 1961;278(7212):1122-1123.
40. Perrins DJ. The effect of hyperbaric oxygen on ischemic skin flaps. *WC Grabb and M B, Myers (Eds), Skin Flaps Boston: Little, Brown.* 1975:53.
41. Garcia-Covarrubias L, McSwain NE, Jr., Van Meter K, Bell RM. Adjuvant hyperbaric oxygen therapy in the management of crush injury and traumatic ischemia: an evidence-based approach. *Am Surg.* Feb 2005;71(2):144-51.
42. Barthélémy L, Bellet M, Michaud A. The value of thermography in the appreciation of the effectiveness of hyperbaric oxygen therapy in the treatment of acute arteritis of the lower limbs. *Bordeaux Med.* 1976;9:1095-1100.
43. Davydkin N. Experience with clinical use of hyperbaric oxygenation in injuries and their complications. *Ortopediia travmatologija i protezirovanie.* 1977;(9):33-35.
44. Gismondi A, Micabella F, Colonna S. Possible use of hyperbaric oxygen in the treatment of certain vascular disease. *Ann Med Nav.* 1978;83:547-558.
45. Illingworth C, Smith G, Lawson D, et al. Surgical and physiological observations in an experimental pressure chamber. *Journal of British Surgery.* 1961;49(214):222-227.
46. Isakov I, Atroschenko Z, Balik I. Hyperbaric oxygenation in the prophylaxis of wound infection in the open trauma of the locomotor system. *Undersea Biomed Res.* 1979;6(1):57-61.
47. Loder RE. Hyperbaric oxygen therapy in acute trauma. *Ann R Coll Surg Engl.* Nov 1979;61(6):472-3.
48. Lukich V, Filimonova M, Bazarova V. Gas exchange during hyperbaric oxygenation in patients with regional ischemia. *Vrachebnoe delo.* 1979;(3):39-43.
49. Lukich V, Filimonova M, Fokina T. Employment of hyperbaric oxygenation in outpatients. *Khirurgija.* 1976;2:82-86.

50. Maudsley R, Hopkinson W, Williams K. Vascular injury treated with high pressure oxygen in a mobile chamber. *The Journal of Bone and Joint Surgery British volume*. 1963;45(2):346-350.
51. Schramek A, Hashmonai M. Vascular injuries in the extremities in battle casualties. *Br J Surg*. Sep 1977;64(9):644-8. doi:10.1002/bjs.1800640911
52. Skurikhina LA. Treatment under altered barometric pressure (barotherapy, vacuum therapy, hyperbaric oxygenation). *Vopr Kurortol Fizioter Lech Fiz Kult*. May-Jun 1976;0(3):83-9. Lechenie izmenennym barometricheskim davleniem (baroterapiia, vakuumterapiia, giperbarooksigneoterapiia).
53. Slack W, Thomas D, Dejode L. Hyperbaric oxygen in the treatment of trauma, ischemic disease of limbs, and varicose ulceration. 1966:621-624.
54. Szekely O, Szanto G, Takats A. Hyperbaric oxygen therapy in injured subjects. *Injury*. May 1973;4(4):294-300. doi:10.1016/0020-1383(73)90002-8
55. Johansen K, Daines M, Howey T, Helfet D, Hansen ST, Jr. Objective criteria accurately predict amputation following lower extremity trauma. *J Trauma*. May 1990;30(5):568-72; discussion 572-3. doi:10.1097/00005373-199005000-00007
56. Whitesides TE, Haney TC, Morimoto K, Harada H. Tissue pressure measurements as a determinant for the need of fasciotomy. *Clinical orthopaedics and related research*. 1975;(113):43-51.
57. Hyperbaric oxygen therapy in replantation of severed limbs. A report of 21 cases. *Chin Med J (Engl)*. May 1975;1(3):197-204.
58. Monies-Chass I, Hashmonai M, Hoerer D, Kaufman T, Steiner E, Schramek A. Hyperbaric oxygen treatment as an adjuvant to reconstructive vascular surgery in trauma. *Injury*. 1977;8(4):274-277.
59. Shupak A, Gozal D, Ariel A, Melamed Y, Katz A. Hyperbaric oxygenation in acute peripheral posttraumatic ischemia. 1987;
60. Strauss M, Hart G. Hyperbaric oxygen and the skeletal muscle compartment syndrome. *Contemp Orthop*. 1989;18:167-74.
61. Radonic V, Baric D, Petricevic A, Kovacevic H, Sapunar D, Glavina-Durdiv M. War injuries of the crural arteries. *Journal of British Surgery*. 1995;82(6):777-783.
62. Bouachour G, Cronier P, Gouello JP, Toulemonde JL, Talha A, Alquier P. Hyperbaric oxygen therapy in the management of crush injuries: a randomized double-blind placebo-controlled clinical trial. *J Trauma*. Aug 1996;41(2):333-9. doi:10.1097/00005373-199608000-00023
63. Kiyoshige Y. Effect of hyperbaric oxygen therapy as a monitoring technique for digital replantation survival. *Journal of reconstructive microsurgery*. 1999;15(05):327-330.
64. Matos L, Hutson J, Bonet H. HBO as an adjunct treatment for limb salvage in crush injuries of the extremities. *Undersea Hyperb Med*. 1999;26:66-7.
65. Caudle RJ, Stern PJ. Severe open fractures of the tibia. *J Bone Joint Surg Am*. Jul 1987;69(6):801-7.
66. Gustilo RB, Williams DN. The use of antibiotics in the management of open fractures. SLACK Incorporated Thorofare, NJ; 1984. p. 1617-1619.
67. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma*. Aug 1984;24(8):742-6. doi:10.1097/00005373-198408000-00009
68. Tscherne H, Oestern HJ. [A new classification of soft-tissue damage in open and closed fractures (author's transl)]. *Unfallheilkunde*. Mar 1982;85(3):111-5. Die Klassifizierung des Weichteilschadens bei offenen und geschlossenen Frakturen.
69. Strauss MB, Moon H, La S, Tan AM, Quang Lu L. Clinical Applications and Validation of an Innovative Wound Score. *Wounds*. Mar 21 2018;
70. Reenstra W, Buras J, Svoboda K. Hyperbaric oxygen increases human dermal fibroblast proliferation, growth factor receptor number and in vitro wound closure. 1998;
71. Brighton C. Hospital Tribune. *May*. 1977;9:4.
72. Gustilo RB. Management of open fractures and their complications. *Management of open fractures and their complications*. 1982:ix, 211-ix, 211.
73. Mackey WC, McCullough JL, Conlon TP, et al. The costs of surgery for limb-threatening ischemia. *Surgery*. Jan 1986;99(1):26-35.
74. Driver VR, Fabbi M, Lavery LA, Gibbons G. The costs of diabetic foot: the economic case for the limb salvage team. *J Vasc Surg*. Sep 2010;52(3 Suppl):17s-22s. doi:10.1016/j.jvs.2010.06.003
75. MacKenzie EJ, Bosse MJ, Pollak AN, et al. Long-term persistence of disability following severe lower-limb trauma. Results of a seven-year follow-up. *J Bone Joint Surg Am*. Aug 2005;87(8):1801-9. doi:10.2106/JBJS.E.00032
76. Mubarak SJ, Owen CA, Hargens AR, Garetto LP, Akeson WH. Acute compartment syndromes: diagnosis and treatment with the aid of the wick catheter. *J Bone Joint Surg Am*. Dec 1978;60(8):1091-5.

77. Strauss M. Hyperbaric oxygen for crush injuries and compartment syndromes; surgical considerations. *Hyperbaric surgery perioperative care Best Publishing Company: Flagstaff (AZ)*. 2002;34157
78. Matsen Fd, Winquist RA, Krugmire R. Diagnosis and management of compartmental syndromes. *J bone joint surg Am*. 1980;62(2):286-91.
79. Matsen FA, 3rd, Mayo KA, Sheridan GW, Krugmire RB, Jr. Monitoring of intramuscular pressure. *Surgery*. Jun 1976;79(6):702-9.
80. Mubarak SJ, Hargens AR. Acute compartment syndromes. *Surg Clin North Am*. Jun 1983;63(3):539-65. doi:10.1016/s0039-6109(16)43030-6
81. Heckman MM, Whitesides TE, Jr., Grewe SR, Judd RL, Miller M, Lawrence JH, 3rd. Histologic determination of the ischemic threshold of muscle in the canine compartment syndrome model. *J Orthop Trauma*. 1993;7(3):199-210. doi:10.1097/00005131-199306000-00001
82. Matava MJ, Whitesides TE, Jr., Seiler JG, 3rd, Hewan-Lowe K, Hutton WC. Determination of the compartment pressure threshold of muscle ischemia in a canine model. *J Trauma*. Jul 1994;37(1):50-8. doi:10.1097/00005373-199407000-00010
83. Nylander G, Otamiri T, Lewis D, Larsson J. Lipid peroxidation products in postischemic skeletal muscle and after treatment with hyperbaric oxygen. *Scandinavian Journal of Plastic and Reconstructive Surgery*. 1989;23(2):97-103.
84. Nylander G, Nordstrom H, Franzen L, Henriksson KG, Larsson J. Effects of hyperbaric oxygen treatment in post-ischemic muscle. A quantitative morphological study. *Scand J Plast Reconstr Surg Hand Surg*. 1988;22(1):31-9. doi:10.3109/02844318809097932
85. Bartlett R, Stroman R, Nickels M, Kalns J, Fuhrman C, Piepmeier E. Rabbit model of the use of fasciotomy and hyperbaric oxygenation in the treatment of compartment syndrome. 1998;
86. Fitzpatrick DT, Murphy PT, Bryce M. Adjunctive treatment of compartment syndrome with hyperbaric oxygen. *Mil Med*. Aug 1998;163(8):577-9.
87. Oriani G, Marroni A, Wattel F. Acute indications of HBO therapy-final report. *Handbook of Hyperbaric Medicine*. Springer; 1996.
88. Strauss M. Editorial: Cost Effective Issues in HBO Therapy: Complicated Fractures. 1988;
89. Francis A, Baynosa RC. Hyperbaric Oxygen Therapy for the Compromised Graft or Flap. *Adv Wound Care (New Rochelle)*. Jan 1 2017;6(1):23-32. doi:10.1089/wound.2016.0707
90. Reinisch JF. The pathophysiology of skin flap circulation. The delay phenomenon. *Plast Reconstr Surg*. Nov 1974;54(5):585-98. doi:10.1097/00006534-197411000-00010
91. Thom S, Strauss M. Frostbite: Pathophysiology, treatment and role of hyperbaric oxygen. *HBO Review*. 1985;6:99-113.
92. Skolnick AA. Early data suggest clot-dissolving drug may help save frostbitten limbs from amputation. *JAMA*. 1992;267(15):2008-2010.
93. Buncke HJ, Alpert BS, Johnson-Giebink R. Digital replantation. *Surg Clin North Am*. Apr 1981;61(2):383-94. doi:10.1016/s0039-6109(16)42388-1
94. Kiyoshige Y, Tsuchida H, Watanabe Y. Color monitoring after replantation. *Plastic and reconstructive surgery*. 1996;97(2):463-468.
95. Zamboni WA, Roth AC, Russell RC, Graham B, Suchy H, Kucan JO. Morphologic analysis of the microcirculation during reperfusion of ischemic skeletal muscle and the effect of hyperbaric oxygen. *Plastic and reconstructive surgery*. 1993;91(6):1110-1123.
96. Pou JD, Graham HD. Pediatric Nasal Tip Amputation Successfully Treated with Nonmicrovascular Replantation and Hyperbaric Oxygen Therapy. *Ochsner J*. Summer 2017;17(2):204-207.
97. Hazinski MF, Cummins RO, Association AH. 1997-99 *Handbook of Emergency Cardiovascular Care for Healthcare Providers*. American Heart Association; 1997.
98. Strauss M. EVIDENCE REVIEW OF HBO FOR CRUSH INJURY, COMPARTMENT SYNDROME AND OTHER TRAUMATIC ISCHEMIAS. 2001;
99. Hart BB. Refractory osteomyelitis. *The Hyperbaric oxygen therapy committee report*. 2003:79-85.
100. *Medicare Coverage Issues Manual*. (2002).

## References

1. Mitchell SJ. Decompression sickness: pathophysiology. In: Edmonds C, Bennett MH, editors. *Diving and Subaquatic Medicine*. 5 ed. Boca Raton, FL: Taylor and Francis; 2015. p. 125-40.
2. Hundemer GL, Jersey SL, Stuart RP, Butler WP, Pilmanis AA. Altitude decompression sickness incidence among U-2 pilots: 1994-2010. *Aviat Space Environ Med*. 2012;83(10):968-74.
3. Kohshi K, Wong RM, Abe H, Katoh T, Okudera T, Mano Y. Neurological manifestations in Japanese Ama divers. *Undersea Hyperb Med*. 2005;32(1):11-20.
4. Schipke JD, Gams E, Kallweit O. Decompression sickness following breath-hold diving. *Res Sports Med*. 2006;14(3):163-78.
5. Van Liew HD, Flynn ET. Direct ascent from air and N<sub>2</sub>-O<sub>2</sub> saturation dives in humans: DCS risk and evidence of a threshold. *Undersea Hyperb Med*. 2005;32(6):409-19.
6. Freiburger JJ, Denoble PJ, Pieper CF, Ugucioni DM, Pollock NW, Vann RD. The relative risk of decompression sickness during and after air travel following diving. *Aviat Space Environ Med*. 2002;73:980-4.
7. Vann RD, Pollock NW, Freiburger JJ, Natoli MJ, Denoble PJ, Pieper CF. Influence of bottom time on preflight surface intervals before flying after diving. *Undersea Hyperb Med*. 2007;34(3):211-20.
8. Webb JT, Pilmanis AA, O'Connor RB. An abrupt zero-preoxygenation altitude threshold for decompression sickness symptoms. *Aviat Space Environ Med*. 1998;69(4):335-40.
9. Webb JT, Kannan N, Pilmanis AA. Gender not a factor for altitude decompression sickness risk. *Aviat Space Environ Med*. 2003;74(1):2-10.
10. Francis TJ, Griffin JL, Homer LD, Pezeshkpour GH, Dutka AJ, Flynn ET. Bubble-induced dysfunction in acute spinal cord decompression sickness. *J Appl Physiol* (1985). 1990;68:1368-75.
11. Philp RB, Schacham P, Gowdey CW. Involvement of platelets and microthrombi in experimental decompression sickness: similarities with disseminated intravascular coagulation. *Aerosp Med*. 1971;42(5):494-502.
12. Nossum V, Koteng S, Brubakk AO. Endothelial damage by bubbles in the pulmonary artery of the pig. *Undersea Hyperb Med*. 1999;26(1):1-8.
13. Nossum V, Hjelde A, Brubakk AO. Small amounts of venous gas embolism cause delayed impairment of endothelial function and increase polymorphonuclear neutrophil infiltration. *Eur J Appl Physiol*. 2002;86:209-14.
14. Berry CA, King AH. Severe dysbarism in actual and simulated flight; a follow-up study of five cases. *U S Armed Forces Med J*. 1959;10(1):1-15.
15. Malette WG, Fitzgerald JB, Cockett AT. Dysbarism. A review of thirty-five cases with suggestion for therapy. *Aerosp Med*. 1962;33:1132-9.
16. Brunner F, Frick P, Bühlmann A. Post-decompression shock due to extravasation of plasma. *Lancet*. 1964;1:1071-3.
17. Boussuges A, Blanc P, Molenat F, Bergmann E, Sainty JM. Haemoconcentration in neurological decompression illness. *Int J Sports Med*. 1996;17:351-5.
18. Levin LL, Stewart GJ, Lynch PR, Bove AA. Blood and blood vessel wall changes induced by decompression sickness in dogs. *J Appl Physiol* (1985). 1981;50:944-9.
19. Ward CA, Koheil A, McCullough D, Johnson WR, Fraser WD. Activation of complement at plasma-air or serum-air interface of rabbits. *J Appl Physiol* (1985). 1986;60:1651-8.
20. Ward CA, McCullough D, Yee D, Stanga D, Fraser WD. Complement activation involvement in decompression sickness of rabbits. *Undersea Biomed Res*. 1990;17:51-66.
21. Little T, Butler BD. Pharmacological intervention to the inflammatory response from decompression sickness in rats. *Aviat Space Environ Med*. 2008;79(2):87-93.
22. Helps SC, Gorman DF. Air embolism of the brain in rabbits pre-treated with mechlorethamine. *Stroke*. 1991;22:351-4.
23. Thom SR, Yang M, Bhopale VM, Huang S, Milovanova TN. Microparticles initiate decompression-induced neutrophil activation and subsequent vascular injuries. *J Appl Physiol* (1985). 2011;110(2):340-51.
24. Yang M, Kosterin P, Salzberg BM, Milovanova TN, Bhopale VM, Thom SR. Microparticles generated by decompression stress cause central nervous system injury manifested as neurohypophysial terminal action potential broadening. *J Appl Physiol* (1985). 2013.
25. Elliott DH, Moon RE. Manifestations of the decompression disorders. In: Bennett PB, Elliott DH, editors. *The Physiology and Medicine of Diving*. Philadelphia, PA: WB Saunders; 1993. p. 481-505.
26. Francis TJR, Mitchell SJ. Manifestations of decompression disorders. In: Brubakk AO, Neuman TS, editors. *Bennett & Elliott's Physiology and Medicine of Diving*. New York, NY: Elsevier Science; 2003. p. 578-99.
27. Vann RD, Butler FK, Mitchell SJ, Moon RE. Decompression illness. *Lancet*. 2011;377(9760):153-64.

28. Mitchell SJ. Decompression sickness: manifestations. In: Edmonds C, Bennett MH, editors. *Diving and Subaquatic Medicine*. 5 ed. Boca Raton, FL: Taylor and Francis; 2015. p. 141-51.
29. Zwirewich CV, Müller NL, Abboud RT, Lepawsky M. Noncardiogenic pulmonary edema caused by decompression sickness: rapid resolution following hyperbaric therapy. *Radiology*. 1987;163:81-2.
30. Trytko B, Mitchell SJ. Extreme survival: a deep technical diving accident. *SPUMS J*. 2005;35:23-7.
31. Ryles MT, Pilmanis AA. The initial signs and symptoms of altitude decompression sickness. *Aviat Space Environ Med*. 1996;67(10):983-9.
32. Blatteau JE, Gempp E, Simon O, Coulange M, Delafosse B, Souday V, Cochard G, Arvieux J, Henckes A, Lafere P, Germonpre P, Lapoussiere JM, Hugon M, Constantin P, Barthelemy A. Prognostic factors of spinal cord decompression sickness in recreational diving: retrospective and multicentric analysis of 279 cases. *Neurocrit Care*. 2011;15(1):120-7.
33. Warren LP, Djang WT, Moon RE, Camporesi EM, Sallee DS, Anthony DC. Neuroimaging of scuba diving injuries to the CNS. *AJNR Am J Neuroradiol*. 1988;9:933-8.
34. Reuter M, Tetzlaff K, Hutzelmann A, Fritsch G, Steffens JC, Bettinghausen E, Heller M. MR imaging of the central nervous system in diving-related decompression illness. *Acta Radiol*. 1997;38(6):940-4.
35. Gempp E, Blatteau JE, Stephant E, Pontier JM, Constantin P, Peny C. MRI findings and clinical outcome in 45 divers with spinal cord decompression sickness. *Aviat Space Environ Med*. 2008;79(12):1112-6.
36. Chung JM, Ahn JY. Relationship between clinical and radiologic findings of spinal cord injury in decompression sickness. *Undersea Hyperb Med*. 2017;44(1):57-62.
37. Pol B, Watelle TJJ. Mémoire sur les effets de la compression de l'air appliquée au creusement des puits à houille. *Ann Hyg Pub Med Leg*. 1854;2:241-79.
38. Moir EW. Tunnelling by compressed air. *J Soc Arts Lond*. 1896;44(May 15):567-85.
39. Bert P. *Barometric Pressure (La Pression Barométrique)*. Bethesda, MD: Undersea Medical Society; 1978.
40. Zuntz N. Zur Pathogenese und Therapie der durch rasche Luftdruckänderungen erzeugten Krankheiten. *Fortschr Med*. 1897;15:632-9.
41. Yarbrough OD, Behnke AR. The treatment of compressed air illness using oxygen. *J Ind Hyg Toxicol*. 1939;21:213-8.
42. Zamboni WA, Roth AC, Russell RC, Graham B, Suchy H, Kucan JO. Morphological analysis of the microcirculation during reperfusion of ischemic skeletal muscle and the effect of hyperbaric oxygen. *Plast Reconstr Surg*. 1993;91:1110-23.
43. Martin JD, Thom SR. Vascular leukocyte sequestration in decompression sickness and prophylactic hyperbaric oxygen therapy in rats. *Aviat Space Environ Med*. 2002;73(6):565-9.
44. Thom SR, Bhopale VM, Yang M. Microparticle-induced vascular injury in mice following decompression is inhibited by hyperbaric oxygen: effects on microparticles and interleukin-1beta. *J Appl Physiol* (1985). 2019;126(4):1006-14.
45. Kindwall EP. Use of short *versus* long tables in the treatment of decompression sickness and arterial gas embolism. In: Moon RE, Sheffield PJ, editors. *Treatment of Decompression Illness*. Kensington, MD: Undersea and Hyperbaric Medical Society; 1996. p. 122-6.
46. Thalmann ED. Principles of US Navy recompression treatments for decompression sickness. In: Moon RE, Sheffield PJ, editors. *Treatment of Decompression Illness*. Kensington, MD: Undersea and Hyperbaric Medical Society; 1996. p. 75-95.
47. Moon RE, Sheffield PJ. Guidelines for treatment of decompression illness. *Aviat Space Environ Med*. 1997;68:234-43.
48. Hadanny A, Fishlev G, Bechor Y, Bergan J, Friedman M, Maliar A, Efrati S. Delayed recompression for decompression sickness: retrospective analysis. *PLoS ONE*. 2015;10(4):e0124919.
49. Chin W, Joo E, Ninokawa S, Popa DA, Covington DB. Efficacy of the U.S. Navy Treatment Tables in treating DCS in 103 recreational scuba divers. *Undersea Hyperb Med*. 2017;44(5):399-405.
50. Navy Department. *US Navy Diving Manual. Revision 7, Change A. Vol 5 : Diving Medicine & Recompression Chamber Operations*. NAVSEA 0910-LP-115-1921. Washington, DC: Naval Sea Systems Command; 2018.
51. Mitchell SJ, Bennett MH, Moon RE. Decompression sickness and arterial gas embolism. *N Engl J Med*. 2022;386(13):1254-64.
52. Mitchell SJ, Doolette DJ, Wachholz CJ, Vann RD, editors. *Management of Mild or Marginal Decompression Illness in Remote Locations*. Durham, NC: Divers Alert Network; 2005.
53. Tuominen LJ, Sokolowski S, Lundell RV, Raisanen-Sokolowski AK. Decompression illness in Finnish technical divers: a follow-up study on incidence and self-treatment. *Diving Hyperb Med*. 2022;52(2):78-84.
54. Mitchell SJ, Bennett MH, Bryson P, Butler FK, Doolette DJ, Holm JR, Kot J, Lafere P. Pre-hospital management of decompression illness: expert review of key principles and controversies. *Diving Hyperb Med*. 2018;48(1):45-55.



55. Kimbrell PN. Treatment of altitude decompression sickness. In: Moon RE, Sheffield PJ, editors. Treatment of Decompression Illness. Kensington, MD: Undersea and Hyperbaric Medical Society; 1996. p. 43-52.
56. Krause KM, Pilmanis AA. The effectiveness of ground level oxygen treatment for altitude decompression sickness in human research subjects. *Aviat Space Environ Med.* 2000;71(2):115-8.
57. Ball R. Effect of severity, time to recompression with oxygen, and retreatment on outcome in forty-nine cases of spinal cord decompression sickness. *Undersea Hyperb Med.* 1993;20:133-45.
58. Ross JAS. Clinical Audit and Outcome Measures in the Treatment of Decompression Illness in Scotland. A report to the National Health Service in Scotland Common Services Agency, National Services Division on the conduct and outcome of treatment for decompression illness in Scotland from 1991-1999. Aberdeen, UK: Department of Environmental and Occupational Medicine, University of Aberdeen Medical School; 2000 27 April 2000.
59. Goodman MW, Workman RD. Minimal recompression oxygen-breathing approach to treatment of decompression sickness in divers and aviators. Washington, DC: US Navy Experimental Diving Unit Report #5-65; 1965 1965.
60. Banham N, Hawkings P, Gawthrop I. A prospective single-blind randomised clinical trial comparing two treatment tables for the initial management of mild decompression sickness. *Diving Hyperb Med.* 2022;52(2):85-91.
61. Bennett MH, Mitchell SJ, Young D, King D. The use of deep tables in the treatment of decompression illness: the Hyperbaric Technicians and Nurses Association 2011 Workshop. *Diving Hyperb Med.* 2012;42(3):171-80.
62. Simmonet B. Prise en charge thérapeutique de l'accident de désaturation médullaire grave en centre hyperbare (MD Thesis) [Therapeutic management of severe spinal cord decompression sickness in a hyperbaric center]. Nancy, France: Université de Lorraine; 2021.
63. Johnson WR, Roney NG, Zhou H, Ciarlone GE, Williams BT, Green WT, Mahon RT, Dainer HM, Hart BB, Hall AA. Comparison of treatment recompression tables for neurologic decompression illness in swine model. *PLoS ONE.* 2022;17(10):e0266236.
64. Vann RD, Bute BP, Ugucioni DM, Smith LR. Prognostic factors in DCI in recreational divers. In: Moon RE, Sheffield PJ, editors. Treatment of Decompression Illness. Kensington, MD: Undersea and Hyperbaric Medical Society; 1996. p. 352-63.
65. Gempp E, Blatteau JE. Risk factors and treatment outcome in scuba divers with spinal cord decompression sickness. *J Crit Care.* 2010;25:236-42.
66. Sokolowski SA, Raisanen-Sokolowski AK, Tuominen LJ, Lundell RV. Delayed treatment for decompression illness: factors associated with long treatment delays and treatment outcome. *Diving Hyperb Med.* 2022;52(4):271-6.
67. Rivera JC. Decompression sickness among divers: an analysis of 935 cases. *Mil Med.* 1964;129:314-34.
68. Workman RD. Treatment of bends with oxygen at high pressure. *Aerosp Med.* 1968;39:1076-83.
69. Doolette DJ, Mitchell SJ. In-water recompression. *Diving Hyperb Med.* 2018;48(2):84-95.
70. Andre S, Lehot H, Morin J, Louge P, de Maistre S, Roffi R, Druelle A, Gempp E, Vallee N, Vergne M, Blatteau JE. Influence of prehospital management on the outcome of spinal cord decompression sickness in scuba divers. *Emerg Med J.* 2022 Feb 7: emermed-2021-211227. On-line ahead of print.
71. How J, Chan G. Management of delayed cases of decompression sickness--3 case reports. *Singapore Med J.* 1973;14(4):582-5.
72. Erde A, Edmonds C. Decompression sickness: a clinical series. *J Occup Med.* 1975;17(5):324-8.
73. Kizer KW. Delayed treatment of dysbarism: a retrospective review of 50 cases. *JAMA.* 1982;247(18):2555-8.
74. Meyers RAM, Bray P. Delayed treatment of serious decompression sickness. *Ann Emerg Med.* 1985;14:254-7.
75. Curley MD, Schwartz HJC, Zwingelberg KM. Neuropsychologic assessment of cerebral decompression sickness and gas embolism. *Undersea Biomed Res.* 1988;15:223-36.
76. Rudge FW, Shafer MR. The effect of delay on treatment outcome in altitude-induced decompression sickness. *Aviat Space Environ Med.* 1991;62:687-90.
77. Kindwall EP. Decompression sickness. In: Davis JC, Hunt TK, editors. *Hyperbaric Oxygen Therapy.* Bethesda, MD: Undersea Medical Society; 1977. p. 125-40.
78. Hart GB, Strauss MB, Lennon PA. The treatment of decompression sickness and air embolism in a monoplace chamber. *J Hyperb Med.* 1986;1:1-7.
79. Elliott DH, Kindwall EP. Decompression sickness. In: Kindwall EP, Whelan HT, editors. *Hyperbaric Medicine Practice.* Flagstaff, AZ: Best Publishing Co; 1999. p. 433-87.
80. Bond JG, Moon RE, Morris DL. Initial table treatment of decompression sickness and arterial gas embolism. *Aviat Space Environ Med.* 1990;61:738-43.
81. Cianci P, Slade JB, Jr. Delayed treatment of decompression sickness with short, no-air-break tables: review of 140 cases. *Aviat Space Environ Med.* 2006;77(10):1003-8.
82. Weaver LK. Monoplace hyperbaric chamber use of U.S. Navy Table 6: a 20-year experience. *Undersea Hyperb Med.* 2006;33(2):85-8.

83. Clarke R. Monoplace chamber treatment of decompression illness: Review and commentary. *Diving Hyperb Med.* 2020;50(3):264-72.
84. Wilson CM, Ross JA, Sayer M. Saturation treatment in shore-based chambers for divers with deteriorating cerebrospinal decompression sickness. *Diving Hyperb Med.* 2009;39(3):170-4.
85. Farm FP, Jr, Hayashi EM, Beckman EL. Diving and decompression sickness treatment practices among Hawaii's diving fisherman. Sea Grant Technical Paper UNIHI-SEAGRANT-TP-86-01. Sea Grant Technical Paper. Honolulu: University of Hawaii; 1986. Report No.: UNIHI-SEAGRANT-TP-86-01.
86. Pyle RL, Youngblood DA. In-water recompression as an emergency field treatment of decompression illness. *SPUMS J.* 1997;27:154-69.
87. Mitchell SJ, Bennett MH, Bryson P, Butler FK, Doolette DJ, Holm JR, Kot J, Lafere P. Consensus guideline: Pre-hospital management of decompression illness: expert review of key principles and controversies. *Undersea Hyperb Med.* 2018;45(3):273-86.
88. Dituri J, Sadler R, Siddiqi F, Sadler C, Javeed N, Annis H, Whelan H. Echocardiographic evaluation of intracardiac venous gas emboli following in-water recompression. *Undersea Hyperb Med.* 2016;43(2):103-12.
89. Dart TS, Butler W. Towards new paradigms for the treatment of hypobaric decompression sickness. *Aviat Space Environ Med.* 1998;69(4):403-9.
90. Butler WP, Topper SM, Dart TS. USAF treatment table 8: Treatment for altitude decompression sickness. *Aviat Space Environ Med.* 2002;73(1):46-9.
91. Moon RE, editor. *Adjunctive Therapy for Decompression Illness.* Kensington, MD: Undersea and Hyperbaric Medical Society; 2003.
92. Bennett M, Mitchell S, Dominguez A. Adjunctive treatment of decompression illness with a non-steroidal anti-inflammatory drug (tenoxicam) reduces compression requirement. *Undersea Hyperb Med.* 2003;30(3):195-205.

## References

1. Commonly Associated ICD-10 codes derived from Set (LDS) claims data CMS Q4 2020 Limited Data.
2. Buciuman N, Marcu LG. Dosimetric justification for the use of volumetric modulated arc therapy in head and neck cancer-A systematic review of the literature. *Laryngoscope Investig Otolaryngol*. 2021 Aug 16;6(5):999-1007. doi: 10.1002/liv.2.642. PMID: 34667842; PMCID: PMC8513433.
3. D'Souza DP, Rumble RB, Fyles A, Yaremko B, Warde P; Members of the IMRT Indications Expert Panel. Intensity-modulated radiotherapy in the treatment of gynaecological cancers. *Clin Oncol (R Coll Radiol)*. 2012 Sep;24(7):499-507. doi: 10.1016/j.clon.2012.05.005. Epub 2012 Jun 13. PMID: 22703725.
4. Dayes I, Rumble RB, Bowen J, Dixon P, Warde P; Members of the IMRT Indications Expert Panel. Intensity-modulated radiotherapy in the treatment of breast cancer. *Clin Oncol (R Coll Radiol)*. 2012 Sep;24(7):488-98. doi: 10.1016/j.clon.2012.05.003. Epub 2012 Jun 28. PMID: 22748561.
5. Lawrie TA, Green JT, Beresford M, Wedlake L, Burden S, Davidson SE, Lal S, Henson CC, Andreyev HJN. Interventions to reduce acute and late adverse gastrointestinal effects of pelvic radiotherapy for primary pelvic cancers. *Cochrane Database Syst Rev*. 2018 Jan 23;1(1):CD012529. doi: 10.1002/14651858.CD012529.pub2. PMID: 29360138; PMCID: PMC6491191.
6. Peterson DE, Doerr W, Hovan A, Pinto A, Saunders D, Elting LS, Spijkervet FK, Brennan MT. Osteoradionecrosis in cancer patients: the evidence base for treatment-dependent frequency, current management strategies, and future studies. *Support Care Cancer*. 2010 Aug;18(8):1089-98. doi: 10.1007/s00520-010-0898-6. Epub 2010 Jun 6. PMID: 20526784
7. Robert E. Marx, DDS, personal communication.
8. Mangar SA, Huddart RA, Parker CC, Dearnaley DP, Khoo VS, Horwich A. Technological advances in radiotherapy for the treatment of localised prostate cancer. *Eur J Cancer*. 2005 Apr;41(6):908-21. doi: 10.1016/j.ejca.2004.12.028. PMID: 15808957.
9. Bian X, Song T, Wu S. Outcomes of xerostomia-related quality of life for nasopharyngeal carcinoma treated by IMRT: based on the EORTC QLQ-C30 and H&N35 questionnaires. *Expert Rev Anticancer Ther*. 2015 Jan;15(1):109-19. doi: 10.1586/14737140.2015.961427. Epub 2014 Sep 18. PMID: 25231774.
10. Rubin P, Casarrett GW. *Clinical Radiation Pathology, Vol I*, pp 38-62, Philadelphia Pa: WB Saunders, 1968.
11. Hall EJ, Giaccia A. *Radiobiology for the radiologist*. Philadelphia, PA:Lippincott, Williams&Wilkins and Walters Kluwer; 2012:35.
12. Dorr W, Hendry H. Consequential late effects in normal tissues. *Radiotherapy and Oncology* 2001; 61: 223-31.
13. Huang A, Glick SA. Genetic susceptibility to cutaneous radiation injury. *Arch Dermatol Res*. 2017 Jan;309(1):1-10. doi: 10.1007/s00403-016-1702-3. Epub 2016 Nov 22. PMID: 27878387.
14. Stone HB, Coleman CN, Anscher MS, McBride WH. Effects of radiation on normal tissue: consequences and mechanisms. *Lancet Oncol*. 2003 Sep;4(9):529-36. doi: 10.1016/s1470-2045(03)01191-4. PMID: 12965273.
15. Early hyperbaric oxygen therapy for reducing radiotherapy side effects: early results of a randomized trial in oropharyngeal and nasopharyngeal cancer. *Int J Radiat Oncol Biol Phys*. 2009 Nov 1;75(3):711-6. doi: Teguh DN, Levendag PC, Noever I, Voet P, van der Est H, van Rooij P, Dumans AG, de Boer MF, van der Huls MP, Sterk W, Schmitz PI. 10.1016/j.ijrobp.2008.11.056. Epub 2009 Apr 20. PMID: 19386439.
16. Mohanti BK, Bansal M. Late sequelae of radiotherapy in adults. *Support Care Cancer*. 2005 Oct;13(10):775-80. doi: 10.1007/s00520-004-0697-z. Epub 2005 Jul 22. PMID: 16041503.
17. Barazzuol L, Coppes RP, van Luijk P. Prevention and treatment of radiotherapy-induced side effects. *Mol Oncol*. 2020 Jul;14(7):1538-1554. doi: 10.1002/1878-0261.12750. Epub 2020 Jun 24. PMID: 32521079; PMCID: PMC7332214.
18. Marx RE. Osteoradionecrosis: a new concept of its pathophysiology. *J Oral Maxillofac Surg* 1983;41:283-288.
19. Delanian S, Lefaix JL. The radiation-induced fibroatrophic process: therapeutic perspective via the antioxidant pathway. *Radiother Oncol*. 2004 Nov;73(2):119-31. doi: 10.1016/j.radonc.2004.08.021. PMID: 15542158.
20. Darby IA, Hewitson TD. Hypoxia in tissue repair and fibrosis. *Cell Tissue Res*. 2016 Sep;365(3):553-62. doi: 10.1007/s00441-016-2461-3. Epub 2016 Jul 16. PMID: 27423661.
21. Fleckenstein K, Gauter-Fleckenstein B, Jackson IL, Rabbani Z, Anscher M, Vujaskovic Z. Using biological markers to predict risk of radiation injury. *Semin Radiat Oncol* 2007;17:89-98.
22. Chen Y, Williams J, Ding I, Hernady E, Liu W, Smudzin T, Finkelstein JN, Rubin P, Okunieff P. Radiation pneumonitis and early circulatory cytokine markers. *Semin Radiat Oncol*. 2002 Jan;12(1 Suppl 1):26-33. doi: 10.1053/srao.2002.31360. PMID: 11917281.
23. Rubin P, Finkelstein J, Shapiro D. Molecular biology mechanisms in the radiation induction of pulmonary injury syndromes. *Int J Radiat Oncol Biol Phys* 1992;24:93-101.

24. Andreassen CN, Alsner J. Genetic variants and normal tissue toxicity after radiotherapy: a systematic review. *Radiother Oncol.* 2009 Sep;92(3):299-309. doi: 10.1016/j.radonc.2009.06.015. Epub 2009 Aug 14. PMID: 19683821.
25. Rosenstein BS. Radiogenomics: Identification of Genomic Predictors for Radiation Toxicity. *Semin Radiat Oncol.* 2017 Oct;27(4):300-309. doi: 10.1016/j.semradonc.2017.04.005. PMID: 28865512; PMCID: PMC5657449.
26. Authors on behalf of ICRP; Stewart FA, Akleyev AV, Hauer-Jensen M, Hendry JH, Kleiman NJ, Macvittie TJ, Aleman BM, Edgar AB, Mabuchi K, Muirhead CR, Shore RE, Wallace WH. ICRP publication 118: ICRP statement on tissue reactions and early and late effects of radiation in normal tissues and organs--threshold doses for tissue reactions in a radiation protection context. *Ann ICRP.* 2012 Feb;41(1-2):1-322. doi: 10.1016/j.icrp.2012.02.001. PMID: 22925378.
27. Marx RE, Johnson RP, Kline SN. Prevention of osteoradionecrosis: A randomized prospective clinical trial of hyperbaric oxygen versus penicillin. *J Am Dent Assoc* 1985;11:49-54.
28. Deshpande SS, Donneys A, Farberg AS, Tchanque-Fossuo CN, Felice PA, Buchman SR. Quantification and characterization of radiation-induced changes to mandibular vascularity using micro-computed tomography. *Ann Plast Surg.* 2014 Jan;72(1):100-3. doi: 10.1097/SAP.0b013e318255a57d. PMID: 23314188; PMCID: PMC4484594.
29. Marx RE. Radiation injury to tissue. In: Whelan, HT, Kindwall EP, ed. *Hyperbaric Medicine Practice*, Fourth Edition. Flagstaff, Best Publishing, 2017, pp 727-76.
30. Marx RE, Ehler WJ, Tayapongsak P, Pierce LW. Relationship of oxygen dose to angiogenesis induction in irradiated tissue. *Am J Surg* 1990;160:519-524.
31. Svalestad J, Thorsen E, Vaagbø G, Hellem S. Effect of hyperbaric oxygen treatment on oxygen tension and vascular capacity in irradiated skin and mucosa. *Int J Oral Maxillofac Surg.* 2014 Jan;43(1):107-12. doi: 10.1016/j.ijom.2013.07.006. Epub 2013 Aug 6. PMID: 23932021.
32. Johnson-Arbor K, Falola R, Kely J, Barbour J, Attinger C. Use of indocyanine green fluorescent angiography in a hyperbaric patient with soft tissue radiation necrosis: a case report. *Undersea Hyperb Med.* 2017 May-Jun;44(3):273-278. doi: 10.22462/5.6.2017.7. PMID: 28779583.
33. Feldmeier JJ, Jelen I, Davolt DA, Valente PT, Meltz ML, Alecu R. Hyperbaric oxygen as a prophylaxis for radiation induced delayed enteropathy. *Radiotherapy and Oncology* 1995; 35:138-144.
34. Feldmeier JJ, Davolt DA, Court WS, Onoda JM, Alecu R. Histologic morphometry confirms a prophylactic effect for hyperbaric oxygen in the prevention of delayed radiation enteropathy. *Undersea Hyper Med* 1998; 25(2):93-97.
35. Sroussi HY, Epstein JB, Bensadoun RJ, Saunders DP, Lalla RV, Migliorati CA, Heavilin N, Zumsteg ZS. Common oral complications of head and neck cancer radiation therapy: mucositis, infections, saliva change, fibrosis, sensory dysfunctions, dental caries, periodontal disease, and osteoradionecrosis. *Cancer Med.* 2017 Dec;6(12):2918-2931. doi: 10.1002/cam4.1221. Epub 2017 Oct 25. PMID: 29071801; PMCID: PMC5727249.
36. Thom SR, Bhopale VM, Velazquez OC, Goldstein LJ, Thom LH, Buerk DG. Stem cell mobilization by hyperbaric oxygen. *Am J Physiol Heart Circ Physiol.* 2006 Apr;290(4):H1378-86. doi: 10.1152/ajpheart.00888.2005. Epub 2005 Nov 18. PMID: 16299259.
37. Milovanova TN, Bhopale VM, Sorokina EM, Moore JS, Hunt TK, Hauer-Jensen M, Velazquez OC, Thom SR. Hyperbaric oxygen stimulates vasculogenic stem cell growth and differentiation in vivo. *J Appl Physiol* (1985). 2009 Feb;106(2):711-28. doi: 10.1152/jappphysiol.91054.2008. Epub 2008 Nov 20. PMID: 19023021; PMCID: PMC2644249.
38. Tobey RE, Kelly JF. Osteoradionecrosis of the jaws. *Otolaryngol Clin North Am.* 1979; 12(1):183- 186.
39. Davis JC, Dunn JM, Gates GA, Heimbach RD. Hyperbaric oxygen. A new adjunct in the management of radiation necrosis. *Arch Otolaryngol.* 1979 Feb;105(2):58-61. doi: 10.1001/archotol.1979.00790140004002. PMID: 760715.
40. Bedwinek JM, Shukovsky LJ, Fletcher GH, Daly TE. Osteonecrosis in patients treated with definitive radiotherapy for squamous cell cancers of the oral cavity and naso- and oropharynx. *Radiology* 1976;119:665-667.
41. Emami B, Lyman J, Brown A, Coia L, Gottein M, Munzenrider JE, Shank B, Solin LJ, Wesson M. Tolerance of normal tissue to therapeutic irradiation. *Int J Radiat Oncol Biol Phys* 1991;21:109-122.
42. Reuther T, Schuster T, Mende U, Kubler A. *Int J Oral Maxillofac Surg.*2003 Jun;32(3):289-95.
43. Nabil S, Samman N. Incidence and prevention of osteoradionecrosis after dental extraction in irradiated patients: a systematic review. *Int J Oral Maxillofac Surg.* 2011 Mar;40(3):229-43. doi: 10.1016/j.ijom.2010.10.005. Epub 2010 Nov 5. PMID: 21115324.
44. Gomez DR, Estilo L, Wolden SL, Zelefsky MJ, Kraus DH, Wong RJ, Saha AR, Jatin JP, Mechalakos JG, Lee NY. Correlation of osteoradionecrosis and dental events with dosimetric parameters in intensity-modulated radiation therapy for head and neck cancer. *Int J Radiat Oncol Biol Phys.* 2011 Nov 15;81(4):e207-13.

45. Caparrotti F, Huang SH, Bratman SV, et al. Osteoradionecrosis of the mandible in carcinoma treated with intensity modulated radiotherapy. *Cancer*. 2017;123(19):369-373.
46. Maesschaick T, Dulguerov N, Caparotti F, et al. Comparison of the incidence of osteoradionecrosis with conventional radiotherapy and intensity-modulated radiotherapy. *Head Neck*. 2016;38(11):1695-1702.
47. Parsons JT. The effect of radiation on normal tissues of the head and neck. In: Million RR, Cassisi NJ, eds. *Management of head and neck cancer: A multi-disciplinary approach*. Philadelphia: JB Lippincott; 1994:245-289.
48. Ma C, Gao W, Liu Z, Zhu D, Zhu F, Li X, He Y. Radiation-Induced Soft Tissue Injuries in Patients With Advanced Mandibular Osteoradionecrosis: A Preliminary Evaluation and Management of Various Soft Tissue Problems Around Radiation-Induced Osteonecrosis Lesions. *Front Oncol*. 2021 Apr 28;11:641061. doi: 10.3389/fonc.2021.641061. PMID: 33996554; PMCID: PMC8113699.
49. Marx RE. Osteoradionecrosis of the jaws: review and update. *HBO Rev*. 1984;5:412-9.
50. Karagozoglu KH, Dekker HA, Rietveld D, de Bree R, Schulten EA, Kantola S, Forouzanfar T, van der Waal I. Proposal for a new staging system for osteoradionecrosis of the mandible. *Med Oral Patol Oral Cir Bucal*. 2014 Sep 1;19(5):e433-7. doi: 10.4317/medoral.19623. PMID: 24316713; PMCID: PMC4192564.
51. He Y, Liu Z, Tian Z, Dai T, Qiu W, Zhang Z. Retrospective analysis of osteoradionecrosis of the mandible: proposing a novel clinical classification and staging system. *Int J Oral Maxillofac Surg*. 2015 Dec;44(12):1547-57. doi: 10.1016/j.ijom.2015.04.006. Epub 2015 Jul 11. PMID: 26169162.
52. Notani K, Yamazaki Y, Kitada H, Sakakibara N, Fukuda H, Omori K, Nakamura M. Management of mandibular osteoradionecrosis corresponding to the severity of osteoradionecrosis and the method of radiotherapy. *Head Neck*. 2003 Mar;25(3):181-6. doi: 10.1002/hed.10171. PMID: 12599284.
53. Feldmeier JJ, Hampson NB. A systematic review of the literature reporting the application of hyperbaric oxygen prevention and treatment of delayed radiation injuries: an evidence based approach. *UHM*. 2002;29:4-30.
54. Tobey RE, Kelly JF. Osteoradionecrosis of the jaws. *Otolaryngol Clin North Am*. 1979;12(1):183-186.
55. Maier A, Gaggl A, Klemen H, Santler G, Anegg U, Fell B, Karcher H, Smolle-Juttner FM, Friehs GB. Review of severe osteoradionecrosis treated by surgery alone or surgery with postoperative hyperbaric oxygenation. *Br J Oral Maxillofac Surg*. 2000;38:173-6.
56. Freiberger JJ, Yoo DS, de Lisle Dear G et al. Multimodality surgical and hyperbaric management of mandibular osteoradionecrosis. *Int J Radiat Oncol Bio Phys*. 2008;75(3):717-24.
57. Annane D, Depondt J, Aubert P et al. Hyperbaric oxygen therapy for radionecrosis of the jaw: a randomized controlled, double-blind trial from ORN96 Study Group. *J Clin Oncol*. 2004;22:4893-4900.
58. Feldmeier JJ, Heimbach RD, Davolt DA, Court WS, Stegmann BJ, Sheffield PJ. Hyperbaric oxygen as an adjunctive treatment for radiation necrosis of the chest wall. *Undersea and Hyperbaric Medicine*. 1995;22(4).
59. Moon RE, McGraw TA, Blakey G. Hyperbaric oxygen therapy for radiation necrosis of the jaw: comments on a randomized study. *UHM*. 2005;32:145-6.
60. Laden G. Hyperbaric oxygen therapy for radionecrosis: clear evidence from confusing data (letter to the editor). *J Clin Oncol*. 2005;23:4465.
61. Mendenhall WM. Mandibular osteoradionecrosis (editorial). *J Clin Oncol*. 2004;22:4867-8.
62. Gal TJ, Yueh B, Futran ND. Influence of prior hyperbaric oxygen therapy in complications following microvascular reconstruction for advanced osteoradionecrosis. *Arch Otolaryngol Head Neck Surg*. 2003;129:72-76.
63. Dielman FJ, Phan TTT, van den Hoogen FJA et al. The efficacy of hyperbaric oxygen related to clinical stage of osteoradionecrosis of the mandible. *Int J Oral and Maxillofac Surg*. 2017;46:428-33.
64. Hirsch DL, Bell RB, Dierks EJ, et al. Analysis of microvascular free flaps for reconstruction of advanced mandibular osteoradionecrosis: a retrospective cohort study. *J Oral Maxillofac Surg*. 2008;66(12):2545-56. 55.
65. Nolen D, Cannady SB, Wax MK, et al. Comparison of complications in free flap reconstruction for osteoradionecrosis in patients with or without hyperbaric oxygen therapy. *Head Neck*. 2014;36(12):1701-4. 56.
66. Van Gemert JT, Abbink JH, van Es RJ, et al. Early and late complications in the reconstructed mandible with free fibular flaps. *J Surg Oncol*. 2018;117:773-80.
67. Information provided by RE Marx, D.D.S.
68. Delainian S, Chatel CC, Porcher R et al. Complete restoration of refractory mandibular osteoradionecrosis by prolonged treatment with a pentoxifylline-tocopherol-clodronate combination (PENTOCLO): a phase II trial. *Int J Radiation Oncology Biol Phys*. 2011;80(30):832-9.
69. Hampson NB, Holm JR, Wreford-Brown CE, Feldmeier JJ. Prospective assessment of outcomes in 411 patients treated with hyperbaric oxygen for chronic radiation issue injury. *Cancer*. 2012;118:3860-8.
70. Clarke R. Challenges threaten, opportunity awaits hyperbaric medicine and the head and neck cancer patient. *Undersea Hyperb Med*. 2019 Jun-Jul-Aug - Third Quarter;46(4):385-397. PMID: 31509895.

71. Marx RE, Feldmeier JJ, Johnson RP. Hyperbaric oxygen is still needed in the management and prevention of mandibular necrosis: a response to Mr. Richard Clarke. *Undersea Hyperb Med.* 2019 Jun-Jul-Aug - Third Quarter;46(4):399-408. PMID: 31509896.
72. Lambert PM, Intrieb N, Eichstaedt R. Management of dental extractions in irradiated jaws: a protocol with hyperbaric oxygen treatment. *J Oral Maxillofac Surg.* 1997;55:268-74.
73. Vudiniabola S, Pirone C, Williamson J, Goss ANN. Hyperbaric oxygen in the prevention of osteoradionecrosis of the jaws. *Australian Dental Journal.* 1999; 44:243-247.
74. David LA, Sandor GK, Evans AW, Brown DH. Hyperbaric oxygen therapy and mandibular osteoradionecrosis: a retrospective study and analysis of treatment outcomes. *J Can Dent Assoc.* 2001; 67:384.
75. Chavez JA, Adkinson CD. Adjunctive hyperbaric oxygen in irradiated patients requiring dental extractions: outcomes and complications. *J Oral Maxillofac Surg.* 2001; 59:518-22. 65. Sulaiman F, Huryn JM, Ziotolow IM. Dental extractions in the irradiated head and neck patient: a retrospective review.
76. Sulaiman F, Huryn JM, Ziotolow IM. Dental extractions in the irradiated head and neck patient: a retrospective analysis of Memorial Sloan-Kettering Cancer Center protocols, criteria, and end results. *J Oral Maxillofac Surg.* 2003;61:1123-31.
77. Makkonen TA, Kiminski A, Makkonen TK et al. Dental extractions in relation to radiation therapy of 224 patients. *Int J Oral Maxillofac Surg.* 1987; 7:16:56-64.
78. Maxymiw WG, Wood RE, Liu FF. Postradiation dental extractions without hyperbaric oxygen. *Oral Surg Oral Med Oral Pathol.* 1991;72(3):270-4.
79. Lye KW, Wee J, Gao F et al. The effect of prior radiation therapy for treatment of nasopharyngeal cancer on wound healing following extractions: incidence of complications and risk factors. *Int J Oral Maxillofac Surg.* 2007;36:315-20.
80. Clayman L. Management of dental extractions in irradiated jaws: a protocol without hyperbaric oxygen. *J Oral Maxillofac Surg.* 1997;55:275-81.
81. Wahl MJ. Osteoradionecrosis prevention myths. *Int J Radiation Oncology Biol Phys.* 2006;64:661-9.
82. Shaw RJ, Butterworth CJ, Silcocks P, Tesfaye BT, Bickerstaff M, Jackson R, Kanatas A, Nixon P, McCaul J, Praveen P, Lowe T, Blanco-Guzman M, Forner L, Brennan P, Fardy M, Parkin R, Smerdon G, Stephenson R, Cope T, Glover M. HOPON (Hyperbaric Oxygen for the Prevention of Osteoradionecrosis): A Randomized Controlled Trial of Hyperbaric Oxygen to Prevent Osteoradionecrosis of the Irradiated Mandible After Dentoalveolar Surgery. *Int J Radiat Oncol Biol Phys.* 2019 Jul 1;104(3):530-539. doi: 10.1016/j.ijrobp.2019.02.044. Epub 2019 Mar 7. PMID: 30851351.
83. Kaur G, Hutchison I, Mehanna H, Williamson P, Shaw R, Tudur Smith C. Barriers to recruitment for surgical trials in head and neck oncology: a survey of trial investigators. *BMJ Open.* 2013 Apr 11;3(4):e002625. doi: 10.1136/bmjopen-2013-002625. PMID: 23585392; PMCID: PMC3641444.
84. Kim JC, Elkin D, Hendrickson FR. Carcinoma of the vocal cords: results of treatment and time-dose relationships.
85. Stell PM, Morrison ND. Radiation necrosis of the larynx: etiology and management. *Arch Oto Rhin Laryngol.* 1973; 98:111-3.
86. Flood LM, brightwell AP. Clinical assessment of the irradiated larynx. *J Laryngol Otol.* 1984;98:493-8.
87. Chandler JR. Radiation fibrosis and necrosis of the larynx. *Ann Otol Rhinol & Laryngol.* 1979;88:509-14. 7
88. Ferguson BJ, Hudson WR, Farmer JC. Hyperbaric oxygen for laryngeal radionecrosis. *Ann Otol Laryngol.* 1987; 96:1-6. 76.
89. Feldmeier JJ, Heimbach RD, Davolt DA, Brakora MJ. Hyperbaric oxygen as an adjunctive treatment for severe laryngeal necrosis: A report of nine consecutive cases. *Undersea Hyperb Med.* 1993;20:329-335.
90. Filintisis GA, Moon RE, Kraft KL, Farmer JC, Scher RL, Piantadosi CA. Laryngeal radionecrosis and hyperbaric oxygen therapy: report of 18 cases and review of the literature. *Ann Otol Rhinol Laryngol.* 2000;109:554-62
91. Narzony W, Sicko Z, Kot J et al. Hyperbaric oxygen therapy in the treatment of complications of irradiation in the head and neck area. *Undersea Hyperb Med.* 2005;32:103-10.
92. HSU YC, Lee KW, Tsai KB et al. Treatment of laryngeal necrosis with hyperbaric oxygen therapy: a case report. *Kaohsiung Med.* 2005;21:88-92.
93. Davis JC, Dunn JM, Gates GA, Heimbach RD. Hyperbaric oxygen: a new adjunct in the management of radiation necrosis. *Arch Otolaryngol.* 1979;105:58-61.
94. Neovius EB, Lind MG, Lind FG. Hyperbaric oxygen for wound complications after surgery in the irradiated head and neck: a review of the literature and a report of 15 consecutive cases. *Head and Neck.* 1997;19:315-322.

95. Feldmeier JJ, Newman R, Davolt DA, Heimbach RD, Newman NK, Hernandez LC. Prophylactic hyperbaric oxygen for patients undergoing salvage for recurrent head and neck cancers following full course irradiation (abstract). *Undersea Hyper Med.* 1998;25(Suppl):10.
96. Sassler AM, Esclamado RM, Wolf GT. Surgery after organ preservation therapy. Analysis of wound complications. *Arch Otolaryngol Head Neck Surg.* 1995 Feb;121(2):162-5
97. Agra IM, Carvalho AL, Pontes E, Campos OD, Ulbrich FS, Magrin J, Kowalski LP. Postoperative complications after en bloc salvage surgery for head and neck cancer. *Arch Otolaryngol Head Neck Surg.* 2003 Dec;129(12):1317-21.
98. Siegel RL, Miller KD, Wagle NS, Jemal A. Cancer statistics, 2023. *CA Cancer J Clin.* 2023 Jan;73(1):17-48. doi: 10.3322/caac.21763. PMID: 36633525.
99. Gerlach NL, Barkhuysen R, Kaanders JH et al. The effect of hyperbaric oxygen therapy on quality of life in oral and oropharyngeal cancer patients treated with radiotherapy. *Int J of Maxillofac Surg.* 2008;37:255-9
100. Teguh DN, Levendag PC, Noever I. et al. Early hyperbaric oxygen therapy for reducing radiotherapy side effects: early results of a randomized trial in oropharyngeal and nasopharyngeal cancer. *Int J Radiation Oncology Biol Phys.* 2009;75(3):711-6. 9.
101. No authors listed. Breast Cancer Treatment (PDQ®)—Patient Version - National Cancer Institute.
102. Hart GB, Manous EG. The treatment of radiation necrosis with hyperbaric oxygen (OHP). *Cancer.* 1976;37:2580-5.
103. Feldmeier JJ, Heimbach RD, Davolt DA, Court WS, Stegmann BJ, Sheffield PJ. Hyperbaric oxygen as an adjunctive treatment for delayed radiation injury of the chest wall: a retrospective review of 23 cases. *Undersea Hyperb Med.* 1995;22:383-393.
104. Carl UM, Hartmann KA. Hyperbaric oxygen treatment for symptomatic breast edema after radiation therapy. *Undersea Hyperb Med.* 1998;25:233-234.
105. Carl UM, Feldmeier JJ, Schmitt G et al. Hyperbaric oxygen therapy for late sequelae in women receiving radiation after breast conservation treatment. *Int J Radiat Oncol Bio Phys.* 2001;49(4):1029-31. 90. No Authors Listed. LENT SOMA scales for all anatomic sites. *Int J Radiat Oncol Biol Phys.* 1995;3
106. No Authors Listed. LENT SOMA scales for all anatomic sites. *Int J Radiat Oncol Biol Phys.* 1995;31(5):1049-91.
107. Teguh DN, Bol Raap R, Strikmans H et al. Hyperbaric oxygen therapy for late radiation-induced tissue toxicity: prospectively patient-reported outcome measures in breast cancer patients. *Radiat Oncol.* 2016;11(1):130-6.
108. Spruijt NE, van den Berg R. The effect of hyperbaric oxygen treatment on late radiation tissue injury after breast cancer: A case-series of 67 patients. *Diving Hyperb Med.* 2020 Sep 30;50(3):206–13. doi: 10.28920/dhm50.3.206-213. PMID: 32957121; PMCID: PMC7819722.
109. Bevers RF, Bakker DJ, Kurth KH. Hyperbaric oxygen treatment for haemorrhagic radiation cystitis. *Lancet.* 1995;346:803-805.
110. Neheman A, Nativ O, Moskovitz B, Melamed Y, Stein A. hyperbaric oxygen therapy for radiation-induced haemorrhagic cystitis. *BJU Int.* 2005;96:107-9.
111. Corman JM, McClure D, Pritchett R, Kozlowski P, Hampson NB. Treatment of radiation induced hemorrhagic cystitis with hyperbaric oxygen. *J Urol.* 2003;160:2200-2.
112. Chong KT, Hampson NB, Corman JM. Early hyperbaric oxygen improves outcome for radiation-induced hemorrhagic cystitis. *Urology.* 2005;65:649-53. 97. Cardinal J, Slade A, McFarland M et al. Scoping review
113. Cardinal J, Slade A, McFarland M et al. Scoping review and meta-analysis of hyperbaric oxygen therapy for radiation-induced hemorrhagic cystitis. *Current Urology Reports.* 2018.;19:38 published on line.
114. Oscarsson N, Müller B, Rosén A, Lodding P, Mölne J, Giglio D, Hjelle KM, Vaagbø G, Hyldegaard O, Vangedal M, Salling L, Kjellberg A, Lind F, Ertala O, Arola O, Seeman-Lodding H. Radiation-induced cystitis treated with hyperbaric oxygen therapy (RICH-ART): a randomised, controlled, phase 2-3 trial. *Lancet Oncol.* 2019 Nov;20(11):1602-1614. doi: 10.1016/S1470-2045(19)30494-2. Epub 2019 Sep 16. Erratum in: *Lancet Oncol.* 2019 Sep 23;; PMID: 31537473.
115. Cheng C, Foo KT. Management of severe chronic radiation cystitis. *Ann Acad Med. Singapore.* 1992;21:368-71.
116. Li A, Sun J, Chao H. Late bladder complications following radiotherapy of carcinoma of the uterine cervix. *Zhonghua Fu Chan Ke.* 1995;30:741-3.
117. Feldmeier JJ, Davolt DA, Court WS, Onoda JM, Alecu R. Histologic morphometry confirms a prophylactic effect for hyperbaric oxygen in the prevention of delayed radiation enteropathy. *Undersea Hyper Med.* 1998; 25(2):93-97.
118. Feldmeier JJ, Jelen I, Davolt DA, Valente PT, Meltz ML, Alecu R. Hyperbaric oxygen as a prophylaxis for radiation induced delayed enteropathy. *Radiotherapy and Oncology.* 1995; 35:138-144.
119. Neurath MF, Branbrink A, Meyer zum Buschenfelde KH, Lohse AW. A new treatment for severe malabsorption due to radiation enteritis. *Lancet.* 1996;347:1302.

120. Jones K, Evans AW, Bristow RG et al. Treatment of radiation proctitis with hyperbaric oxygen. *Radiotherapy and Oncology*. 2006;78:91-4.
121. Girinius S, Ceronysky N, Gesell L et al. Treatment of refractory radiation-induced hemorrhagic proctitis with hyperbaric oxygen therapy. *Am J Clin Oncol*. 2006;29:588-92.
122. . Dall’Era MA, Hampson NB, His RA et al. Hyperbaric oxygen therapy for radiation induced proctopathy in men treated for prostate cancer. *J Urol*. 2006;176:87-90.
123. Marshall GT, Thirlby RC, Bredfeldt JE, Hampson NB. Treatment of gastrointestinal radiation injury with hyperbaric oxygen *Undersea Hyperb Med*. 2007;34:35-42. 105.
124. Clarke RE, Tenorio LMC, Hussey JR et al. Hyperbaric oxygen treatment of chronic refractory radiation proctitis: a randomized and controlled double-blind crossover trial with long term follow-up. *Int J Radiat Oncol Biol Phys*. 2008;72(1):13
125. Glover M, Smerdon GR, Andeyev HJ et al. Hyperbaric oxygen for patients with chronic bowel dysfunction after pelvic radiotherapy (HBOT2): a randomized double-blind, sham-controlled phase 3 trial. *Lancet Oncol*. 2016;17(2):224-33.
126. Paquette IM, Vogel JD, Abbas MA, et al. The American Society of Colon and Rectal Surgeons clinical practice guidelines for the treatment of chronic radiation proctitis. *Dis Colon Rectum*. 2018;61:1135-40.
127. Williams JAA, Clarke D, Dennis WAA, Dennis EJJ, Smith STT. Treatment of pelvic soft tissue radiation necrosis with hyperbaric oxygen. *Am J Obstet Gynecol*. 1992; 167:415-416.
128. Feldmeier JJ, Heimbach RD, Davolt DA, Court WS, Stegmann BJ, Sheffield PJ. Hyperbaric oxygen as an adjunctive treatment for delayed radiation injuries of the abdomen and pelvis. *Undersea Hyperb Med*. 1997;23(4):205-213.
129. Fink D, Chetty N, Lehm JP, Marsden DE, Hacker NF. Hyperbaric oxygen therapy for delayed radiation injuries in gynecological cancers. *Int J Gynecol Cancer*. 2006;16:638-42. 112.
130. Craighead P, Shea-Budgell MA, Nation J, Esmail R, Evans AW, Parliament M, Oliver TK, Hagen NA. Hyperbaric oxygen for late radiation tissue injury in gynecologic malignancies. *Curr Oncol*. 2011;18(5):220-7.
131. Farmer JC Jr, Shelton DL, Angelillo JD, Bennett PD, Hudson WR. Treatment of radiation-induced tissue injury by hyperbaric oxygen. *Ann Otol Rhinol Laryngol*. 1978 Sep-Oct;87(5 Pt 1):707-15. doi: 10.1177/000348947808700517. PMID: 718068.
132. Feldmeier JJ, Heimbach RD, Davolt DA, McDonough MJ, Stegmann BJ, Sheffield PJ. Hyperbaric oxygen in the treatment of delayed radiation injuries of the extremities *Undersea Hyper Med*. 2000;27(1):15-19.
133. Borab Z, Mirmanesh MD, Gantz M, Cusano A, Pu LL. Systematic review of hyperbaric oxygen therapy for the treatment of radiation-induced skin necrosis. *J Plast Reconstr Aesthet Surg*. 2017 Apr;70(4):529-538. doi: 10.1016/j.bjps.2016.11.024. Epub 2016 Dec 14. PMID: 28081957.
134. Marcus RB Jr, Million RR. The incidence of transverse myelitis after radiation of the cervical spinal cord. *Int J Radiat Oncol Biol Phys*. 1990;19:3-8.
135. Hart GB, Manous EG. The treatment of radiation necrosis with hyperbaric oxygen (OHP). *Cancer*. 1976;37:2580-5
136. Glassburn JR, Brady LW. Treatment with hyperbaric oxygen for radiation myelitis. *Proc. 6th Int Cong on Hyperbaric Medicine*. 1977:266-77.
137. Calabro F, Jinkins JR. MRI of radiation myelitis: a report of a case treated with hyperbaric oxygen. *Eur Radiol*. 2000;10:1079-84.
138. Feldmeier JJ, Lange JD, Cox SD, Chou L, Ciaravino V. Hyperbaric oxygen as a prophylaxis or treatment for radiation myelitis. *Undersea Hyper Med*. 1993;20(3):249-255.
139. Sminia P, Van der Kleij AJ, Carl UM, Feldmeier JJ, Hartmann KA. Prophylactic hyperbaric oxygen treatment and rat spinal cord re-irradiation. *Cancer Lett*. 2003 Feb 28;191(1):59-65.
140. Feldmeier J, Borrillo D Siebenhaller G. The benefits of hyperbaric oxygen in the treatment of delayed spinal cord radiation induced injury. *Undersea Hyper Med*. 2009;36(4)
141. Schulteiss TE, Stephen LC, Peters LJ. Survival in radiation myelopathy. *Int J Radiat Oncol Biol Phys*. 1986;12:1765-9.
142. Chao ST, Ahluwalia MS, Barnett GH, Stevens GH, Murphy ES, Stockham AL, Shiue K, Suh JH. Challenges with the diagnosis and treatment of cerebral radiation necrosis. *Int J Radiat Oncol Biol Phys*. 2013 Nov 1;87(3):449-57. doi: 10.1016/j.ijrobp.2013.05.015. Epub 2013 Jun 19. PMID: 23790775.
143. Fetko K, Lukas RV, Watson L et al. Survival and complications of stereotactic radiosurgery:a systematic review of stereotactic radiosurgery for newly diagnosed and recurrent high-grade gliomas. *Medicine (Baltimore)*. 2017; 96(43):e8293.



144. Chuba PJ, Aronin P, Bhambhani K, Eichenhorn M, Zamarano L, Cianci P, Muhlbauer M, Porter AT, Fontanesi J. Hyperbaric oxygen therapy for radiation-induced brain injury in children. *Cancer*. 1997;80:2005-2012.
145. Leber KA, Eder HG, Kovac H, Anegg U, Pendl G. Treatment of cerebral radionecrosis by hyperbaric oxygen therapy. *Sterotact Funct Neurosurg*. 1998;70(Suppl 1):229-36.
146. Cirafisi C, Verderame F. Radiation-induced rhomboencephalopathy. *Ital J Neurol Sci*. 1999;20:55-8.
147. Dear GdeL, Rose RE, Dunn R, Piantadosi CA, Stolp BW, Carraway MS, Thalmann ED, Kraft K, Rice JR, Friedman AH, Friedman HS, Moon RE. Treatment of neurological symptoms of radionecrosis of the brain with hyperbaric oxygen: a case series. Presented at the 35th Annual Undersea and Hyperbaric Medical Society Scientific Meeting. San Diego, CA: 28-30 June 2002.
148. Gesell LB, Warnick R, Breneman J, Albright R, Racadio J, Mink, S. Effectiveness of hyperbaric oxygen for the treatment of soft tissue radionecrosis of the brain. Presented at the 35th Annual Undersea and Hyperbaric Medical Society
149. Drezner N, Hardy KK, Wells E, Vezina G, Ho CY, Packer RJ, Hwang EI. Treatment of pediatric cerebral radiation necrosis: a systematic review. *J Neurooncol*. 2016 Oct;130(1):141-148. doi: 10.1007/s11060-016-2219-5. Epub 2016 Jul 20. PMID: 27438082.
150. Co J, De Moraes MV, Katznelson R, Evans AW, Shultz D, Laperriere N, Millar BA, Berlin A, Kongkham P, Tsang DS. Hyperbaric Oxygen for Radiation Necrosis of the Brain. *Can J Neurol Sci*. 2020 Jan;47(1):92-99. doi: 10.1017/cjn.2019.290. Epub 2019 Oct 21. PMID: 31466539.
151. Furuse M, Nonoguchi N, Kuroiwa T et al. A prospective multi-centre, single-arm clinical trial of bevacizumab for patients with surgically untreatable symptomatic brain radiation necrosis. *Neurooncol Pract*. 2016;3(4):272-80.
152. Borruat FXX, Schatz NJJ, Glaser JSS, Feun LGG, Matos L. Visual recovery from radiation-induced optic neuropathy. The role of hyperbaric oxygen therapy. *J Clin Neuroophthalmol*. 1993;13:98-101.
153. Fontanesi J, Golden EB, Cianci PC, Heideman RL. Treatment of radiation-induced optic neuropathy in the pediatric population. *Journal of Hyperbaric Medicine*. 1991;6(4):245-248.
154. Boschetti M; De Lucchi M; Giusti M; Spina C; Corallo G; Goglia U; Ceresola E; Resmini E; Vera L; Minuto F; Ferone D. Partial visual recovery from radiation-induced optic neuropathy after hyperbaric oxygen therapy in a patient with Cushing disease. *Eur J Endocrinol*. 01 June 2006;154(6):813-8.
155. Guy J, Schatz NJJ. Hyperbaric oxygen in the treatment of radiation-induced optic neuropathy. *Ophthalmology*. 1986;93:1083-8.
156. Roden D, Bosley TM, Fowble B, Clark J, Savino PJ, Sergott RC, Schatz NJ. Delayed radiation injury to the retrobulbar optic nerves and chiasm. Clinical syndrome and treatment with hyperbaric oxygen and corticosteroids. *Ophthalmology*. 1990;97:346-51.
157. Guy J. Letter to the Editor. *Ophthalmology*. 1990;97:1246-7.
158. Malik A, Golnik K. Hyperbaric oxygen in the treatment of radiation optic neuropathy. *J Neuroophthalmol*. 2012;32(2):128-31.
159. Li CQ, Gerson S, Snyder B. Case report; hyperbaric oxygen and MRI findings in radiation-induced optic neuropathy. *Undersea Hyperb Med*. 2014;41(1):59-63.
160. Videtic GM, Venkatesan VM. Hyperbaric oxygen corrects sacral plexopathy due to osteoradionecrosis appearing 15 years after pelvic irradiation. *Clin Oncol (R Coll Radiol)*. 1999;11(3):198-9.
161. Pritchard J, Anand P, Broome J, et al. Double-blind randomized phase II study of hyperbaric oxygen in patients with radiation-induced brachial plexopathy. *Radiother Oncol*. 2001;58:279-86.
162. Niezgodna JA, Serena TE, Carter MJ. Outcomes of Radiation Injuries Using Hyperbaric Oxygen Therapy: An Observational Cohort Study. *Adv Skin Wound Care*. 2016 Jan;29(1):12-19. doi: 10.1097/01.ASW.0000473679.29537.c0. PMID: 26650092.
163. Mathieu D, Marroni A, Kot J. Tenth European Consensus Conference on Hyperbaric Medicine: recommendations for accepted and non-accepted clinical indications and practice of hyperbaric oxygen treatment. *Diving Hyperb Med*. 2017 Mar;47(1):24-32. doi: 10.28920/dhm47.1.24-32. Erratum in: *Diving Hyperb Med*. 2017 Jun;47(2):131-132. PMID: 28357821; PMCID: PMC6147240.
164. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008 Apr 26;336(7650):924-6. doi: 10.1136/bmj.39489.470347.AD. PMID: 18436948; PMCID: PMC2335261.
165. Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, Wales PW. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol*. 2014 Apr;67(4):401-9. doi: 10.1016/j.jclinepi.2013.12.002. PMID: 24581294.

166. Bennett MH, Feldmeier J, Hampson NB, Smee R, Milross C. Hyperbaric oxygen therapy for late radiation tissue injury. *Cochrane Database of Systematic Reviews* 2016, Issue 4. Art. No.: CD005005. DOI: 10.1002/14651858.CD005005.pub4.
167. Cumpston M, Li T, Page MJ, Chandler J, Welch VA, Higgins JP, Thomas J. Updated guidance for trusted systematic reviews: a new edition of the *Cochrane Handbook for Systematic Reviews of Interventions*. *Cochrane Database Syst Rev.* 2019 Oct 3;10:ED000142. doi: 10.1002/14651858.ED000142. PMID: 31643080.
168. Dirix P, Nuyts S, Van den Bogaert W. Radiation-induced xerostomia in patients with head and neck cancer: a literature review. *Cancer.* 2006 Dec 1;107(11):2525-34. doi: 10.1002/cncr.22302. PMID: 17078052.
169. Jensen SB, Vissink A, Limesand KH, Reyland ME. Salivary Gland Hypofunction and Xerostomia in Head and Neck Radiation Patients. *J Natl Cancer Inst Monogr.* 2019 Aug 1;2019(53):lgz016. doi: 10.1093/jncimonographs/ lgz016. PMID: 31425600.
170. Fontanesi j, Golden EB, Cianci P. Hyperbaric oxygen therapy can reverse radiation-induced xerostomia. *J of Hyperbaric Med* 1991; 6(3):215-21.
171. Fox NF, Xiao C, Sood AJ, Lovelace TL, Nguyen SA, Sharma A, Day TA. Hyperbaric oxygen therapy for the treatment of radiation-induced xerostomia: a systematic review. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2015 Jul;120(1):22-8. doi: 10.1016/j.oooo.2015.03.007. Epub 2015 Mar 25. PMID: 26093680.
172. Granstrom G. Placement of dental implants in irradiated bone: the case for hyperbaric oxygen. *Int J Oral Maxillofac.* 2006;64:812-8.
173. Ueda M, Kaneda T, Takahashi H. Effect of hyperbaric oxygen therapy on osseointegration of titanium implants in irradiated bone: A preliminary report. *Int J Oral Maxillofac Implants.* 1993;8:41-44.
174. Pomeroy BD, Keim LW, Taylor RJ. Preoperative hyperbaric oxygen therapy for radiation induced injuries. *J Urol.* 1998;159:1630-1632.
175. Sessler AM, Esclamado RM, Wolf GT. Surgery after organ preservation therapy: analysis of wound complications. *Arch Otolaryngol Head and Neck Surg.* 1995; 121(2):162-5.
176. Gray LH, Conger AD, Ebert M et al. The concentration of oxygen dissolved in tissues at the time of radiation as a factor in radiotherapy. *Br J Radiol.* 1953;26:638-48.
177. Churchill-Davidson I. The oxygen effect in radiotherapy: historical review. *Front Radiat Ther Oncol.* 1968.1:1-15. 145.
178. Overgaard J. Hypoxic radiosensitization: adored and ignored. *J Clin Oncol.* 2007 Sep 10;25(26):4066-74. doi: 10.1200/JCO.2007.12.7878. PMID: 17827455.
179. Koshi K, Kinoshita Y, Imada H et al. Effects of radiotherapy after hyperbaric oxygenation on malignant gliomas. *Br J Cancer.* 1990;80:236-41.
180. Beppu T, Kamada K, Arai H et al. Change of oxygen pressure in glioblastoma tissue under various conditions. *J Neurooncol.* 2002;58:47-52.
181. Becker A, Kuhn T, Liedtke H et al. Oxygenation measurements in head and neck cancers during hyperbaric oxygenation. *Strahlenther Onkol.* 2002;178:105-8.
182. Hartford AC, Davis TH, Buckley JC, Foote RL, Sinesi MS, Williams BB, Fariss AK, Schaner PE, Claus PL, Okuno SH, Hussey JR, Clarke RE. Hyperbaric Oxygen as Radiation Sensitizer for Locally Advanced Squamous Cell Carcinoma of the Oropharynx: A Phase 1 Dose-Escalation Study. *Int J Radiat Oncol Biol Phys.* 2017 Mar 1;97(3):481-486. doi: 10.1016/j.ijrobp.2016.10.048. Epub 2016 Nov 15. PMID: 28126298.
183. Personal communication with Mr. Richard E. Clarke, CHT. May 2023.
184. Allen BG, Bhatia SK, Anderson CM et al. Ketogenic diets as an adjuvant to cancer therapy: history and potential mechanism. *Redox Biol.* 2014;2:963-70. 151.
185. Warburg O, Wind F, Negelein E. The metabolism of tumors in the body. *Journal of Physiol.* 1926:519-30.
186. Poff AM, Ari C, Seyfried TN and D'Agostino DP. The ketogenic diet and hyperbaric oxygen therapy prolong survival in mice with systemic metastatic cancer. *PLOS One.* 2013.;8(6):1-9. |
187. İyikesici MS, Slocum AK, Slocum A, Berkarda FB, Kalamian M, Seyfried TN. Efficacy of Metabolically Supported Chemotherapy Combined with Ketogenic Diet, Hyperthermia, and Hyperbaric Oxygen Therapy for Stage IV Triple-Negative Breast Cancer. *Cureus.* 2017 Jul 7;9(7):e1445. doi: 10.7759/cureus.1445. PMID: 28924531; PMCID: PMC5589510.1.
188. İyikesici MS, Slocum AK, Winters N, Kalamian M, Seyfried TN. Metabolically Supported Chemotherapy for Managing End-Stage Breast Cancer: A Complete and Durable Response. *Cureus.* 2021 Apr 26;13(4):e14686. doi: 10.7759/cureus.14686. PMID: 33927959; PMCID: PMC8072186.

189. Iyikesici MS. Long-Term Survival Outcomes of Metabolically Supported Chemotherapy with Gemcitabine-Based or FOLFIRINOX Regimen Combined with Ketogenic Diet, Hyperthermia, and Hyperbaric Oxygen Therapy in Metastatic Pancreatic Cancer. *Complement Med Res.* 2020;27(1):31-39. English. doi: 10.1159/000502135. Epub 2019 Sep 17. PMID: 31527373.
190. Iyikesici MS. Long-Term Survival Outcomes of Metabolically Supported Chemotherapy with Gemcitabine-Based or FOLFIRINOX Regimen Combined with Ketogenic Diet, Hyperthermia, and Hyperbaric Oxygen Therapy in Metastatic Pancreatic Cancer. *Complement Med Res.* 2020;27(1):31-39. English. doi: 10.1159/000502135. Epub 2019 Sep 17. PMID: 31527373.
191. Iyikesici MS. Survival outcomes of metabolically supported chemotherapy combined with ketogenic diet, hyperthermia, and hyperbaric oxygen therapy in advanced gastric cancer. *Niger J Clin Pract.* 2020 May;23(5):734-740. doi: 10.4103/njcp.njcp\_509\_18. PMID: 32367884.
192. Feldmeier J, Carl U, Hartmann K, Sminia P. Hyperbaric oxygen: Does it promote growth or recurrence of malignancy. *UHM.* 2003; 30(1):1-18.
193. Stuhr LE, Iverson VV, Straume O, Maehle BO, Reed RK. Hyperbaric oxygen alone or combined with 5-FU attenuates growth of DMBA induced rat mammary tumors. *Cancer Lett.* 2004;210(1):3540.
194. Daruwalla J, Christophi C. Hyperbaric oxygen therapy for malignancy. *World J Surg.* 2006;30:2112-31.
195. Moen I, Stuhr LE. Hyperbaric oxygen therapy and cancer-review. *Targ Oncol.* 2012;7:233-42.
196. Chong KT, Hampson NB, Bostwick DG, Vessella RL, Corman JM. Hyperbaric oxygen does not accelerate latent in vivo prostate cancer: implications for the treatment of radiation-induced haemorrhagic cystitis. *BJU Int.* 2004 Dec;94(9):1275-8. doi: 10.1111/j.1464-410X.2004.05156.x. PMID: 15610104.
197. Sun TB, Chen RL, Hsu YH. The effect of hyperbaric oxygen on human oral cancer cells. *Undersea Hyperb Med.* 2004;31(2):251-60.
198. Shi Y, Lee CS, Wu J, Koch CJ, Thom SR, Maity A, Bernhard EJ. Effects of hyperbaric oxygen exposure on experimental head and neck tumor growth, oxygenation, and vasculature. *Head Neck.* 2005 May;27(5):362-9.
199. Granowitz EV, Tonomura N, Benson RM, Katz DM, Band V, Makari-Judson GP, Osborne BA. Hyperbaric oxygen inhibits benign and malignant human mammary epithelial cell proliferation. *Anticancer Res.* 2005;25:3833-42.
200. Daruwalla J, Christophi C. The effect of hyperbaric oxygen therapy on tumour growth in a mouse model of colorectal cancer liver metastases. *Eur J Cancer.* 2006 Dec;42(18):3304-11.
201. Haroon AT, Patel M, Al-Mehdi AB. Lung metastatic load limitation with hyperbaric oxygen *Undersea Hyperb Med. Int J Radiat Oncol Biol Bys.* 2009;74(4):1077-82. 2007 Mar-Apr;34(2):83-90.
202. FELDMEIER JJ, Onoda JM, Bossung DE, Court WS, Alecu R. Effect of Hyperbaric Oxygen on Cancer Cell Metastatic Potential and Proliferation. *Undersea and Hyperbaric Medicine*, 1997, Vol. 24, Suppl. 1.
203. Eltorai I, Hart GB, Strauss MB. Et al. Does hyperbaric oxygen provoke an occult carcinoma in man? In Kindwall EP, ed. *Proceedings of the eighth international congress on hyperbaric medicine.* San Pedro, CA. 1987:18-29.
204. Bradfield JJ, Kinsella JB, Mader JT et al. Rapid progression of head and neck squamous carcinoma after hyperbaric oxygen. *Otolaryngol Head and Neck Surg.* 1996;114:793-7.
205. Lin HY, Ku CH, Liu DW et al. Hyperbaric oxygen therapy for late radiation-associated tissue necroses: Is it safe in patients with locoregionally recurrent and the successfully salvaged head-and-neck cancers? *Int J Radiat Oncol Biol Phys.* 2009;74:1077-82.
206. Elbers JBW, Veldhuis LI, Bhairosing PA et al. Salvage surgery for advanced stage head and neck squamous cell carcinoma following radiotherapy or chemoradiation. *Eur Arch Otorhinolaryngol.* 2019; Epub ahead of print.
207. Comparison of two hyperbaric oxygen dosing protocols in the management of radiation cystitis. Ajayi OD, Masters TC, Westgard BC, Logue CJ, Walter JW, Hendriksen SM Division of Hyperbaric Medicine Department of Emergency Medicine / Hennepin Healthcare (Hennepin County Medical Center) Minneapolis, MN Presented at the UHMS Annual Scientific Meeting 2019.

## References

1. Fetterman BL, Saunders JE, Luxford WM. Prognosis and treatment of sudden sensorineural hearing loss. *Am J Otol.* 1996 Jul; 17(4):529–536.
2. O'Malley MR, Haynes DS. Sudden hearing loss. *Otolaryngol Clin N Am.* 2008;41: 633–649.
3. Haberkamp TJ, Tanyeri HM. Management of idiopathic sudden sensorineural hearing loss. *Am J Otol.* 1999 Sept;20:587–592.
4. Stachler R, Chandrasekhar S, Archer S, Rosenfeld R, Schwartz S, Barrs D, Brown S, Fife T, Ford P, Ganiats T, Hollingsworth D, Lewandowski C, Montano J, Saunders J, Tucci D, Valente M, Warren B, Yaremchuk K, Robertson P. Clinical practice guidelines: sudden hearing loss. *Otolaryngology – Head and Neck Surgery.* 2012;146:S1-35.
5. Rauch SD. Idiopathic sudden sensorineural hearing loss. *N Engl J Med.* 2008 Aug 21;359(8):833–840.
6. Byl FM Jr. Sudden hearing loss: eight years' experience and suggested prognostic table. *Laryngoscope.* 1984 May; 94 (5 Pt 1): 647–661.
7. Alexander TH, Harris JP. Incidence of sudden sensorineural hearing loss." *Otol Neurotol.* 2013;34:1586–1589.
8. Teranishi M, Katayama N, Uchida Y, Tominaga M, Nakashima T. Thirty-year trends in sudden deafness from four nationwide epidemiological surveys in Japan. *Acta Otolaryngol.* 2007;127:1259–1265.
9. Klemm E, Deutscher A, Mosges R. A Present investigation of the epidemiology in idiopathic sudden sensorineural hearing loss." *Laryngorhinootologie.* 2009;88:524 –527.
10. Hallberg OE. Sudden deafness of obscure origin. *Laryngoscope.* 1956 Oct; 66(10):1237–1267.
11. Byl FM. Seventy-six cases of presumed sudden hearing loss occurring in 1973; prognosis and incidence. *Laryngoscope.* 1977 May;87(5 Pt 1):817–825.
12. Mattox DE, Simmons FB. Natural history of sudden sensorineural hearing loss. *Ann Otol Rhinol Laryngol.* 1977 Jul-Aug; 86(4 Pt 1):463–480.
13. Shaia FT, Sheehy JL. Sudden sensori-neural hearing impairment: a report of 1,220 cases. *Laryngoscope.* 1976 Mar; 86(3):389–398.
14. Jourdy DN, Donatelli LA, Victor JD, Selesnick SH. Assessment of variation throughout the year in the incidence of idiopathic sudden sensorineural hearing loss. *Otol Neurotol.* 2010 Jan;31(1):53–57.
15. Wilson WR, Byl FM, Laird N. The efficacy of steroids in the treatment of idiopathic sudden hearing loss. A double-blind clinical study." *Arch Otolaryngol.* 1980 Dec; 106(12):772–776.
16. Chandrasekhar SS. Intratympanic dexamethasone for sudden sensorineural hearing loss: clinical and laboratory evaluation. *Otol Neurotol.* 2001 Jan; 22(1):18 –23.
17. Battaglia A, Burchette R, Cueva R. Combination therapy (intratympanic dexamethasone + high-dose prednisone taper) for the treatment of idiopathic sudden sensorineural hearing loss." *Otol Neurotol.* 2008 Jun;29(4):453–460.
18. De Kleyn A. Sudden complete or partial loss of function of the octavus system in apparently normal persons. *Acta Otolaryngologica.* 1944(32):407–429.
19. Cole RR, Jahrsdoerfer RA. Sudden hearing loss: an update. *Am J Otol.* 1988 May; 9 (3):211–215.
20. Hughes GB, Freedman MA, Haberkamp TJ, Guay ME. Sudden sensorineural hearing loss. *Otolaryngol Clin North Am.* 1996 Jun; 29(3):393–405.
21. Alimoglu Y, Inci E, Edizer DT, Ozdilek A, Aslan M. Efficacy comparison of oral steroid, intratympanic steroid, hyperbaric oxygen and oral steroid and hyperbaric oxygen treatments in idiopathic sudden sensorineural hearing loss cases. *Eur Arch Otorhinolaryngol.* 2011 Dec; 268(12):1735–1741.
22. Lamm C, Walliser U, Schumann K, Lamm K. Oxygen partial pressure measurements in the perilymph and the scala tympani in normo- and hyperbaric conditions. An animal experiment study. *HNO.* 1988 Sept;35(9):363–366.
23. Lamm K, Lamm C, Lamm H, Schumann K. Simultaneous determinations of oxygen partial pressure in the scala tympani, electrocochleography and blood pressure measurements in noise stress in guinea pigs. *HNO.* 1988 Sep; 36(9):367–372.
24. Belal A Jr. Pathology of vascular sensorineural hearing impairment. *Laryngoscope.* 1980 Nov;90(11 Pt 1):1831–1839.
25. Yoon TH, Paparella MM, Schachern PA, Alleva M. Histopathology of sudden hearing loss. *Laryngoscope.* 1990 Jul;100(7):707–715.
26. Pirodda A, Ferri GG, Modugno GC, Borghi C. Systemic hypotension and the development of acute sensorineural hearing loss in young healthy subjects." *Arch Otolaryngol Head Neck Surg.* 2001 Sep;127:1049–1052.
27. Lehnhardt E, Hesch RD. Causes of inner ear deafness: a critique of therapy. *HNO.* 1980;28:73–79.
28. Maass B. Autonomic nervous system and hearing. *Adv Otorhinolaryngol.* 1981;27:14–25.

29. Pirodda A, Saggese D, Giausa G, Ferri GG, Nascetti S, Gaddi A. Can hypotension episodes cause cochlear damage in young subjects? *Med Hypotheses*. 1997;48:195–186.
30. Pirodda A, Ferri Gg, Modugno GC, Gaddi A. Hypotension and sensorineural hearing loss: a possible correlation. *Acta Otolaryngol*. 1999;119(7):758–762.
31. Kawakami M, Makimoto K, Fukuse S, Takahashi H. Autoregulation of cochlear blood flow. A comparison of cerebral blood flow with muscular blood flow. *Eur Arch Otorhinolaryngol*. 1991;248:471–474.
32. Ciccone MM, Cortese F, Pinto m, Di Teo C, Fornarelli F, Gesualdo M, Mezzina A, Sabatelli E, Scicchitano P, Quaranta N. Endothelial function and cardiovascular risk in patients with idiopathic sudden sensorineural hearing loss. *Atherosclerosis*. 2012;225:511–516.
33. Brant LJ, Gordon-Salant S, Pearson JD, Klein LL, Morrell CH, Metter EJ, Fozard JL. Risk factors related to age-associated hearing loss in the speech frequencies. *J Am Acad Audiol*. 1996;7:152–160.
34. Rudack C, Langer C, Stoll W, Rust S., Walter M. Vascular risk factors in sudden hearing loss. *Thromb Haemost*. 2006;95:454–561.
35. Aimoni C, Bianchini C, Borin M, Ciorba A, Fellin R, Martini A, Scanelli G, Volpato S. Diabetes, cardiovascular risk factors and idiopathic sudden sensorineural hearing loss: a case-control study. *Audio Neurotol*. 2010;15(2):111–115.
36. Lin HC, Chao PZ, Lee HC. Sudden sensorineural hearing loss increases the risk of stroke: a 5-year follow-up study. *Stroke*. 2008 Oct;39 (10):2744–2748.
37. Ozler GS. Increased neutrophil-lymphocyte ratio in patients with idiopathic sudden sensorineural hearing loss. *J Craniofac Surg*. 2014 May;25(3): e260–e263.
38. Gloddek B, Lamm K, Arnold W. Pharmacological influence on inner ear endothelial cells in relation to the pathogenesis of sensorineural hearing loss. *Adv Otorhinolaryngol*. 2002;59:75–83.
39. Merchant SN, Durand ML, Adams JC. Sudden deafness: is it viral? *ORL J Otorhinolaryngol Relat Spec*. 2008;70:52–62.
40. Merchant SN, Adams JC, Nadol JB Jr. Pathology and pathophysiology of idiopathic sudden sensorineural hearing loss. *Otol Neurotol*. 2005 Mar;26(2):151–160.
41. Stokroos RJ, Albers FW, Schirm J. The etiology of idiopathic sudden sensorineural hearing loss: experimental herpes simplex virus infection of the inner ear. *Am J Otol*. 1998 Jul;19(4):447–452.
42. Shirwany NA, Seidman MD, Tang W. Effect of transtympanic injection of steroids on cochlear blood flow, auditory sensitivity, and histology in the guinea pig. *Am J Otol* 1998; 19:230 –235.
43. Nagura M, Iwasaki S, Wu R, Mizuta K, Umemura K, Hoshino T. Effects of corticosteroid, contrast medium and ATP on focal microcirculatory disorders of the cochlea. *Eur J Pharmacol*. 1999 Jan 29;366(1):47–53.
44. Tabuchi K, Oikawa K, Uemaetomari I, Tsuji S, Wada T, Hara A. Glucocorticoids and dehydroepiandrosterone sulfate ameliorate ischemia-induced injury of the cochlea. *Hear Res*. 2003 Jun; 180(1-2):51–56.
45. Lin DW, Trune DR. Breakdown of stria vascularis blood-labyrinth barrier in C3H/lpr autoimmune disease mice. *Otolaryngol Head Neck Surg*. 1997 Nov;117(5):530– 534.
46. Trune DR, Wobig RJ, Kempton JB, Hefeneider SH. Steroid treatment improves cochlear function in the MRL. MpJ-Fas(lpr) autoimmune mouse. *Hear Res*. 1999 Nov;137(1-2):160–166.
47. Alexiou C, Arnold W, Fauser C, Schratzenstaller B, Gloddek B, Fuhrmann S, Lamm K. Sudden sensorineural hearing loss: does application of glucocorticoids make sense? *Arch Otolaryngol Head Neck Surg*. 2001, Mar; 127(3):253-258.
48. Slattery WH, Fisher LM, Iqbal Z, Friedman RA, Liu N. Intratympanic steroid injection for treatment of idiopathic sudden hearing loss. *Otolaryngol Head Neck Surg*. 2005 Aug; 133(2):251–259.
49. Dispenza F, Amodio E, De Stefano A, Gallina S, Marchese D, Mathur N, Riggio F. Treatment of sudden sensorineural hearing loss with transtympanic injection of steroids as single therapy: a randomized clinical study. *Eur Arch Otorhinolaryngol*. 2011 Sep;268(9):1273-1278.
50. Seggas I, Koltsidopoulos P, Bibas A, Tzonou A, Sismanis A. Intratympanic steroid therapy for sudden hearing loss: a review of the literature. *Otol Neurotol*. 2011 Jan; 32(1):29–35.
51. Spear SA, Schwartz SR. Intratympanic steroids for sudden sensorineural hearing loss. A systematic review. *Otolaryngol Head Neck Surg*. 2011 Oct;145(4):534–543.
52. Ferri E, Frisina A, Fasson AC, Armato E, Spinato G, and Amadori M. Intratympanic steroid treatment for idiopathic sudden sensorineural hearing loss after failure of intravenous therapy. *ISRN Otolaryngology*. 2012;1–6.
53. Haynes DS, O'Malley M, Cohen S, Watford K, Labadie RF. Intratympanic dexamethasone for sudden sensorineural hearing loss after failure of systemic therapy. *Laryngoscope*. 2007 Jan;117(1):3–15.
54. Cinamon U, Bendet E, Kronenberg J. Steroids, carbogen or placebo for sudden hearing loss: a prospective double-blind study. *Eur Arch Otorhinolaryngol*. 2001 Nov;258(9):477–480.

55. Zadeh MH, Storper IS, Spitzer JB. Diagnosis and treatment of sudden-onset sensorineural hearing loss: a study of 51 patients. *Otolaryngol Head Neck Surg.* 2003 Jan;128(1):92–98.
56. Parnes LS, Sun AH, Freeman DJ. Corticosteroid pharmacokinetics in the inner ear fluids: an animal study followed by clinical application. *Laryngoscope.* 1999 Jul; 109(7 Pt 2):1–17.
57. Bird PA, Begg EJ, Zhang M, Keast AT, Murray DP, Balkany TJ. Intratympanic versus intravenous delivery of methylprednisolone to cochlear perilymph. *Otol Neurotol.* 2007 Dec; 28(8):1124–1130.
58. Plontke SK, Biegner T, Kammerer B, Delabar U, Salt AN. Dexamethasone concentration gradients along scala tympani after application to the round window membrane. *Otol Neurotol.* 2008 Apr; 29(3):401–406.
59. Wei BPC, Stathopoulos D, O’Leary S. Steroids for idiopathic sudden sensorineural hearing loss. *Cochrane Database of Systematic Reviews.* 2013; Issue 7. Art. No.: CD003998.
60. Gao Y, Liu D. Combined intratympanic and systemic use of steroids for idiopathic sudden sensorineural hearing loss: a meta-analysis. *Eur Arch Otorhinolaryngol.* 2016; 273:3699–3711.
61. Qiang Q, Wu X, Yang T, Yang C, Sun H. A comparison between systemic and intratympanic steroid therapies as initial therapy for idiopathic sudden sensorineural hearing loss: a meta-analysis. *Acta Oto-Laryngologica.* 2016 Dec 6: 1–8 ISSN:0001-6489.
62. Ho HG, Lin HC, Shu MT, Yang CC, Tsai HT. Effectiveness of intratympanic dexamethasone injection in sudden-deafness patients as salvage treatment. *Laryngoscope.* 2004 Jul;114(7):1184–1189.
63. Xenellis J, Papadimitriou N, Nikolopoulos T, Maragoudakis P, Segas J, Tzagaroulakis A, Ferekidis E. Intratympanic steroid treatment in idiopathic sudden sensorineural hearing loss: a control study. *Otolaryngol Head Neck Surg.* 2006 Jun;134(6):940–945.
64. Ahn JH, Han MW, Kim JH, Chung JW, Yoon TH. Therapeutic effectiveness over time of intratympanic dexamethasone as salvage treatment of sudden deafness. *Acta Otolaryngol.* 2008 Feb;128(2):128–131.
65. Kilic R, Safak MA, Oguz H, Kargin S, Demirci M, Samim E, Ozluoglu LN. Intratympanic methylprednisolone for sudden sensorineural hearing loss. *Otol Neurotol.* 2007 Apr;28(3):312–316.
66. Plaza G, Herraiz C. Intratympanic steroids for treatment of sudden hearing loss after failure of intravenous therapy. *Otolaryngol Head Neck Surg.* 2007 Jul;137(1): 74–78.
67. Hong SM, Park CH, Lee JH. Hearing outcomes of daily intratympanic dexamethasone alone as a primary treatment modality for ISSHL. *Otolaryngol Head Neck Surg.* 2009 Nov;141(5):579–583.
68. Tsai YJ, Liang JG, Wu WB, Ding YF, Chiang RP, Wu SM. Intratympanic injection with dexamethasone for sudden sensorineural hearing loss. *J Laryngol Otol.* 2011 Feb; 125(2):133–137.
69. Cavallazzi GM. Relations between O<sub>2</sub> and hearing function. Eds: Marroni A, Oriani G, Wattel F. *Proceedings of International Joint Meeting on Hyperbaric and Underwater Medicine.* Milano, Italy. 1996a Sept 4–8; 633–645.
70. Nagahara K, Fisch U, Yagi N. Perilymph oxygenation in sudden and progressive sensorineural hearing loss. *Acta Otolaryngol.* 1983 Jul – Aug;96(1–2):57–68.
71. Lamm H. Der einfluss der hyperbaren sauerstofftherapie auf den tinnitus und horverlust bei akuten und chronischen innenohrschaden. *Otorhinolaryngol Nova.* 1995; 5:161–169.
72. Tsunoo M, Perlman MB. Temporary arterial obstruction. Effects on perilymph oxygen and microphonics. *Acta Otolaryngol.* 1969;67:460–466.
73. Schwab B, Flunkert C, Heermann R, Lenarz T. HBO in the therapy of cochlear dysfunctions – first results of a randomized study. *EUBS diving and hyperbaric medicine, collected manuscripts of XXIV Annual Scientific Meeting of the European Underwater and Baromedical Society.* Stockholm: EUBS. 1998:40–42.
74. Fattori B, Berrettini S, Casani A, Nacci A, De Vito A, De Iaco G. Sudden hypoacusis treated with hyperbaric oxygen therapy: a controlled study. *Ear Nose Throat J.* 2001 Sept;80(9):655–660.
75. Racic G, Maslovara S, Roje Z, Dogas Z, Tafra R. Hyperbaric oxygen in the treatment of sudden hearing loss. *ORL J Otorhinolaryngol Relat Spec.* 2003 Nov–Dec;65(6): 317–320.
76. Dundar K, Gumus T, Ay H, Yetiser S, Ertugrul E. Effectiveness of hyperbaric oxygen on sudden sensorineural hearing loss: prospective clinical research. *J Otolaryngol.* 2007 Feb;36(1):32–37.
77. Hoffmann G, Bohmer D, Desloovere C. Hyperbaric oxygenation as a treatment for sudden deafness and acute tinnitus. *Proceedings of the Eleventh International Congress on Hyperbaric Medicine.* Flagstaff, AZ: Best Publishing Company; 1995. Pp:146–151.
78. Lamm K, Lamm H, Arnold W. Effect of hyperbaric oxygen therapy in comparison to conventional or placebo therapy or no treatment in idiopathic sudden hearing loss, acoustic trauma, noise-induced hearing loss and tinnitus. *A Literature Survey. Adv Otorhinolaryngol.* 1998;54:86–89.
79. Marchesi G, Valetti TM, Amer M, Ross M, Tiberti R, Ferani R, Mauro G Di. The HBO effective in sudden hearing loss treatment. *UHMS Meeting Abstracts, 2000.* <http://archive.rubicon-foundation.org/6781>.

80. Murakawa T, Kosaka M, Mori Y, Fukazawa M, Misaki K. Treatment of 533 patients with sudden deafness performed oxygenation at high pressure. *Nihon Jibiinkoka Gakkai Kaiho*. 2000 May;103(5):506–515.
81. Muzzi E, Zennaro B, Visentin R, Soldano F, Sacilotto C. Hyperbaric oxygen therapy as salvage treatment for sudden sensorineural hearing loss: review of rationale and preliminary report. *J Laryngol Otol*. 2010;124(2):e2.
82. Ohno K, Noguchi Y, Kawashima Y, Yagishita K, Kitamura K. Secondary hyperbaric oxygen therapy for idiopathic sudden sensorineural hearing loss in the subacute and chronic phases. *J Med Dent Sci*. 2010;57(2):127–132.
83. Cvorovic L, Jovanovic MG, Milutinovic Z, Arsovic N, Djeric D. Randomized prospective trial of hyperbaric oxygen therapy and intratympanic steroid injection as salvage treatment of sudden sensorineural hearing loss. *Otol and Neurotology*. 2013;34(6):1021–1026.
84. Yang CH, Wu RW, Hwang CF. Comparison of intratympanic steroid injection, hyperbaric oxygen and combination therapy in refractory sudden sensorineural hearing loss. *Otol and Neurotology*. 2013;34:1411–1416.
85. Pezzoli M, Magnano M, Maffi L, Pezzoli L, Marcato P, Orione M, Cupi D, Bongioannini G. Hyperbaric oxygen therapy as salvage treatment for sudden sensorineural hearing loss: a prospective controlled study. *Eur Arch Otorhinolaryngol*. 2015 Jul; 272(7):1659–1666.
86. Schumann K, Lamm K, Hettich M. Effect and effectiveness of hyperbaric oxygen therapy in chronic hearing disorders. Report of 557 cases 1989. *HNO*. 1990 Nov; 38(11):408–411.
87. Hoffman G, Bohmer D, Desloovere C. Hyperbaric oxygenation as a treatment of chronic forms of inner ear hearing loss and tinnitus. *Proceedings of the Eleventh International Congress on Hyperbaric Medicine*. Flagstaff, AZ: Best Publishing Company; 1995. Pp:141–145.
88. Kramer MR, Springer C, Berkman N, Glazer M, Bubil M, Bar-Yishay E, Godfrey S. Rehabilitation of hypoxemic patients with COPD at low altitude at the dead sea, the lowest place on earth. *Chest*. 1998 Mar;113(3):571–575.
89. Dean JB, Mulkey DK. Continuous Intracellular recordings from mammalian neurons exposed to hyperbaric helium, oxygen, or air. *J Appl Physiol*. 2000 Aug 89 (2):807–822.
90. Kau RJ, Sendtner-Gress K, Ganzer U, Arnold W. Effectiveness of hyperbaric oxygen therapy in patients with acute and chronic cochlear disorders. *ORL J Otorhinolaryngol Relat Spec*. 1997 Mar–Apr; 59(2):78–83.
91. Giger HL. Therapy of sudden deafness with O<sub>2</sub> / CO<sub>2</sub> inhalation. *HNO*. 1979 Mar; 27(3):107–109.
92. Goto F, Fujiiita T, Kitani Y, Kanno M, Kamei T, Ishii H. Hyperbaric oxygen and stellate ganglion blocks for idiopathic sudden hearing loss. *Acta Otolaryngol*. 1979;88(5– 6):335–342.
93. Pilgramm M, Lamm H, Schumann K. Hyperbaric oxygen therapy in sudden deafness. *Laryngol, Rhinol, Otol*. 1985 Jul;64(7):351–354.
94. Dauman R, Poisot D, Cros AM, Zennaro O, Bertrand B, Duclos JY, Esteban D, Milacic M, Boudey C, Bebear JP. Sudden deafness: a randomized comparative study of 2 administration modalities of hyperbaric oxygenotherapy combined with naftidrofuryl. *Rev Laryngol Otol Rhinol (Bord)*. 1993;114(1):53–58.
95. Zennaro O, Dauman R, Poisot A, Esteben D, Duclose JY, Bertrand B, Cros AM, Milacic M, Bebear JP. Value of the association of normovolemic dilution and hyperbaric oxygenation in the treatment of sudden deafness. A retrospective study. *Ann Otolaryngol Cir Cervicofac*. 1993;110(3):162–169.
96. Cavallazzi G, Pignataro L, Capaccio P. Italian experience in hyperbaric oxygen therapy for idiopathic sudden sensorineural hearing loss. *Proceedings of the International Joint Meeting on Hyperbaric and Underwater Medicine*. Bologna: Grafica Victoria; 1996. Pp: 647–649.
97. Aslan I, Oysu C, Veyseller B, Baserer N. Does the addition of hyperbaric oxygen therapy to the conventional treatment modalities influence the outcome of sudden deafness? *Otolaryngol Head Neck Surg*. 2002 Feb;126(2):121–126.
98. Topuz E, Yigit O, Cinar U, Seven H. Should hyperbaric oxygen be added to treatment in idiopathic sudden sensorineural hearing loss? *Eur Arch Otorhinolaryngol*. 2004 Aug;261(7)393–396.
99. Narozny W, Kuczkowski J, Kot J, Stankiewicz C, Sicko Z, Mikaszewski B. Prognostic factors in sudden sensorineural hearing loss: our experience and a review of the literature. *Ann Otol Rhinol Laryngol*. 2006 Jul;115(7):553–558.
100. Suzuki H, Fujimura T, Shiomori T, Ohbuchi T, Kitamura T, Hashida K, Udaka T. Prostaglandin E1 versus steroid in combination with hyperbaric oxygen therapy for idiopathic sudden sensorineural hearing loss. *Auris Nasus Larynx*. 2008 Jun;35 (2):192–197.
101. Suzuki H, Fujimura T, Ikeda K, Shiomori T, Udaka T, Ohbuchi T, Nagatani G. Prostaglandin E1 in combination with hyperbaric oxygen therapy for idiopathic sudden sensorineural hearing loss. *Acta Otolaryngol*. 2008 Jan;128(1):61–65.
102. Cekin E, Cincik H, Ulubil SA, Gungor A. Effectiveness of hyperbaric oxygen therapy in management of sudden hearing loss. *J Laryngol Otol*. 2009;123:609–612.

103. Liu Y, Sun D, Shao S, Jiang W, Sun Z, Li Z. The effect of hyperbaric oxygen therapy to different degree of hearing loss and types of threshold curve in sudden deafness patients. *Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi*. 2010 Oct; 24(19):890– 894.
104. Korpınar S, Alkan Z, Yigit O, Gor AP, Toklu AS, Cakir B, Soyuyuce OG, Ozkul H. Factors influencing the outcome of idiopathic sudden sensorineural hearing loss treated with hyperbaric oxygen therapy. *Eur Arch Otorhinolaryngol*. 2011 Jan; 268 (1):41–47.
105. Holy R, Navara M, Dosel P, Fundova P, Prazenica P, Hahn A. Hyperbaric oxygen therapy in idiopathic sudden sensorineural hearing loss (ISSHL) in association with combined treatment. *Undersea Hyperb Med*. 2011 Mar – Apr;38(2):137–142.
106. Liu SC, Kang BH, Lee JC, Lin YS, Huang KL, Liu DW, Su WF, Kao CH, Chu YH, Chen HC, Wang CH. Comparison of therapeutic results in sudden sensorineural hearing loss with/without additional hyperbaric oxygen therapy: a retrospective review of 465 audiotically controlled cases. *Clin Otolaryngol*. 2011 Apr;36(2):121–128.
107. Fujimura T, Suzuki H, Shiomori T, Udaka T, Mori T. Hyperbaric oxygen and steroid therapy for idiopathic sudden sensorineural hearing loss. *Eur Arch Otorhinolaryngol*. 2007 Aug;264(8):861–866.
108. Suzuki H, Mori T, Hashida K, Shibata M, Nguyen KH, Wakasugi T, Hohchi N. Prediction model for hearing outcome in patients with idiopathic sudden sensorineural hearing loss. *Eur Arch Otorhinolaryngol*. 2011;268(4):497–500.
109. Filipo R, Attanasio G, Viccaro M, Russo FY, Mancini P, Rocco M, Pietropaoli P, Covelli E. Hyperbaric oxygen therapy with short duration intratympanic steroid therapy for sudden hearing loss. *Acta Otolaryngol*. 2012 May;132(5):475–481.
110. Capuano L, Cavaliere M, Parente G, Damiano A, Pezzuti G, Lopardo D, Lemma M. Hyperbaric oxygen for idiopathic sudden hearing loss: is the routine application helpful? *Acta Oto-Laryngologica*. 2015 Jul;135(7):692–697.
111. Carneiro SN, Guerreiro DV, Cunha AM, Camacho OF, Aguiar IC. Hyperbaric oxygen therapy in sudden sensorineural hearing loss following spinal anesthesia: case reports. *Undersea Hyperb Med*. 2016;43(2):153 –159.
112. Hosokawa S, Sugiyama K, Takashashi G, Takebayashi S, Mineta H. Prognostic factors for idiopathic sudden sensorineural hearing loss treated with hyperbaric oxygen therapy and intravenous steroids. *J Laryngol and Otol*. 2017;131:77–82.
113. Bennett MH, Kertesz T, Perleth M, Yeung P, Lehm JP. Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus. *Cochrane Database Syst Rev*. 2012; Issue 10. Art. No.:CD004739.
114. Yildirim E, Murat Ozcan K, Palah M, Ali Cetin M, Ensari S, Dere H. Prognostic effect of hyperbaric oxygen therapy starting time for sudden sensorineural hearing loss. *Eur Arch Otorhinolaryngol*. 2015;272:23–28.
115. Bennett MH, Kertesz T, Yeung P. Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus. *Cochrane Database Syst Rev*. 2005 Jan 25 (1):CD004739.
116. Bennett MH, Kertesz T, Yeung P. Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus. *Cochrane Database Syst Rev*. 2007 Jan 24 (1):CD004739.
117. Bennett MH, Kertesz T, Matthias P, Yeung P. Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus. *Cochrane Database Syst Rev*. 2010 Jan 20(1):CD004739.
118. Conlin AE, Parnes LS. Treatment of sudden sensorineural hearing loss. A systematic review. *Arch Otolaryngol Head Neck Surg*. 2008 Jun;133:573–581.
119. Agarwal L, Pothier Dd. Vasodilators and vasoactive substances for idiopathic sudden sensorineural hearing loss. *Cochrane Database Syst Rev*. 2009 Oct 7;(4): CD003422.
120. Tucci DL, Farmer JC, Kitch RD, Witsell DL. Treatment of sudden sensorineural hearing loss with systemic steroids and valaciclovir. *Otol Neurotol*. 2002;23:301– 308.
121. Stokroos RJ, Albers FWJ, Tenvergert EM. Antiviral treatment of idiopathic sudden sensorineural hearing loss: a prospective, randomized, double-blinded clinical trial. *Acta Otolaryngol*. 1998b;118: 488–485.
122. Westerlaken BO, Stokroos RJ, Dhooge IJ, Wit HP, Albers FW. Treatment of idiopathic sudden sensorineural hearing loss with antiviral therapy: a prospective, randomized, double-blind clinical trial. *Ann Otol Rhinol Laryngol*. 2003;112:993– 100.
123. Uri N, Doweck I, Cohen-Kerem R, Greenberg E. Acyclovir in the treatment of idiopathic sudden sensorineural hearing loss. *Otolaryngol Head Neck Surg*. 2003; 128:544–549.
124. Awad Z, Huins C, Pothier DD. Antivirals for idiopathic sudden sensorineural hearing loss. *Cochrane Database Syst Rev*. 2012 Aug 15;(8):1–22.
125. Wei BP, Mubiru S, O’Leary S. Steroids for idiopathic sudden sensorineural hearing loss. *Cochrane Database Syst Rev*. 2006 Jan 25;(1):CD003998.
126. Nosrati-Zarenou R, Hultcrantz E. Corticosteroid Treatment of Idiopathic Sudden sensorineural hearing loss: randomized triple-blind placebo-controlled trial. *Otol Neurotol*. 2012 Jun; 22(4):523–531.



127. Plontke SK, Meisner C, Caye-Thomasen P, Parnes L, Agrawal S, Mikulee T. Intratympanic glucocorticoids for sudden sensorineural hearing loss. *Cochrane Database Syst Rev.* 2009 Oct 7(1):CD0088080.
128. Kranke P, Bennett MH, Debus SE, Roedel-Wiedmann I, Schnabel A. Hyperbaric oxygen therapy for chronic wounds. *Cochrane Database Syst Rev.* 2009 Jul 8(1): CD004123.
129. Piper SM, Murphy-Lavoie H, LeGros TL. Idiopathic sudden sensorineural hearing loss. In: *Hyperbaric Oxygen Therapy Indications: The Hyperbaric Oxygen Therapy Committee Report.* North Palm Beach, Florida; 2014. Best Publishing Company.
130. Uzun G, Mutluoglu M, Metin S. The use of hyperbaric oxygen treatment for sudden sensorineural hearing loss in Europe. *Diving Hyperb Med.* 2016 Mar;46 (1):43– 46.
131. Grades of Hearing Impairment. World Health Organization. 2011. [http://www.who.int/pbd/deafness/hearing\\_impairment\\_grades/en/index.html](http://www.who.int/pbd/deafness/hearing_impairment_grades/en/index.html).
132. Deafness and Hearing Impairment. World Health Organization Fact Sheet. April 2010. <http://www.who.int/mediacentre/factsheets/fs300/en/index.html>.
133. World Health Organization. *The Global Burden of Disease: 2004 Update.* 2008. WHO, Geneva, Switzerland. WHO Press. ISBN 978 92 4 156371 0.
134. Narozny W, Sicko Z, Przewony T, Stankiewicz C, Kot J, Kuczkowski J. Sudden sensorineural hearing loss: a treatment protocol including glucocorticoids and hyperbaric oxygen therapy. *Otolaryngol Pol.* 2004;58(4): 821-830.

## References

1. Brouwer MC, Tunkel AR, McKhann GM, 2nd, van de Beek D. Brain abscess. *N Engl J Med*. 2014;371(5):447-456.
2. Brouwer MC, Coutinho JM, van de Beek D. Clinical characteristics and outcome of brain abscess: systematic review and meta-analysis. *Neurology*. 2014;82(9):806-813.
3. Widdrington, J. D., Bond, H., Schwab, U., Price, D. A., Schmid, M. L., McCarron, B., Chadwick, D. R., Narayanan, M., Williams, J., & Ong, E. (2018). Pyogenic brain abscess and subdural empyema: presentation, management, and factors predicting outcome. *Infection*, 46(6), 785-792.
4. Wu, S., Wei, Y., Yu, X., Peng, Y., He, P., Xu, H., Qian, C., Chen, G. (2019, November). Retrospective analysis of brain abscess in 183 patients: A 10-year survey. *Medicine (Baltimore)* 98(46): e17670.
5. Bodilsen, J., Dalager-Pedersen, M., Kjærgaard, N., van de Beek, D., Brouwer, M. C., & Nielsen, H. (2018). Positive predictive value of ICD-10 diagnosis codes for brain abscess in the Danish National Patient Registry. *Clinical epidemiology*, 10, 1503–1508.
6. Kanu, O. O., Ojo, O., Esezobor, C., Bankole, O., Olatosi, J., Ogunleye, E., Asoegwu, C., Eghosa, M., Adebayo, B., Oladele, R., & Nwawolo, C. (2021). Pediatric brain abscess - etiology, management challenges and outcome in Lagos Nigeria. *Surgical neurology international*, 12, 592.
7. Tunkel AR. Brain abscess. In: Bennett JE, Dolin R, Blaser MJ, editors. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases*, Updated Edition. 8 ed. Philadelphia, PA: Elsevier Saunders; 2015. p. 1164-1176.
8. Tekkok IH, Erben A. Management of brain abscess in children: review of 130 cases over a period of 21 years. *Childs Nerv Syst*. 1992;8(7):411-416.
9. Udayakumar S, Onyia CU, Kumar RK. Forgotten? Not Yet. Cardiogenic brain abscess in children: a case series-based review. *World Neurosurg*. 2017;107:124-129.
10. Gelfand MS, Stephens DS, Howell EI, Alford RH, Kaiser AB. Brain abscess: association with pulmonary arteriovenous fistula and hereditary hemorrhagic telangiectasia: report of three cases. *Am J Med*. 1988;85(5):718-720.
11. Press OW, Ramsey PG. Central nervous system infections associated with hereditary hemorrhagic telangiectasia. *Am J Med*. 1984;77(1):86-92.
12. Chang YT, Lu CH, Chuang MJ, Huang CR, Chuang YC, Tsai NW, et al. Supratentorial deep-seated bacterial brain abscess in adults: clinical characteristics and therapeutic outcomes. *Acta Neurol Taiwan*. 2010;19(3):178-183.
13. Sukoff MH, Ragatz RE. Hyperbaric oxygenation for the treatment of acute cerebral edema. *Neurosurgery*. 1982;10:29-38.
14. Mader JT, Brown GL, Guckian JC, Wells CH, Reinartz JA. A mechanism for the amelioration by hyperbaric oxygen of experimental staphylococcal osteomyelitis in rabbits. *J Infect Dis*. 1980;142:915-922.
15. Siddiqui A, Davidson JD, Mustoe TA. Ischemic tissue oxygen capacitance after hyperbaric oxygen therapy: a new physiologic concept. *Plast Reconstr Surg*. 1997;99(1):148-155.
16. Price JC, Stevens DL. Hyperbaric oxygen in the treatment of rhinocerebral mucormycosis. *Laryngoscope*. 1980;90:737-747.
17. Ferguson BJ, Mitchell TG, Moon R, Camporesi EM, Farmer J. Adjunctive hyperbaric oxygen for treatment of rhinocerebral mucormycosis. *Rev Infect Dis*. 1988;10(3):551-559.
18. Roden MM, Zaoutis TE, Buchanan WL, Knudsen TA, Sarkisova TA, Schaufele RL, et al. Epidemiology and outcome of zygomycosis: a review of 929 reported cases. *Clin Infect Dis*. 2005;41(5):634-653.
19. Verklin RM, Jr., Mandell GL. Alteration of effectiveness of antibiotics by anaerobiosis. *J Lab Clin Med*. 1977;89(1):65-71.
20. Madsen ST. Sepsis, endocarditis, and brain abscess. *Scand J Gastroenterol Suppl*. 1983;85:48-54.
21. Kaide CG, Khandelwal S. Hyperbaric oxygen: applications in infectious disease. *Emerg Med Clin North Am*. 2008;26(2):571-95, xi.
22. Larsson A, Engstrom M, Uusijarvi J, Kihlstrom L, Lind F, Mathiesen T. Hyperbaric oxygen treatment of postoperative neurosurgical infections. *Neurosurgery*. 2008;62 Suppl 2:652-671.
23. Bartek J, Jr., Jakola AS, Skyrman S, Forander P, Alpkvist P, Schechtmann G, et al. Hyperbaric oxygen therapy in spontaneous brain abscess patients: a population-based comparative cohort study. *Acta Neurochir (Wien)*. 2016;158(7):1259-1267.
24. Nakahara K, Yamashita S, Ideo K, Shindo S, Suga T, Ueda A, et al. Drastic therapy for listerial brain abscess involving combined hyperbaric oxygen therapy and antimicrobial agents. *J Clin Neurol*. 2014;10(4):358-362.

25. Valente Aguiar, P., Carvalho, B., Monteiro, P., Linhares, P., Camacho, Ó., & Vaz, R. (2021, March 31). Hyperbaric oxygen treatment: Results in seven patients with severe bacterial postoperative central nervous system infections and refractory mucormycosis. *Diving and hyperbaric medicine*, 51(1), 86–93.
26. Kutlay M, Colak A, Yildiz S, Demircan N, Akin ON. Stereotactic aspiration and antibiotic treatment combined with hyperbaric oxygen therapy in the management of bacterial brain abscesses. *Neurosurgery*. 2008;62 Suppl 2:540-546.
27. Lampl LA. Hyperbaric oxygen in intracranial abscess. In: Whelan HT, Kindwall EP, editors. *Hyperbaric Medicine Practice*. 4th ed. North Palm Beach, FL: Best Publishing Company; 2017. 467-483.
28. Kjellberg, A., Bjerin, O., Franzén-Röhl, E., Bartek, J., Jr, & Lindholm, P. (2021). Lemierre's syndrome caused by *Fusobacterium necrophorum* complicated with multiple brain abscesses-A case report, literature review, and suggested management. *Clinical case reports*, 9(12), e05142.
29. Baechli H, Schmutz J, Mayr JM. Hyperbaric oxygen therapy (HBO) for the treatment of an epidural abscess in the posterior fossa in an 8-month-old infant. *Pediatr Neurosurg*. 2008;44(3):239-242.
30. Conley, W., Cox, R. E., & Robey, T. (2022, April 20). Rhinocerebral mucormycosis associated with anterior skull base *Actinomyces osteomyelitis* in a pediatric patient with type 1 diabetes. *Cureus*, 14(4), e24311.
31. Mandour, C., Gassas, M., & Mostarchild, B. E. (2018, January). Hyperbaric oxygen therapy in the treatment of brain abscess: about a case. *Romanian Neurosurgery*, 32(1), 125-128.
32. Zhou, W., Shao, X., & Jiang, X. (2019). A Clinical Report of Two Cases of Cryptogenic Brain Abscess and a Relevant Literature Review. *Frontiers in neuroscience*, 12, 1054.
33. Kohshi K, Abe H, Mizoguchi Y, Shimokobe M. Successful treatment of cervical spinal epidural abscess by combined hyperbaric oxygenation. *Mt Sinai J Med*. 2005;72(6):381-384.
34. Kurschel S, Mohia A, Weigl V, Eder HG. Hyperbaric oxygen therapy for the treatment of brain abscess in children. *Childs Nerv Syst*. 2006;22(1):38-42.
35. Serrato, PDJ, Gutierrez, A., Chacon, L., Donato, A. (2022). Frontal bilateral brain abscess, hyperbaric medicine, surgery and antimicrobial therapy in rare germ. Case report and literature review. *Neurol Neurocir Psiquiatr*, 50(3), 109-113.

## References

1. Jones J. Surgical Memoirs of the War of the Rebellion. Investigation Upon the Nature, Causes, and Treatment of Hospital Gangrene as Prevalled in the Confederate Armies 1861-1865. United States Sanitary Commision;New York, NY. p.1871.
2. Meloney FL. Hemolytic streptococcus gangrene. Arch Surg. 1924;9:317-364.
3. Wilson B. Necrotizing fasciitis. Am Surg.1952;18:416-431.
4. Soltani AM, Best MJ, Francis CS, Allan BJ, Askari M, Panthaki ZJ. Trends in the incidence and treatment of necrotizing soft tissue infections: An analysis of the national hospital discharge survey. J Burn Care Res. 2014;35:449-454.
5. Madsen MB, Skrede S, Perner A, Arnell P, Nekludov M, Bruun T, et al. Patient's characteristics and outcomes in necrotizing soft-tissue infections: Results from a Scandinavian, multicenter, prospective cohort study. Intensive Care Med. 2019;45:1241-51.
6. Shaw JJ, Psoinos C, Emhoff TA, et al. Not just full of hot air: Hyperbaric oxygen therapy increases survival in cases of necrotizing soft tissue infections. Surg Infect (Larchmt). 2014;15:328-335.
7. Kao LS, Lew DF, et al. Local variations in the epidemiology, microbiology, and outcome of necrotizing soft tissue infections: a multicenter study. Am J Surg 2011;202:139.
8. Hua C, Urbina T, Bosc R, et al. Necrotizing soft-tissue infections. Lancet Infect Dis 2022.
9. Hakkari TW, Kopari NM, Pham TN, Evans HL. Necrotizing soft tissue infections: Review and current concepts in treatment, systems of care, and outcomes. Curr Probl Surg. 2014 August;51(8):344-362.
10. Sartelli M, Guirao X, Hardcastle TC, et al. 2018 WSES/SIS-E consensus conference: recommendations for the management of skin and soft tissue infections. World J Emerg Surg. 2018;13:58.
11. Faraklas I, Yang D, et al. A Multicenter Review of Care Patterns and Outcomes in Necrotizing Soft Tissue Infections. Surgical Infections. 2016;Volume 17(6).
12. Mandell G. Bactericidal activity of aerobic and anaerobic polymorphonuclear neutrophils. Infect Immun. 1974;9:337-341.
13. Madder JT, Adams KR, Sulton TE. Infectious diseases: pathophysiology and mechanisms of hyperbaric oxygen. J Hyperbaric Med. 1987;2:133-140.
14. Hunt TK, Linsey M, Grislis G, et al. The effect of differing ambient oxygen tension on wound infection. Ann Surg. 1975 Jan;181(1):35-39.
15. Morten Hedetoft, Peter Ostrup Jensen, Claus Moser, Julie Vinkel, and Ole Hyldegaard. Hyperbaric oxygen treatment impacts oxidative stress markers in patients with necrotizing soft tissue infection. J Investig Med. 2021 Oct; 69(7): 1330-1338.
16. Ryter SW. Therapeutic potential of heme oxygenase-1 and carbon monoxide in acute organ injury, critical illness, and inflammatory disorders. Antioxidants 2020;9:1153.
17. Memar MY, Yekani M, Alizadeh N, Baghi HB. Hyperbaric oxygen therapy: Antimicrobial mechanisms and clinical application for infections. Biomed Pharmacother 2019; 109:440.
18. Park MK, Muhvich KH, Myers RA, Marsella L. Hyperoxia prolongs the aminoglycoside-induced post antibiotic effect in Pseudomonas aeruginosa. Antimicrob Agents Chemother. 1991;35(4):691-695.
19. Gozal D, Ziser A, et al. Necrotizing fasciitis. Arch Surg. 1986;121:233.
20. Anaya DA, Patchen Dellinger E. Necrotizing soft-tissue infection: diagnosis and management. Clin Infect Dis. 2007;44:705-710.
21. Miller LG, Perdreau-Remington F, Rieg G, Mehdi S, Perloth J, Bayer AS, Tang AW, Phung TO, Spellberg B. Necrotizing fasciitis caused by community-associated methicillin-resistant Staphylococcus aureus in Los Angeles. N Engl J Med. 2005;352:1445-1453.
22. Giuliano A, Lewis F, et al. Bacteriology of necrotizing fasciitis. Am J Surg.1977;1134(1):52-57.
23. Miller L, Carrick M, et al. Necrotizing fasciitis caused by community associated methicillin-resistant Staphylococcal aureus in Los Angeles. N Engl J Med. 2005;352(14):1445-1453.
24. Bryant AE, Stevens DL, et al. clostridial myonecrosis: new insights in pathogenesis and management. Curr Infect Dis Rep. 2010;12(5):383-391.
25. Stevens DL, Aldape MJ, et al. Life threatening clostridial infections. Anaerobe. 2011;18(2):254-259.
26. Stevens DL, Aldape MJ, et al. Life threatening clostridial infections. Anaerobe. 2011;18(2):254-259.
27. Eke N. Fournier's gangrene: a review of 1726 cases. Br J Surg. 2000;87:718.
28. Toro C, Castillo A, et al. Cervical necrotizing fasciitis: Report of 6 cases and review of literature. European Annals Otorhinolaryngology, Head and Neck Diseases. 2014;131:357-359.

29. US Food and Drug Administration. FDA warns about rare occurrences of a serious infection of the genital area with SGLT2 inhibitors for diabetes. <https://www.fda.gov/downloads/Drugs/DrugSafety/UCM618466.pdf> (Accessed on October 05, 2018).
30. Flanagan C, Daramola O, et al. Surgical debridement and adjunctive hyperbaric oxygen in cervical necrotizing fasciitis. *Otorhinolaryngology, Head and Neck Diseases*. 2009;140 (5):730-4.
31. Stevens DL, Bryant AE. Necrotizing soft tissue infections. *N Engl J Med*. 2017;377:2253.
32. Shiroff A, Herlitz G, Gracias V. Necrotizing soft tissue infections. *J Intensive Care Med*. 2014;29(3):138-144.
33. Darenberg J, Luca-Harari B, et al. Molecular and clinical characteristics of invasive GAS infection in Sweden. *Clin Infect Dis*. 2007;45:450. Copyright © 2019 Undersea and Hyperbaric Medical Society, Inc.
34. Hau V, Ho CO. Necrotizing fasciitis caused by *Vibrio vulnificans* in the lower limb following exposure to seafood on the hand. *Hong Kong Med J*. 2011;17:335.
35. Goodell J, Jordan M, et al. Rapidly advancing necrotizing fasciitis caused by *Phytobacterium (Vibrio) damsela*: a hyperaggressive variant. *Crit Care Med*. 2004;32(1):278-281.
36. Brogan TV, Nizet V, Waldhausen JHT, Rubens CE, Clarke W. Group A streptococcal necrotizing fasciitis complicating primary varicella: a series of fourteen patients. *Pediatr Infect Dis J*. 1995;14:588-594.
37. Stevens DL, Bryant AE, et al. Necrotizing soft tissue infections. *N Engl J Med*. 2017;377:2253.
38. Stevens DL. Could nonsteroidal anti-inflammatory drugs (NSAIDs) enhance the progression of bacterial infections to toxic shock syndrome? *Shock*. 2013;21(4):977-980.
39. Hamilton SM, Bayer CR, Stevens DL, and Bryant AE. Effects of selective and nonselective nonsteroidal anti-inflammatory drugs on antibiotic efficacy of experimental Group A Streptococcal myonecrosis. *Jour Infect Dis*. 2014; 209:1429-1435.
40. LaRock CN, Todd J, LaRock DL et al. IL-1 $\beta$  is an innate immune sensor of microbial proteolysis. *Sci. Immunol*. 2016;1,eaah3539.
41. Sawin RS, Schaller RT, Tapper D, Morgan A, Cahill J. Early recognition of neonatal abdominal wall necrotizing fasciitis. *Am J Surg*. 1994;167:481-484.
42. Baker-Austin C, Oliver JD. *Vibrio vulnificans*: new insights into a deadly opportunistic pathogen. *Environ Microbiol* 2018; 20:423.
43. Nigro OD, James-Davis LI, De Carlo EH, et al. Variable Freshwater Influences on the Abundance of *Vibrio vulnificans* in a Tropical Urban Estuary. *Appl Environ Microbiol* 2022; 88:e0188421.
44. Wang TL, Hung CR. Role of tissue oxygen saturation monitoring in diagnosing necrotizing fasciitis of the lower limbs. *Ann Emerg Med*. 2004;44:222-228.
45. Lally KP, Atkinson JB, Wooley MM, Mahour GH. Necrotizing fasciitis: a serious sequela of omphalitis in the newborn. *Ann Surg*. 1984;199:101-103.
46. Sawin RS, Schaller RT, Tapper D, Morgan A, Cahill J. Early recognition of neonatal abdominal wall necrotizing fasciitis. *Am J Surg*. 1994;167:481-484.
47. Keung E, Liu X, et al. Immunocompromised status in patients with necrotizing soft tissue infections. *JAMA Surg*. 2013;148(5):419-426.
48. Stamenkovic I, Lew PD. Early recognition of potentially fatal necrotizing fasciitis: the use of frozen-section biopsy. *N Engl J Med*. 1984;310:1689-1693.
49. Horn CB, Wesp BM, Fiore NB, et al. Fungal Infections Increase the Mortality Rate Three-Fold in Necrotizing Soft-Tissue Infections. *Surg Infect (Larchmt)* 2017; 18:793.
50. Carbonetti F, Cremona A, et al. The role of contrast enhanced computed tomography in the diagnosing of necrotizing fasciitis and comparison with the Laboratory risk indicator for Necrotizing fasciitis (LRINEC). *Radiol Med*. 2016 Feb;121(2):106-121.
51. Wysoki MG, Santora TA, Shah RM, Friedman AC. Necrotizing fasciitis: CT characteristics. *Radiology*. 1997;203:859-863.
52. Wu PH, Wu KH, Hsiao CT, et al. Utility of modified Laboratory Risk Indicator for Necrotizing Fasciitis (MLRINEC) score in distinguishing necrotizing from non-necrotizing soft tissue infections. *World J Emerg Surg* 2021; 16:26.
53. Bruls RJM, Kwee RM. CT in necrotizing soft tissue infection: diagnostic criteria and comparison with LRINEC score. *Eur Radiol* 2021; 31:8536.
54. Wong C, Khin L, et al. The LRINEC (laboratory risk indicator for necrotizing fasciitis) score: a tool for distinguishing necrotizing fasciitis from other soft tissue infections. *Crit Care Med*. 2004;32(7):1535-1541.
55. Fernando SM, Tran A, Cheng W, et al. Necrotizing Soft Tissue Infection: Diagnostic Accuracy of Physical Examination, Imaging, and LRINEC Score: A Systematic Review and Meta-Analysis. *Ann Surg* 2019; 269:58.

56. Bechar J, Sepehrpour S, et al. Laboratory risk indicator for necrotizing fasciitis (LRINEC) score for the assessment of early necrotizing fasciitis: a systematic review of the literature. *Ann R Coll Surg Engl.* 2017;99:341-346.
57. Borschitz T, Schlicht S, et al. Improvement of a clinical score for necrotizing fasciitis: 'pain out of proportion' and high CRP levels aid the diagnosis. *PLoS One* 2015;10(7):e0132775.
58. Hansen MB, Rasmussen LS, et al. Association between cytokine response, the LRINEC score and outcome in patients with necrotizing soft tissue infection: a multicenter, prospective study. *Sci Rep.* 2017; 7:42179.
59. Stevens DL, Bisno AL, et al. Practice guidelines for the diagnosis and management of skin and soft tissue infections:2014 update by the infectious diseases society of America. *Clin Infect Dis.* 2014;59:147.
60. Bruun T, Rath E, Madsen MB, et al. Risk Factors and Predictors of Mortality in Streptococcal Necrotizing Soft-tissue Infections: A Multicenter Prospective Study. *Clin Infect Dis* 2021; 72:293.
61. Faraklas I, Yang D, et al. A Multicenter Review of Care Patterns and Outcomes in Necrotizing Soft Tissue Infections. *Surgical Infections.* 2016; Volume 17(6).
62. Sablier F, Slaouti T, et al. Nosocomial transmission of necrotizing fasciitis. *Lancet.* 2010;375:1052.
63. Thrane, Jens Fauni, Ovesen, Therese. Scarce evidence of efficacy of hyperbaric oxygen therapy in necrotizing soft tissue infection: a systematic review. *Infectious Disease.* 2019 March;51(7):485-492.
64. Gore M. Odontogenic necrotizing fasciitis: a systematic review of the literature. *BMC Ear, Nose and Throat Disorders.* 2018;18:14.
65. Millar IL, Lind FG, Jansson K-A, Hájek M, Smart DR, Fernandes TD, McGinnes RA, Williamson OD, Miller RK, Martin CA, Gabbe BJ, Myles PS, Cameron PA. Hyperbaric Oxygen for Lower Limb Trauma (HOLLT): an international multicenter randomized clinical trial. *Diving and Hyperbaric Medicine.* 2022 30 September;52(3):164–174.
66. Wilkinson D, Doolette D. Hyperbaric oxygen treatment and survival from necrotizing soft tissue infection. *Arch Surg.* 2004;139:1339-1345.
67. Escobar SJ, Slade JB, Hunt TK, Cianci P. Adjuvant hyperbaric oxygen therapy (HBO2) for treatment of necrotizing fasciitis reduces mortality and amputation rate. *Undersea Hyperb Med.* 2006;32(6):437-443.
68. Brown DR, Davis NL, Lepawsky M, Cunningham J, Kortbeek J. A multicenter review of the treatment of major truncal necrotizing infections with and without hyperbaric oxygen therapy. *Am J Surg.* 1994;167:485-489.
69. Monestersky JH, Myers RAM. Letter to the editor: hyperbaric oxygen treatment of necrotizing fasciitis. *Am J Surg.* 1995;169:187-188.
70. Anaya DA, McMahan K, Nathens AB, Sullivan SR, Foy H, Bulger E. Predictors of mortality and limb loss in necrotizing soft tissue infections. *Arch Surg.* 2005;140:151-157.
71. McHenry CR, Piotrowski JJ, Petrinic D, Malangoni MA. Determinants of mortality for necrotizing soft-tissue infections. *Ann Surg.* 1995;221:558-563.
72. Hedetoft, Morten, Bennett, Michael, Hyldegaard, Ole. Adjunctive hyperbaric oxygen for necrotizing soft tissue infections: a systematic review and meta-analysis. *Diving Hyperbaric Med.* 2021. Mar; 51(1):34-43.
73. Hsieh WH, Yang, PH, Chao HC, Lai JY. Neonatal necrotizing fasciitis: report of 3 cases and review of the literature. *Pediatrics.* 1999;103(4):e53. Available at: <http://pediatrics.aappublications.org/cgi/content/full/103/4/e53>
74. Lally KP, Atkinson JB, Wooley MM, Mahour GH. Necrotizing fasciitis: a serious sequela of omphalitis in the newborn. *Ann Surg.* 1984;199:101-103.
75. Sawin RS, Schaller RT, Tapper D, Morgan A, Cahill J. Early recognition of neonatal abdominal wall necrotizing fasciitis. *Am J Surg.* 1994;167:481-484.
76. Laor E, Palmer LS, Tolia BM. Outcome prediction in patients with Fournier's gangrene. *J Urol.* 1995;154:89-92.
77. Dahm P, Roland FH, Vaslef SN, Moon RE, Price DT, Georgiade GS, Viewig J. Outcome analysis in patients with primary necrotizing fasciitis of the male genitalia. *Urol.* 2000;56:31-36.
78. Michele Altomare, Laura Benuzzi, Mattia Molteni, Francesco Virdis, Andrea Spota, Stefano Piero Bernardo Cioffi, Elisa Reitano, Federica Renzi, Osvaldo Chiara, Giovanni Sesana, and Stefania Cimbanassi. Negative Pressure Wound Therapy for the Treatment of Fournier's Gangrene: A rare case with rectal fistula and Systematic Review of the Literature. *J Pers Med.* 2022 Oct; 12 (10) 1695.
79. Mallikarjuna M, Vijayakumar A, et al. Fournier's gangrene: current practices. *ISRN Surgery* 2012(ID 942437):1-8.
80. Hollabaugh RS, Dmochowski RR, Hickerson WL. Fournier's gangrene: therapeutic impact of hyperbaric oxygen. *Plast Reconstr Surg.* 1998;101:94-100.
81. Willy C, Rieger H, et al. Hyperbaric oxygen therapy for NSTI. *Chirurg* 2012;83:960.
82. Eggerstedt M, Gamelli RL, et al. The care of necrotizing soft tissue infections. Patterns of definitive intervention at a large referral center. *J Burn Care Res.* 2015;36:105-110.
83. Holena DN, Mills AM, et al. Transfer status: A risk factor for mortality in patients with necrotizing fasciitis. *Surgery.* 2011;150:363-370.

84. Davaney B, Frawley G, et al. Necrotising soft tissue infections: the effect of hyperbaric oxygen on mortality. *Anaesth Intensive Care*. 2015;43:6.
85. Trond Bruun, Eivind Rath, Martin Bruun Madsen, Oddvar Oppegaard, Michael Nekludov, Per Arnell, Ylva Karlsson, Anshu Babbar, Francois Bergey, Andreas Itzek, Ole Hyldegaard, Anna Norrby-Teglund, Steinar Skrede, and INFECT Study Group. Risk factors and predictors of mortality in Streptococcal Necrotising Soft tissue Infections: A multicenter prospective study. *Clin Infect Dis*. 2021 Jan 15; 72(2): 293–300.
86. Shaw JJ, Psoinos C, Emhoff TA, et al. Not just full of hot air: Hyperbaric oxygen therapy increases survival in cases of necrotizing soft tissue infections. *Surg Infect (Larchmt)*. 2014;15:328-335.
87. Shaw JJ, Psoinos C, Emhoff TA, et al. Not just full of hot air: Hyperbaric oxygen therapy increases survival in cases of necrotizing soft tissue infections. *Surg Infect (Larchmt)*. 2014;15:328-335.
88. Parks T, Wilson C, Curtis N, et al. Polyspecific Intravenous Immunoglobulin in Clindamycin-treated Patients With Streptococcal Toxic Shock Syndrome: A Systematic Review and Meta-analysis. *Clin Infect Dis* 2018; 67:1434.
89. Torp KD, Carraway MS. Safe administration of hyperbaric oxygen after bleomycin:a case series of 15 patients. *Undersea Hyperb Med*. 2012;39:873.
90. Karagoz B, Suleymanoglu S, et al. Hyperbaric Oxygen therapy does not potentiate doxorubicin-induced cardiotoxicity in rats. *Basic Clin Pharmacol Toxicol*. 2008;102:287

## References

1. CMS. National Coverage Determination (NCD) for Hyperbaric Oxygen Therapy (20.29). 2017. Last access May 12, 2023 at <https://www.cms.gov/medicare-coverage-database/view/ncd.aspx?NCDId=12&ncdver=4&bc=AAAAAgAAAAAA&>.
2. Perrins DJD, et al. OHP in the management of chronic osteomyelitis. In third international conference on hyperbaric medicine. Washington D.C.: National Academy of Sciences-National Research Council;1966.
3. Slack WK, Thomas DA, Perrins D. Hyperbaric oxygenation chronic osteomyelitis. *Lancet*. 1965;14:1093-4.
4. Hamblen DL. Hyperbaric oxygenation. Its effect on experimental staphylococcal osteomyelitis in rats. *J Bone Joint Surg Am*. 1968;50(6):1129-41.
5. Sippel HW, Nyberg CD, Alvis HJ. Hyperbaric oxygen as an adjunct to the treatment of chronic osteomyelitis of the mandible: report of case. *J Oral Surg*. 1969;27(9):739-41.
6. Niinikoski J, Hunt TK. Oxygen tensions in healing bone. *Surg Gynecol Obstet*. 1972;134(5):746-50.
7. Mader JT, et al. A mechanism for the amelioration by hyperbaric oxygen of experimental staphylococcal osteomyelitis in rabbits. *J Infect Dis*. 1980;142(6):915-22.
8. Park MK, Myers RA, Marzella L. Oxygen tensions and infections: modulation of microbial growth, activity of antimicrobial agents, and immunologic responses. *Clin Infect Dis*. 1992;14(3):720-40.
9. Hohn DC. Oxygen and leukocyte microbial killing, in hyperbaric oxygen therapy. Davis JC, Hunt TK eds. Bethesda, Maryland: Undersea Medical Society; 1977. Pp.101-10.
10. Kindwall EP. Uses of hyperbaric oxygen therapy in the 1990s. *Cleve Clin J Med*. 1992;59(5):517-28.
11. Esterhai Jr, JL, et al. Effect of hyperbaric oxygen exposure on oxygen tension within the medullary canal in the rabbit tibial osteomyelitis model. *J Orthop Res*.1986;4(3):330-6.
12. Verklin Jr, RM, Mandell GL. Alteration of effectiveness of antibiotics by anaerobiosis. *J Lab Clin Med*. 1977;89(1):65-71.
13. Mader JT, Adams KR, Couch LA. Potentiation of tobramycin by hyperbaric oxygen in experimental *Pseudomonas aeruginosa* osteomyelitis. In 27th interscience conference on antimicrobial agents and chemotherapy. New York;1997.
14. Mader JT, et al. Hyperbaric oxygen as adjunctive therapy for osteomyelitis. *Infect Dis Clin North Am*.1990;4(3):433-40.
15. Mendel V, et al. Therapy with hyperbaric oxygen and cefazolin for experimental osteomyelitis due to *Staphylococcus aureus* in rats. *Undersea Hyperb Med*. 1999;26(3):169-74.
16. Mader J, Shirliff M, Calhoun JH. The use of hyperbaric oxygen in the treatment of osteomyelitis. In hyperbaric medicine practice. Kindwall EP, Whelan HT, eds. Flagstaff, AZ: Best Publishing Company, 1999. Pp.603-616.
17. Sugihara A, et al. The effect of hyperbaric oxygen therapy on the bout of treatment for soft tissue infections. *J Infect*. 2004;48(4):330-3.
18. Mader JT, Ortiz M, Calhoun JH. Update on the diagnosis and management of osteomyelitis. *Clin Podiatr Med Surg*. 1996;13(4):701-24.
19. Coulson DB, Ferguson Jr, AB, Diehl Jr, RC. Effect of hyperbaric oxygen on the healing femur of the rat. *Surg Forum*. 1966;17:449-50.
20. Niinikoski J, Penttinen R, Kulonen K. Effect of hyperbaric oxygenation on fracture healing in the rat: a biochemical study. *Calcif Tissue Res*. 1970;p.Suppl:115-6.
21. Penttinen R. Biochemical studies on fracture healing in the rat, with special reference to the oxygen supply. *Acta Chir Scand Suppl*. 1972;432:1-32.
22. Yablon IG, Cruess RL. The effect of hyperbaric oxygen on fracture healing in rats. *J Trauma*. 1968;8(2):186-202.
23. Steed DL. Enhancement of osteogenesis with hyperbaric oxygen therapy. A clinical study. *J Dent Res*.1982;61A: 288.
24. Ueng SW, et al. Bone healing of tibial lengthening is enhanced by hyperbaric oxygen therapy: a study of bone mineral density and torsional strength on rabbits. *J Trauma*.1998;44(4):676-81.
25. Sawai T, et al. Histologic study of the effect of hyperbaric oxygen therapy on autogenous free bone grafts. *J Oral Maxillofac Surg*.1996;54(8):975-81.
26. Jones Jr, JP. The effect of hyperbaric oxygen on osteonecrosis. Anaheim, CA: Orthopaedic Research Society;1991.
27. Strauss MB. Effect of hyperbaric oxygen on bone resorption in rabbits. In seventh annual conference on the clinical applications of hyperbaric oxygen. Anaheim, CA; 1982.
28. Strauss MB, Bryant B. Hyperbaric oxygen. *Orthopedics*. 2002;25(3):303-10.
29. Skyhar MJ, et al. Hyperbaric oxygen reduces edema and necrosis of skeletal muscle in compartment syndromes associated with hemorrhagic hypotension. *J Bone Joint Surg Am*. 1986;68(8):1218-24.



30. Strauss MB, et al. Reduction of skeletal muscle necrosis using intermittent hyperbaric oxygen in a model compartment syndrome. *J Bone Joint Surg Am.* 1983;65(5):656-62.
31. Zamboni WA, et al. Morphologic analysis of the microcirculation during reperfusion of ischemic skeletal muscle and the effect of hyperbaric oxygen. *Plast Reconstr Surg.* 1993;91(6):1110-23.
32. Nylander G, et al. Reduction of postischemic edema with hyperbaric oxygen. *Plast Reconstr Surg.* 1985;76(4):596-603.
33. Hunt TK, Halliday B, Knighton DR.. Impairment of microbicidal function in wounds: correction with oxygenation, in soft and hard tissue repair. Hunt TK, Heppenstall RB, Pines E, eds. Praeger: New York; 1984;455-68.
34. Hohn DC, et al. Effect of O<sub>2</sub> tension on microbicidal function of leukocytes in wounds and in vitro. *Surg Forum.* 1976;27(62):18-20.
35. Hunt TK, Pai MP. The effect of varying ambient oxygen tensions on wound metabolism and collagen synthesis. *Surg Gynecol Obstet.* 1972;135(4):561-7.
36. Connolly WB, et al. Influence of distant trauma on local wound infection. *Surg Gynecol Obstet.* 1969;128:713-8.
37. Wald ER. Risk factors for osteomyelitis. *Am J Med.* 1985;78(6B):206-12.
38. Le Saux N, et al. Shorter courses of parenteral antibiotic therapy do not appear to influence response rates for children with acute hematogenous osteomyelitis: a systematic review. *BMC Infect Dis.* 2002;2:16.
39. Lew DP, Waldvogel FA. Osteomyelitis. *Lancet.* 2004;364(9431):369-79.
40. Davis JC, Heckman JD. Refractory osteomyelitis, in problem wounds: the role of oxygen. Davis JC, Hunt TK, eds. New York: Elsevier Science Publishing Co., Inc.; 1988. Pp.125-142.
41. Attinger C, Cooper P. Soft tissue reconstruction for calcaneal fractures or osteomyelitis. *Orthop Clin North Am.* 2001;32(1):135-70.
42. Lazzarini L, Lipsky BA, Mader JT. Antibiotic treatment of osteomyelitis: what have we learned from 30 years of clinical trials? *Int J Infect Dis.* 2005;9(3):127-38.
43. Zalavras CG, Singh A, Patzakis MJ. Novel technique for medullary canal debridement in tibia and femur osteomyelitis. *Clin Orthop Relat Res.* 2007;461:31-4.
44. Thonse R, Conway J. Antibiotic cement-coated interlocking nail for the treatment of infected nonunions and segmental bone defects. *J Orthop Trauma.* 2007;21(4):258-68.
45. Kocaoglu M, et al. Reconstruction of segmental bone defects due to chronic osteomyelitis with use of an external fixator and an intramedullary nail. *J Bone Joint Surg Am.* 2006;88(10):2137-45.
46. Chen F, et al. [The treatment of deep wound infection after posterior thoracic and lumbar instrumentation]. *Zhonghua Wai Ke Za Zhi.* 2005;43(20):1325-7.
47. Varzos PN, et al. Chronic osteomyelitis associated with monofilament wire fixation. *J Foot Surg.* 1983;22(3):212-7.
48. Chang WC, et al. Successful treatment of extended epidural abscess and long segment osteomyelitis: a case report and review of the literature. *Surg Neurol.* 2008 Feb;69(2):117-20. Note original 2007 citation was for an Epub.
49. Barbarossa V, et al. Treatment of osteomyelitis and infected non-union of the femur by a modified Ilizarov technique: follow-up study. *Croat Med J.* 2001;42(6):634-41.
50. Pappou IP, et al. Postoperative infections in interbody fusion for degenerative spinal disease. *Clin Orthop Relat Res.* 2006;444:120-8.
51. Talmi YP, et al. Postsurgical prevertebral abscess of the cervical spine. *Laryngoscope.* 2000;110(7):1137-41.
52. Przybylski GJ, Sharan AD. Single-stage autogenous bone grafting and internal fixation in the surgical management of pyogenic discitis and vertebral osteomyelitis. *J Neurosurg.* 2001;94(1 Suppl):1-7.
53. May Jr. JW, Gallico III, GG, Lukash FN. Microvascular transfer of free tissue for closure of bone wounds of the distal lower extremity. *N Engl J Med.* 1982;306(5):253-7.
54. Steinlechner CW, Mkandawire NC. Nonvascularised fibular transfer in the management of defects of long bones after sequestrectomy in children. *J Bone Joint Surg Br.* 2005;87(9):1259-63.
55. Simard S, Marchant M, Mencio G. The Ilizarov procedure: limb lengthening and its implications. *Phys Ther.* 1992;72(1):25-34.
56. Daver NG, et al. Oral step-down therapy is comparable to intravenous therapy for *Staphylococcus aureus* osteomyelitis. *J Infect.* 2007;54(6):539-44.
57. Aneziokoro CO, et al. The effectiveness and safety of oral linezolid for the primary and secondary treatment of osteomyelitis. *J Chemother.* 2005;17(6):643-50.
58. Cole WG, Dalziel RE, Leitel S. Treatment of acute osteomyelitis in childhood. *J Bone Joint Surg Br.* 1982;64(2):218-23.
59. Gentry LO. Overview of osteomyelitis. *Orthop Rev.* 1987;16(4):255-8.
60. Ketterl R, et al. Use of ofloxacin in open fractures and in the treatment of post-traumatic osteomyelitis. *J Antimicrob Chemother.* 1988;22 (Supp.C):159-66.
61. Lamp KC, et al. Clinical experience with daptomycin for the treatment of patients with osteomyelitis. *Am J Med.* 2007;120(10 Sup p.1):S13-20.

62. Miller,DJ, Mejicano GC, Vertebral osteomyelitis due to Candida species: case report and literature review. Clin Infect Dis. 2001;33(4):523-30.
63. Petersen S, et al. Acute haematogenous osteomyelitis and septic arthritis in childhood. A 10-year review and follow-up. Acta Orthop Scand.1980;51(3):451-7.
64. Powers T, Bingham DH. Clinical and economic effect of ciprofloxacin as an alternative to injectable antimicrobial therapy. Am J Hosp Pharm. 1990;47(8):1781-4.
65. Rayner CR et al. Linezolid in the treatment of osteomyelitis: results of compassionate use experience. Infection. 2004;32(1):8-14.
66. Schurman DJ, Dillingham M. Clinical evaluation of cefoxitin in treatment of infections in 47 orthopedic patients. Rev Infect Dis.1979;1(1):206-9.
67. Stefanovski N, Van Voris LP. Pyogenic vertebral osteomyelitis: report of a series of 23 patients. Contemp Ortho. 1995;31(3):159-64.
68. Stratov I, Korman TM, Johnson PD. Management of Aspergillus osteomyelitis: report of failure of liposomal amphotericin B and response to voriconazole in an immunocompetent host and literature review. Eur J Clin Microbiol Infect Dis. 2003;22(5):277-83.
69. Bingham EL, Hart GB. Hyperbaric oxygen treatment of refractory osteomyelitis. Postgrad Med. 1977;61(6):70-6.
70. Depenbusch FL, hompson RE, Hart GB. Use of hyperbaric oxygen in the treatment of refractory osteomyelitis: a preliminary report. J Trauma. 1972;12(9):807-12.
71. Davis JC, et al. Chronic non-hematogenous osteomyelitis treated with adjuvant hyperbaric oxygen. J Bone Joint Surg Am. 1986;68(8):1210-7.
72. Morrey BF, et al. Hyperbaric oxygen and chronic osteomyelitis. Clin Orthop Relat Res.1979(144):121-7.
73. Sheps SB. Hyperbaric oxygen for osteomyelitis and osteoradionecrosis. Vancouver: University of British Columbia;1992. Pp.1-21.
74. Senneville E, et al. Effectiveness and tolerability of prolonged linezolid treatment for chronic osteomyelitis: a retrospective study. Clin Ther. 2006;28(8):1155-63.
75. Priest DH, Peacock, Jr JE. Hematogenous vertebral osteomyelitis due to Staphylococcus aureus in the adult: clinical features and therapeutic outcomes. South Med J. 2005;98(9):854-62.
76. Gomez J, et al. [Orthopedic implant infection: prognostic factors and influence of long-term antibiotic treatment on evolution. Prospective study, 1992-1999]. Enferm Infecc Microbiol Clin. 2003;21(5):232-6.
77. Eckardt JJ, Wirganowicz PZ, Mar T. An aggressive surgical approach to the management of chronic osteomyelitis. Clin Orthop Relat Res.1994(298):229-39.
78. Hall BB, Fitzgerald, Jr.,RH, Rosenblatt JE. Anaerobic osteomyelitis. J Bone Joint Surg Am. 1983;65(1):30-5.
79. Marx RE. Chronic osteomyelitis of the jaws. Oral Maxillofac Surg Clin North Am.1991;3:367-81.
80. Mercuri LG. Acute osteomyelitis of the jaws. Oral Maxillofac Surg Clin North Am.1991;3:355-65.
81. Mader JT, et al. Antimicrobial treatment of chronic osteomyelitis. Clin Orthop Relat Res.1999(360):47-65.
82. Waldvogel FA, Medoff G, Swartz MN. Osteomyelitis: a review of clinical features, therapeutic considerations and unusual aspects (second of three parts). N Engl J Med. 1970;282(5):260-6.
83. Gomis M, et al. Oral ofloxacin versus parenteral imipenem-cilastatin in the treatment of osteomyelitis. Rev Esp Quimioter.1999;12(3):244-9.
84. Mader JT, Cantrell JS, Calhoun J. Oral ciprofloxacin compared with standard parenteral antibiotic therapy for chronic osteomyelitis in adults. J Bone Joint Surg Am. 1990;72(1):104-10.
85. Gentry LO, Rodriguez-Gomez G. Ofloxacin versus parenteral therapy for chronic osteomyelitis. Antimicrob Agents Chemother. 1991;35(3):538-41.
86. Jauregui LE, Hageage G, Martin M. Oral enoxacin versus conventional intravenous antimicrobial therapy for chronic osteomyelitis. J Chemother.1989;1(4 Suppl):735-6.
87. Swiontkowski MF, et al. A comparison of short- and long-term intravenous antibiotic therapy in the postoperative management of adult osteomyelitis. J Bone Joint Surg Br. 1999;81(6):1046-50.
88. Spencer,CH. Bone and joint infections in children. Curr Opin Rheumatol. 1998;10(5):494-7.
89. Tetzlaff TR, McCracken Jr. GH, Nelson JD. Oral antibiotic therapy for skeletal infections of children. II. Therapy of osteomyelitis and suppurative arthritis. J Pediatr. 1978;92(3):485-90.
90. Wall EJ. Childhood osteomyelitis and septic arthritis. Curr Opin Pediatr. 1998;10(1):73-6.
91. Higuchi T, et al. Preliminary report of the safety and efficacy of hyperbaric oxygen therapy for specific complications of lung transplantation. J Heart Lung Transplant.2006;25(11):1302-9.
92. Larsson A,et al. Hyperbaric oxygen treatment of postoperative neurosurgical infections. Neurosurgery. 2002;50(2): 287-95; discussion 295-6.

93. Lucente FE, Parisier SC, Som PM. Complications of the treatment of malignant external otitis. *Laryngoscope*.1983;93(3):279-81.
94. Waldvogel FA, Medoff G, Swartz MN. Osteomyelitis: a review of clinical features, therapeutic considerations and unusual aspects. *N Engl J Med*.1970;282(4):198-206.
95. Waldvogel FA, Medoff G, Swartz MN. Osteomyelitis: a review of clinical features, therapeutic considerations and unusual aspects. Osteomyelitis associated with vascular insufficiency. *N Engl J Med*. 1970;282(6):316-22.
96. Ger R. Muscle transposition for treatment and prevention of chronic post-traumatic osteomyelitis of the tibia. *J Bone Joint Surg Am*. 1977;59(6):784-91.
97. Gordon L, Chiu EJ. Treatment of infected nonunions and segmental defects of the tibia with staged microvascular muscle transplantation and bone-grafting. *J Bone Joint Surg Am*. 1988;70(3):377-86.
98. Kelly PJ. Infected nonunion of the femur and tibia. *Orthop Clin North Am*. 1984;15(3):481-90.
99. May Jr. JW, et al. Clinical classification of posttraumatic tibial osteomyelitis. *J Bone Joint Surg Am*. 1989;71(9):1422-8.
100. Weiland AJ, Moore JR, Daniel RK. The efficacy of free tissue transfer in the treatment of osteomyelitis. *J Bone Joint Surg Am*. 1984;66(2):181-93.
101. Mader JT, Shirliff M, Calhoun JH. Staging and staging application in osteomyelitis. *Clin Infect Dis*. 1997;25(6):1303-9.
102. Cierny III G, Mader JT, Penninck JJ. A clinical staging system for adult osteomyelitis. *Clin Orthop Relat Res*. 2003(414):7-24.
103. Fanning WJ, Vasko JS, Kilman JW. Delayed sternal closure after cardiac surgery. *Ann Thorac Surg*. 1987;44(2):169-72.
104. Clarkson JH, et al. Our experience using the vertical rectus abdominis muscle flap for reconstruction in 12 patients with dehiscence of a median sternotomy wound and mediastinitis. *Scand J Plast Reconstr Surg Hand Surg*. 2003;37(5):266-71.
105. Farinas MC, et al. Suppurative mediastinitis after openheart surgery: a case-control study covering a seven-year period in Santander, Spain. *Clin Infect Dis*. 1995;20(2):272-9.
106. Athanassiadi K, et al. Omental transposition: the final solution for major sternal wound infection. *Asian Cardiovasc Thorac Ann*. 2007;15(3):200-3.
107. Rezaei AR, et al. Contemporary management of spinal osteomyelitis. *Neurosurgery*. 1999;44(5):1018-25; discussion 1025-6.
108. Osei-Yeboah C, et al. Osteomyelitis of the frontal bone. *Ghana Med J*. 2007;41(2):88-90.
109. Blomstedt GC. Craniotomy infections. *Neurosurg Clin N Am*. 1992;3(2):375-85.
110. Malone DG, et al. Osteomyelitis of the skull base. *Neurosurgery*. 1992;30(3):426-31.
111. Stieg PE, Mulliken JB. Neurosurgical complications in craniofacial surgery. *Neurosurg Clin N Am*. 1991;2(3):703-8.
112. Gallagher RM, Gross CW, Phillips CD. Suppurative intracranial complications of sinusitis. *Laryngoscope*. 1998;108(11 Pt 1):1635-42.
113. Lucente FE et al. Malignant external otitis: a dangerous misnomer? *Otolaryngol Head Neck Surg*.1982;90(2):266-9.
114. Tisch M, Maier H. [Malignant external otitis]. *Laryngorhinootologie*. 2006;85(10):763-9; quiz 770-3.
115. Bhandary, S, Karki P, Sinha BK. Malignant otitis externa: a review. *Pac Health Dialog*. 2002;9(1):64-7.
116. Slattery III, WH, Brackmann DE. Skull base osteomyelitis. Malignant external otitis. *Otolaryngol Clin North Am*. 1996;29(5):795-806.
117. Triplett RG, et al. Experimental mandibular osteomyelitis: therapeutic trials with hyperbaric oxygen. *J Oral Maxillofac Surg*.1982;40(10):640-6.
118. Mendel V, Simanowski HJ, Scholz H. Synergy of HBO2 and a local antibiotic carrier for experimental osteomyelitis due to *Staphylococcus aureus* in rats. *Undersea Hyperb Med*.2004;31(4):407-16.
119. Mader JT, et al. Therapy with hyperbaric oxygen for experimental osteomyelitis due to *Staphylococcus aureus* in rabbits. *J Infect Dis*. 1978;138(3):312-8.
120. Triplett RG, Branham GB. Treatment of experimental mandibular osteomyelitis with hyperbaric oxygen and antibiotics. *Int J Oral Surg*. 1981;10(Sup p.1):178-82.
121. Esterhai Jr. JL, et al. Adjunctive hyperbaric oxygen therapy in the treatment of chronic refractory osteomyelitis. *J Trauma*. 1987;27(7):763-8.
122. Esterhai Jr. JL, et al. Treatment of chronic osteomyelitis complicating nonunion and segmental defects of the tibia with open cancellous bone graft, posterolateral bone graft, and soft-tissue transfer. *J Trauma*. 1990;30(1):49-54.
123. MacGregor RR, Graziani AL, Esterhai JL. Oral ciprofloxacin for osteomyelitis. *Orthopedics*. 1990;13(1):55-60.

124. Barili F, et al. Role of hyperbaric oxygen therapy in the treatment of postoperative organ/space sternal surgical site infections. *World J Surg.* 2007;31(8):1702-6.
125. Welsh FML, Matos LU, deTreville TP. Medical hyperbaric oxygen therapy: 22 cases. *Aviat Space Environ Med.* 1980;51(6):611-4.
126. Eltorai I, Hart GB, Strauss MB. Osteomyelitis in the spinal cord injured: a review and a preliminary report on the use of hyperbaric oxygen therapy. *Paraplegia.* 1984;22(1):17-24.
127. Maynor ML, et al. Chronic osteomyelitis of the tibia: treatment with hyperbaric oxygen and autogenous microsurgical muscle transplantation. *J South Orthop Assoc.* 1998;7(1):43-57.
128. Chen CY, et al. Chronic refractory tibia osteomyelitis treated with adjuvant hyperbaric oxygen: a preliminary report. *Changeng Yi Xue Za Zhi.* 1998;21(2):165-71.
129. Chen CE, et al. Hyperbaric oxygen therapy in the treatment of chronic refractory osteomyelitis: a preliminary report. *Chang Gung Med J.* 2003;26(2):114-21.
130. Chen CE, et al. Results of chronic osteomyelitis of the femur treated with hyperbaric oxygen: a preliminary report. *Chang Gung Med J.* 2004;27(2):91-7.
131. Calhoun KH, et al. Osteomyelitis of the mandible. *Arch Otolaryngol Head Neck Surg.* 1988;114(10):1157-62.
132. Jamil MU, Eckardt A, Franko W. [Hyperbaric oxygen therapy. Clinical use in treatment of osteomyelitis, osteoradionecrosis and reconstructive surgery of the irradiated mandible]. *Mund Kiefer Gesichtschir.* 2000;4(5):320-3.
133. Handschel J, et al. Evaluation of hyperbaric oxygen therapy in treatment of patients with osteomyelitis of the mandible. *Mund Kiefer Gesichtschir;* 2007.
134. Lentrodt S, et al. Hyperbaric oxygen for adjuvant therapy for chronically recurrent mandibular osteomyelitis in childhood and adolescence. *J Oral Maxillofac Surg.* 2007;65(2):186-91.
135. Mainous EG. Hyperbaric oxygen in maxillofacial osteomyelitis, osteoradionecrosis, and osteogenesis enhancement. In hyperbaric oxygen therapy. Davis JC, Hunt TK, eds. Bethesda, Maryland: Undersea Medical Society; 1977. Pp.191-203.
136. Van Merkesteyn JP, et al. Hyperbaric oxygen treatment of chronic osteomyelitis of the jaws. *Int J Oral Surg.* 1984; 13(5):386-95.
137. Aitasalo K, et al. A modified protocol for early treatment of osteomyelitis and osteoradionecrosis of the mandible. *Head Neck.*1998;20(5):411-7.
138. Carragee EJ, et al. The clinical use of erythrocyte sedimentation rate in pyogenic vertebral osteomyelitis. *Spine.*1997;22(18):2089-93.
139. Kovalenko DG, Savchenko AV, Milovanova EM. [Osteoplasty in surgical treatment of hematogenous osteomyelitis of the spine]. *Vestn Khir Im I I Grek.* 1978;120(3):89-93.
140. Ibarra S, et al. [Osteomyelitis of the frontal bone (Pott's puffy tumor). A report of 5 patients]. *Enferm Infecc Microbiol Clin.*1999;17(10):489-92.
141. Balm AJ, Tiwari RM, de Rijcke TB. Osteomyelitis in the head and neck. *J Laryngol Otol.* 1985;99(10):1059- 65.
142. Boeckx WD, et al. The role of free flaps in the treatment of persistent scalp osteomyelitis. *Neurosurgery.* 2006;59 (1 Sup p.1).ONS64-7; discussion ONS64-7.
143. Marshall AH, Jones NS. Osteomyelitis of the frontal bone secondary to frontal sinusitis. *J Laryngol Otol.* 2000;114(12):944-6.
144. Levy R, et al. Oral ofloxacin as treatment of malignant external otitis: a study of 17 cases. *Laryngoscope.*1990; 100(5)548-51.
145. Lang R, et al. Successful treatment of malignant external otitis with oral ciprofloxacin: report of experience with 23 patients. *J Infect Dis.* 1990;161(3):537-40.
146. Gehanno P. Ciprofloxacin in the treatment of malignant external otitis. *Chemotherapy.* 1994;(40 Sup p.1):35-40.
147. Martel, J. et al. [Malignant or necrotizing otitis externa: experience in 22 cases]. *Ann Otolaryngol Chir Cervicofac,* 2000. 117(5): p.291.
148. Narozny W, et al. Value of hyperbaric oxygen in bacterial and fungal malignant external otitis treatment. *Eur Arch Otorhinolaryngol.* 2006; 263(7):680-4.
149. Davis JC, et al. Adjuvant hyperbaric oxygen in malignant external otitis. *Arch Otolaryngol Head Neck Surg.* 1992;118(1):89-93.
150. Strecker T, et al. Sternal wound infections following cardiac surgery: risk factor analysis and interdisciplinary treatment. *Heart Surg Forum.* 2007;10(5):E366-71.
151. Newman LG, et al. Unsuspected osteomyelitis in diabetic foot ulcers. Diagnosis and monitoring by leukocyte scanning with indium in 111 oxyquinoline. *Jama.* 1991;266(9):1246-51.
152. Grayson ML, et al. Probing to bone in infected pedal ulcers. A clinical sign of underlying osteomyelitis in diabetic patients. *Jama.* 1995;273(9):721-3.

153. Roeckl-Wiedmann I, Bennett M, Kranke P. Systematic review of hyperbaric oxygen in the management of chronic wounds. *Br J Surg.* 2005;92(1):24-32.
154. Zamboni WA, et al. Evaluation of hyperbaric oxygen for diabetic wounds: a prospective study. *Undersea Hyperb Med.* 1997;24(3):175-9.
155. Abidia A, et al. The role of hyperbaric oxygen therapy in ischaemic diabetic lower extremity ulcers: a double-blind randomised-controlled trial. *Eur J Vasc Endovasc Surg.* 2003;25(6):513-8.
156. Kessler L, et al. Hyperbaric oxygenation accelerates the healing rate of nonischemic chronic diabetic foot ulcers: a prospective randomized study. *Diabetes Care.* 2003;26(8):2378-82.
157. Warriner III RA, Hopf HW. Enhancement of healing in selected problem wounds, in hyperbaric oxygen 2003: indications and results: the hyperbaric oxygen therapy committee report. Feldmeier JJ, Editor. Kensington: Undersea and Hyperbaric Medical Society; 2003. Pp.41-55.
158. Strauss MB. Economic considerations in chronic refractory osteomyelitis. In fifth annual conference on clinical applications of hyperbaric oxygen. Long Beach,CA; 1980.
159. Riddick M. Sternal wound infections, dehiscence, and sternal osteomyelitis: the role of hyperbaric oxygen therapy, in hyperbaric medicine practice. Kindwall EP, Whelan HT, eds. 1999, Flagstaff, AZ: Best Publishing Company; 1999. Pp.617-39.
160. Shandley S, et al. Hyperbaric oxygen therapy in a mouse model of implant-associated osteomyelitis. *J Orthop Res.* 2012;30(2):203-8.
161. Chen CY, et al. Adjuvant hyperbaric oxygen therapy in the treatment of hemodialysis patients with chronic osteomyelitis. *Ren Fail.* 2008;30(2):233-7.
162. Roje Z, et al. Influence of adjuvant hyperbaric oxygen therapy on short-term complications during surgical reconstruction of upper and lower extremity war injuries: retrospective cohort study. *Croat Med J.* 2008;49(2):224-32.
163. Ahmed R, Severson MA, Traynelis VC. Role of hyperbaric oxygen therapy in the treatment of bacterial spinal osteomyelitis. *J Neurosurg Spine.* 2009;10(1):16-20.
164. Sandner A, et al. [Value of hyperbaric oxygen in the treatment of advanced skull base osteomyelitis]. *Laryngorhinootologie.* 2009;88(10):641-6.
165. Yu WK, et al. Hyperbaric oxygen therapy as an adjunctive treatment for sternal infection and osteomyelitis after sternotomy and cardiothoracic surgery. *J Cardiothorac Surg.* 2011;6:141.
166. Hart BB. Refractory osteomyelitis, in Hyperbaric oxygen therapy indications. Thirteenth edition. Weaver, LK, ed. North Palm Beach, FL: Best Publishing Company; 2014. Pp.179-207.
167. Onen MR, et al. Efficacy of hyperbaric oxygen therapy in iatrogenic spinal infections. *Spine.* 2015;40(22):1743-8.
168. Coulson A, Peek A, Haugen D. Femoral vein cannulation in the treatment of osteomyelitis. *Wounds.* 2016;28(6):194-9.
169. Skeik N, et al. Hyperbaric oxygen treatment outcome for different indications from a single center. *Ann Vasc Surg.* 2015;29(2):206-214.
170. Yehekeli E, et al. Temporomandibular joint involvement as a positive clinical prognostic factor in necrotizing external otitis. *J Laryngol Otol.* 2016;130(5)435-9.
171. Kawashima M, et al. Hyperbaric oxygen therapy in orthopedic conditions. *Undersea Hyperb Med.* 2004 Spring;31(1):155-62.
172. Lázaro-Martínez JL, Aragón-Sánchez J, García-Morales E. Antibiotics versus conservative surgery for treating diabetic foot osteomyelitis: a randomized comparative trial. *Diabetes Care.* 2014. 37 (3):789-95.
173. Savvidou OD, Kaspiris A, Bolia IK, Chloros GD, Goumenos SD, Papagelopoulos PJ, Tsiodras S. Effectiveness of Hyperbaric Oxygen Therapy for the Management of Chronic Osteomyelitis: A Systematic Review of the Literature. *Orthopedics.* 2018 Jul 1;41(4):193-199. doi: 10.3928/01477447-20180628-02. PMID: 30035798.
174. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Int J Surg.* 2010;8:336e341.
175. Byun YJ, Patel J, Nguyen SA, Lambert PR. Hyperbaric oxygen therapy in malignant otitis externa: A systematic review of the literature. *World J Otorhinolaryngol Head Neck Surg.* 2020;7(4):296-302. Published 2020 May 4. doi:10.1016/j.wjorl.2020.04.002
176. Litwinowicz R, Bryndza M, Chrapusta A, Kobielska E, Kapelak B, Grudziń G. Hyperbaric oxygen therapy as additional treatment in deep sternal wound infections - a single center's experience. *Kardiochir Torakochirurgia Pol.* 2016;13(3):198-202. doi:10.5114/kitp.2016.62604

## References

1. Van Slyke DD, Neill JM. The determination of gases in blood and other solutions by vacuum extraction and manometric measurement. *J Biol Chem.* 1924;61:523-573.
2. Chance EM, Chance B. Oxygen delivery to tissue: calculation of oxygen gradient in the cardiac cell. *Adv Exp Med Biol.* 1988;222:69-75.
3. Fick A. Uber die messung des blut quantums in der herzventrikeln. *SB Phys-Med Ges Wurzburg.* 1870:16.
4. Rebel A, Beck A, Efron P, et al. Successful rescue therapy for severe acute anemia: managing the critically ill Jehovah's Witness. *Amer Surg* 2015;81:E263-E265.
5. Gohel MS, Bulbulia RA, Slim FJ, et al. How to approach major surgery where patients refuse blood transfusion (including Jehovah's Witnesses). *Ann Roy Coll Surg Engl* 2005;27:3-14.
6. Greensmith JE. Hyperbaric oxygen reverses organ dysfunction in severe anemia. *Anesthes* 2000;93(4):1149-1152.
7. Shander A, Javidroozi M. The approach to patients with bleeding disorders who do not accept blood-derived products. *Sem Thromb Hemost* 2013;19:182-190.
8. Johnson-Arbor K, Verstraete R. No bad blood – surviving severe anemia without transfusion. *JAMA Int Med* 2021;181(1):7-8.
9. Zeybek B, Childress A, Kilic GC, et al. Management of the Jehovah's Witness in obstetrics and gynecology: comprehensive medical, ethical and legal approach. *Obstet Gynecol Surg* 2016;71(8):488-500.
10. Dische S, Hewitt HB. Carcinoma of cervix with severe anemia: treatment by radiotherapy without blood transfusion using hyperbaric oxygen *Brit J Rad* 1972;45:848-850.
11. Thenuwara K, Thomas J, Isben M. Use of hyperbaric oxygen therapy and PEGylated carboxyhemoglobin bovine in a Jehovah's Witness with life-threatening anemia following postpartum hemorrhage. *Int J Obstet Anesthes* 2016;29:73-80.
12. Long B, Koyfman A. Emergency medicine evaluation and management of anemia. *Emerg Med Clin N Am* 2018;36:609-630.
13. Chaves DG, da Silva Malta MCF, Boy L, et al. Analysis of current SARS-CoV2-infection in a large population of blood donors evidenced that RNAemia is rate in plasma. *Transfusion* 2021;61(7):2137-2445.
14. Shoemaker WC, Appel PL, Kram HB. Tissue oxygen debt as a determinant of lethal and nonlethal post-operative organ failure. *Crit Care Med.* 1988;16:1117-1120.
15. Goodnough LT, Schander A, Brecher ME. Transfusion medicine: looking into the future. *Lancet.* 2003;361:161-169.
16. Johnson JL, Moore EE, Gonzalez RJ, et al. Alteration of the post-injury hyperinflammatory response by means of resuscitation with a red cell substitute. *J Trauma.* 2003;54:133-140.
17. Vamvakas EC. Transfusion associated cancer recurrence and post-operative infection: meta-analysis of randomized controlled clinical trials. *Transfusion.* 1996;36:175-186.
18. Winslow RM. Blood substitutes. *Curr Opin Hematol.* 2002;9:146-151.
19. Cohn C, Cushing M. Oxygen therapeutics: perfluorocarbons and blood substitute safety. *Crit Care Med.* 2009;25:399-414.
20. Kindwall EP, editor. *Hyperbaric oxygen therapy: a committee report.* Bethesda, MD: Undersea and Hyperbaric Medical Society; 1977.
21. Hampson NB, editor. *Hyperbaric oxygen therapy: a committee report.* Bethesda, MD: Undersea and Hyperbaric Medical Society; 1999. P. 35-36.
22. Hart GB. Hyperbaric oxygen and exceptional blood loss anemia. In: Kindwall EP, Whelan HT, editors. *Hyperbaric medicine practice.* 2nd ed. revised. Flagstaff, AZ: Best Publishing Co.; 2002. P. 741-751.
23. DeBets J, Theunissen S, Devriendt J, et al. The normobaric oxygen paradox: does it increase hemoglobin. *Diving and Hyperbar Med.* 2012;42(2):67-71.
24. Brozak J, Grande F. Body composition and basal metabolism in man correlation analysis versus physiologic approach. *Human Biol.* 1955;27:22-31.
25. Boerema I, Meyne NG, Brummelkamp WH, et al. Life without blood. *Arch Chir Neerl.* 1959;11:70-84.
26. McLoughlin PL, Cope TM, Harrison JC. Hyperbaric oxygen therapy in management of severe acute anemia in a Jehovah's witness. *Anesthesia.* 1999;54:879-898.
27. Cummins RO, Hazinski MF, Kerber RE, et al. Low-energy biphasic waveform defibrillation: evidence-based review applied to emergency cardiovascular care guidelines. *Circulation.* 1998;97:1654-1667.
28. Burnet W, Clark RG, Duthie HL, et al. The treatment of shock by oxygen under pressure. *Scot Med J.* 1959;4:535-538.

29. Cowley RA, Attar S, Esmond WG, et al. Electrocardiographic and biochemical study in hemorrhagic shock in dogs treated with hyperbaric oxygen. *Circulation*. 1963;27:670-675.
30. Blair E, Henning G, Esmond WG, et al. The effect of hyperbaric oxygenation (OHP) on three forms of shock – traumatic, hemorrhagic, and septic. *J Trauma*. 1964;4:652-663.
31. Clark RG, Young DG. Effects of hyperoxygenation and sodium bicarbonate in hemorrhagic hypotension. *Brit J Surg*. 1965;52:705-708.
32. Cowley RA, Attar S, Blair E, et al. Prevention and treatment of shock by hyperbaric oxygenation. *Ann NY Acad Sci*. 1965;117:673-683.
33. Elliot DP, Paton BC. Effect of 100% oxygen at 1 and 3 atmospheres on dogs subjected to hemorrhagic hypotension. *Surg*. 1965;57:401-408.
34. Attar S, Scanlan E, Cowley RA. Further evaluation of hyperbaric oxygen in hemorrhagic shock. In: Brown IW, Cox B, editors. *Proceedings of the third international congress on hyperbaric medicine*. Washington DC: NAS/NRC; 1965. P. 417-424.
35. Jacobson YG, Keller ML, Mundth ED, et al. Hyperbaric oxygen therapy in experimental hemorrhagic shock. In: Brown IW, Cox B, editors. *Proceedings of the third international congress on hyperbaric medicine*. Washington DC: NAS/NRC; 1966. P. 425-431.
36. Jacobson YG, Keller ML, Mundth ED, et al. Hemorrhagic shock: influence of hyperbaric oxygen on metabolic parameters. *Calif Med*. 1966;105:93-96.
37. Navarro RU, Ferguson CC. Treatment of experimental hemorrhagic shock by the combined use of hyperbaric oxygen and low-molecular weight dextran. *Surg*. 1968;63:775-781.
38. Doi Y, Onji Y. Oxygen deficit in hemorrhagic shock under hyperbaric oxygen. In: Wada J, Iwa JT, editors. *Proceedings of the fourth international congress on hyperbaric medicine*. Baltimore, MD: Williams and Wilkins; 1970. P. 181-184.
39. Necas E, Neuwirt J. Lack of erythropoietin in plasma of anemic rats exposed to hyperbaric oxygen. *Life Sci*. 1969;8:1221-1228.
40. Oda T, Takeori M. Effect of viscosity of the blood on increase in cardiac output following acute hemodilution. In: Wada J, Iwa JT, editors. *Proceedings of the fourth international congress on hyperbaric medicine*. Baltimore, MD: Williams and Wilkins; 1970. P. 191-196.
41. Norman JN. Hemodynamic studies in total blood replacement. *Biblio Haema*. 1975;41:203-208.
42. Luenov AN, Yakovlev VN. Role played by cerebral nitrogen metabolism in the mechanism of the therapeutic oxygen effects under high pressure in the hemorrhagic shock. *Biull Eksp Biol Med*. 1977;83:418-420.
43. Gross DR, Moreau PM, Jabor M, Welch DW, Fife WP. Hemodynamic effects of dextran-40 on hemorrhagic shock during hyperbaria and hyperbaric hyperoxia. *Aviat Space Environ Med*. 1983;54:413-419.
44. Gross DR, Moreau PM, Chaikin BN, et al. Hemodynamic effects of lactated Ringers' solution on hemorrhagic shock during exposure to hyperbaric air and hyperbaric hyperoxia. *Aviat Space Environ Med*. 1983;54:701-708.
45. Gross DR, Dodd KT, Welch DW, Fife WP. Hemodynamic effects of 10% dextrose and of dextran-70 on hemorrhagic shock during exposure to hyperbaric air and hyperbaric hyperoxia. *Aviat Space Environ Med*. 1984;55:1118-1128.
46. Bitterman H, Reissman P, Bitterman N, et al. Oxygen therapy in hemorrhagic shock. *Circ Shock*. 1991;33:183-191.
47. Wen-Ren L. Resection of aortic aneurysms under 3 ATA of hyperbaric oxygenation. In: Bakker DJ, Cramer JS, editors. *Proceedings of the tenth international congress of hyperbaric medicine*. Flagstaff, AZ: Best Publishing Co.; 1992. P. 94-95.
48. Adir Y, Bitterman N, Katz E, et al. Salutory consequences of oxygen therapy or long-term outcome of hemorrhagic shock in awake, unrestrained rats. *Undersea Hyperb Med*. 1995;22:23-30.
49. Yamashita M, Yamashita M. Hyperbaric oxygen treatment attenuates cytokine induction after massive hemorrhage. *Am J Physiol Endocrin Metab*. 2000;28:E811-E816.
50. Boerema I, Meyne NG, Brummelkamp WH, et al. Life without blood: a study of the influence of high atmosphere pressure and hypothermia on dilution of the blood. *J Cardiovasc Surg*. 1960;1:133-146.
51. Attar S, Esmond WG, Cowley RA. Hyperbaric oxygenation in vascular collapse. *J Thoracic Cardiovasc Surg*. 1962;42:759-770.
52. Trytyshnikov IM. Effect of acute massive blood loss during hyperbaric oxygen therapy on nucleic and metabolism in the albino rat liver. *Biull Eksp Biol Med*. 1974;77:23-25.
53. Frank HA, Fine J. Traumatic shock V: a study of the effect of oxygen on hemorrhagic shock. *J Clin Invest*. 1943;22:305-314.

54. Whalen RE, Moor GF, Mauney FM, et al. Hemodynamic responses to "Life Without Blood." In: Brown IW, Cox B, editors. Proceedings of the third international congress on hyperbaric medicine. Washington DC: NAS/NRC; 1965. P. 402-408.
55. Barkova EN, Petrov AV. The effect of oxygen barotherapy on erythropoiesis in the recuperative period following hemorrhagic collapse. *Bull Eksp Biol Med.* 1976;81:156-158.
56. Marzella L, Yin A, Darlington D, et al. Hemodynamic responses to hyperbaric oxygen administration in a rat model of hemorrhagic shock. *Circ Shock.* 1992;37:12.
57. Cancer.Net. Levels of evidence: explanation in therapeutic studies (PDQ). Internet Service of the National Cancer Institute, 1999.
58. Barton S, editor. *Clinical evidence.* London: BMJ Publishing Group; 2001.
59. Wiggers CJ, Werle JM. Exploration of method for standardizing hemorrhagic shock. *Proc Soc Exper Biol Med.* 1942;49:604.
60. Bellamy RF, Maningas PA, Wenger BA, et al. Current shock models and clinical correlations. *Ann Emerg Med.* 1986;15:1392-1395.
61. Ledingham IM. Hyperbaric oxygen in shock. *Anes Clin.* 1969;7:819-839.
62. Amonic RS, Cockett ATK, Lonhan PH, et al. Hyperbaric oxygen therapy in chronic hemorrhagic shock. *JAMA.* 1969;208:2051-2054.
63. Hart GB. Exceptional blood loss anemia. *JAMA.* 1974;228:1028-1029.
64. Myking O, Schreinen A. Hyperbaric oxygen in hemolytic crisis. *JAMA.* 1974;227:1161-1162.
65. Hart GB, Lennon PA, Strauss MB. Hyperbaric oxygen in exceptional acute blood loss anemia. *J Hyperbar Med.* 1987;2:205-210.
66. Meyerstein N, Mazor D, Tsach T, et al. Resistance of human red blood cells to hyperbaric oxygen under therapeutic conditions. *J Hyperbar Med.* 1989;4:1-5.
67. Young BA, Burns JR. Management of the severely anemic Jehovah's Witness. *Ann Int Med.* 1992;119:170.
68. Van Meter KW. A systematic review of the literature reporting the application of hyperbaric oxygen in the treatment of exceptional blood loss anemia: an evidence-based approach. *Undersea Hyperb Med.* 2005;32(1):61-83.
69. Hillard JR. Severe claustrophobia in a patient requiring hyperbaric oxygen treatment. *Psychosomatics.* 1990;31:107-108.
70. Ross ME, Yolton DP, Yolton RL, et al. Myopia associated with hyperbaric oxygen therapy. *Optometry and Vision Sci.* 1996;73:487-494.
71. Ueno S, Sakoda M, Kurahara H, et al. Safety and efficacy of early post-operative hyperbaric oxygen therapy with restriction of transfusions in patient with HCC who have undergone partial hepatectomy. *Arch Surg.* 2011;396:99-106.
72. Blanchard J, Toma A, Bryson P, et al. Middle ear barotrauma in patients undergoing hyperbaric oxygen therapy. *Clin Otolaryn.* 1996;21:400-403.
73. Youngberg JT, Myers AM. Complications from hyperbaric oxygen therapy. *Ann Emerg Med.* 1990;19:1356-1357.
74. Van Meter KW, Harch PG. HBO in emergency medicine. In: Jain KK, editor. *Textbook of hyperbaric medicine.* Cambridge, MA: Hogrefe & Huber Publishers; 1996. P. 453-481.
75. Van Meter KW. Hyperbaric oxygen therapy as an adjunct to pre-hospital advanced life support. *Surg Technol Int.* 2011 Dec 1;XXI:61-73.
76. Donat A, Damani E, Zuccan S, et al. Effects of short-term hyperoxia on erythropoietin levels and microcirculation in critically ill patients: a prospective, observational pilot study. *MMC Anesthesiology* 2017;17:49-59
77. Van Meter K. The effect of hyperbaric oxygen on severe anemia. *Undersea Hyper Med* 2012;39(5):937-942.
78. Saa P, Proctor M, Foster-Getal. Investigational testing for Zika virus among US blood donors. *NEJM* 2018;378:1778-1788.
79. Harrington T, Kuehnent MJ, Kamel H, et al. West Nile virus infection transmitted by blood transfusion. *Transfusion* 2004;3:1018-1022.
80. Graffeo C, Dishong W. Severe blood loss anemia in a Jehovah's Witness treated with adjunctive hyperbaric oxygen therapy. *Am J Emerg Med* 2013;31:756.
81. Guttierrez G, Brotherton J. Management of severe anemia secondary to menorrhagia in a Jehovah's Witness: a case report and treatment algorithm. *Am J Obstet Gynec* 2011;205(2):E5-E8.
82. Wright JK, Ehler W, McGlasson DL, Thompson W. Facilitation of recovery from acute blood loss with hyperbaric oxygen. *Arch Surg* 2002;137:850-853.
83. Bunn HF. Oxygen delivery in the treatment of anemia. *NEJM* 2022;387:362-365.



## References

1. American Burn Association, National Burn Repository Version 12.0. 2016.
2. American Burn Association, National Burn Repository Version 13.0. 2023.
3. Wolf SE, Tompkins RG, Herndon DN. On the horizon – Research priorities in burns for the next decade. *Surg Clin N Am.* 2014;94:917-930.
4. Atiyeh BS, Gunn SW, Hayek SN. State of the art in burn treatment. *World J Surg.* 2005;29(2):131-148.
5. Arturson G. Pathophysiology of the burn wound. *Ann Chir Gynaecol.* 1980;69:178-190.
6. Demling RH. The burn edema process: current concepts. *J Burn Care Rehabil.* May/June 2005;26:207-227.
7. Boykin JV, Eriksson E, Pittman RN. In vivo microcirculation of a scald burn and the progression of postburn dermal ischemia. *Plast Reconstr Surg.* 1980;66:191-198.
8. Monafo WW. Initial management of burns. *NEJM.* 1996;335(21):1581-1586.
9. Arturson G. The pathophysiology of severe thermal injury. *J Burn Care Rehabil.* 1985;6(2):129-146.
10. Hegggers JP, Robson MC, Zachary LS. Thromboxane inhibitor for the prevention of progressive dermal ischemia due to the thermal injury. *J Burn Care Rehabil.* 1985;6:466-468.
11. Miller TA, Korn HN. Epithelial burn injury and repair, In: Davis JC, Hunt TK, editors. *Hyperbaric oxygen therapy.* Bethesda, MD: Undersea Medical Society, Inc.; 1977. P. 251.
12. Demling RH. Burns and other thermal injuries. In: Way LW, Doherty GM, editors. *Current surgical diagnosis and treatment.* 11th ed. New York, NY: McGraw-Hill Medical; 2003. P. 267.
13. Deitch EA, Wheelahan TM, Rose MP, Clothier J, Cotter J. Hypertrophic burn scars: Analysis of variables. *J Trauma.* 1983;23:895-898.
14. Alexander JW, Meakins JL. A physiological basis for the development of opportunistic infections in man. *Ann Surg.* 1972;176:273.
15. Alexander JW, Wixson D. Neutrophil dysfunction and sepsis in burn injury. *Surg Gynec Obstet.* 1970;130:431.
16. Barber RC, Aragaki CC, Rivera-Chavez FA. TLR4 and TNF-alpha polymorphisms are associated with an increased risk for severe sepsis following burn injury. *J Med Genet.* 2004;41:808-813.
17. Church D, Elsayed S, Reid O, Winston B, Lindsay R. Burn wound infections. *Clin Microbiol Rev.* 2006;19(2):403-434.
18. Ikeda K, Ajiki H, Nagao H, Karino K, Sugii S, Iwa T, Wada J. Experimental and clinical use of hyperbaric oxygen in burns. In: Wada J, Iwa JT, editors. *Proceedings of the fourth international congress on hyperbaric medicine.* Baltimore, MD: Williams and Wilkins; 1970. P. 370.
19. Hartwig J, Kirste G. Experimentelle untersuchungen uber die revaskularisierung von verbrennungswunden unter hyperbarer sauersto therapie. *Zbl Chir.* 1974;99:1112-1117.
20. Nylander G, Nordstrom H, Eriksson E. Effects of hyperbaric oxygen on oedema formation after a scald burn. *Burns Incl Therm Inj.* 1984 Feb;10(3):193-196.
21. Kaiser W, Schnaidt U, von der Leith H. Auswirkungen hyperbaren sauersto es auf die fresche brandwunde. *Handchir Mikrochir Plast Chir.* 1989;21:158-163.
22. Kaiser W, Voss K. Influence of hyperbaric oxygen on the edema formation in experimental burn injuries. *Jugoslav Physiol Pharmacol Acta.* 1992;28(9):87-98.
23. Ketchum SA, Zubrin JR, Thomas AN, Hall AD. Effect of hyperbaric oxygen on small first, second and third degree burns. *Surg Forum.* 1967;18:65-67.
24. Ketchum SA, Thomas AN, Hall AD. Angiographic studies of the effect of hyperbaric oxygen on burn wound revascularization. In: Wada J, Iwa JT, editors. *Proceedings of the fourth international congress on hyperbaric medicine.* Tokyo: Igaku Shoin Ltd.; 1970. P. 388.
25. Niccolle MW, Thornton JW, Danet RT, Bartlett RH, Tavis MJ. Hyperbaric oxygen in burn management: a controlled study. *Surgery.* 1977;82:727-733.
26. Gruber RP, Brinkley B, Amato JJ, Mendelson JA. Hyperbaric oxygen and pedicle flaps, skin grafts, and burns. *Plast Reconstr Surg.* 1970;45:24-30.
27. Wells CH, Hilton JG. Effects of hyperbaric oxygen on post-burn plasma extravasation. In: Hunt TK, Davis JC, editors. *Hyperbaric oxygen therapy.* Bethesda, MD: Undersea and Hyperbaric Medical Society; 1977. P. 259.
28. Stewart RJ, Yamaguchi KT, Cianci PE, Knost PM, Samadani S, Mason SW, Roshdieh B. Effects of hyperbaric oxygen on adenosine triphosphate in thermally injured skin. *Surg Forum.* 1988;39:87.
29. Stewart RJ, Yamaguchi KT, Cianci PE, Mason WW, Roshdieh BB, Dabbassi N. Burn wound levels of ATP after exposure to elevated levels of oxygen. In: *Proceedings of the American Burn Association, New Orleans, LA; 1989.* P. 67.
30. Germonpré P, Reper P, Vanderkelen A. Hyperbaric oxygen therapy and piracetam decrease the early extension of deep partial thickness burns. *Burns.* 1996;22(6):468-473.

31. Korn HN, Wheeler ES, Miller TA. Effect of hyperbaric oxygen on second-degree burn wound healing. *Arch Surg.* 1977;112:732-737.
32. Saunders J, Fritz E, Ko F, Bi C, Gottlieb L, Krizek T. The effects of hyperbaric oxygen on dermal ischemia following thermal injury. In: *Proceedings of the American Burn Association.* New Orleans, LA; 1989. P. 58.
33. Bleser F, Benichoux R. Experimental surgery: e treatment of severe burns with hyperbaric oxygen. *J Chir (Paris).* 1973;106:281-290.
34. Perrins DJD. Failed attempt to limit tissue destruction in scalds of pig's skin with hyperbaric oxygen. In: Wada J, Iwa T, editors. *Proceedings of the fourth international congress on hyperbaric medicine.* Tokyo, Japan: Igaku Shoin Ltd.; 1970. P. 381.
35. Shoshani O, Shupak A, Barak Y, Ullman Y, Ramon Y, Lindenbaum E, Peled Y. Hyperbaric oxygen therapy for deep second degree burns: an experimental study in the guinea pig. *Brit J Plast Surg.* 1998;51:67-73.
36. Traystman RJ, Kirsch JR, Koehler RC. Oxygen radical mechanisms of brain injury following ischemia and reperfusion. *J Appl Physiol.* 1991;71:1185-1195.
37. Ward PA, Mulligan MS. New insights into mechanisms of oxyradical and neutrophil mediated lung injury. *Klin Wochenschr.* 1991;69:1009-1011.
38. Ward PA, Till GO. The autodestructive consequences of thermal injury. *J Burn Care Rehabil.* 1985;6:251-255.
39. McCord JM. Oxygen-derived free radicals in postischemic tissue injury. *N Engl J Med.* 1985;312:159-163.
40. Yamada T, Taguchi T, Hirata Y, Suita S, Yugi H. The protective effect of hyperbaric oxygenation on the small intestine in ischemia-reperfusion injury. *J Pediatr Surg.* 1995;30:786-790.
41. Zamboni WA, Roth AC, Russell RC, Graham B, Suchy H, Kucan JO. Morphological analysis of the microcirculation during reperfusion of ischemic skeletal muscle and the effect of hyperbaric oxygen. *Plast Reconstr Surg.* 1993;91: 1110-1123.
42. Nylander G, Nordstrom H, Lewis D, Larsson J. Metabolic effects of hyperbaric oxygen in postischemic muscle. *Plast Reconstr Surg.* 1987;79:91-97.
43. Takahashi M, Iwatsuki N, Ono K, Koga Y. Hyperbaric oxygen therapy accelerates neurologic recovery after 15-minute complete global cerebral ischemia in dogs. *Crit Care Med.* 1992;20(11):1588-1594.
44. Thom SR. Functional inhibition of leukocyte B2 integrins by hyperbaric oxygen in carbon monoxide-mediated brain injury in rats. *Toxicol Appl Pharmacol.* 1993;123:248-256.
45. Veltkamp R, Siebing DA, Schwab S, Schwaninger M. Hyperbaric oxygen reduces blood-brain barrier damage and edema after transient focal cerebral ischemia. *Stroke.* 2005;36:1679-1683.
46. Kolski JM, Mazolewski PJ, Stephenson LL, Zamboni WA. Effect of hyperbaric oxygen therapy on testicular ischemia-reperfusion injury. *J of Urology.* Aug 1998;160:601-604.
47. Yogaratnam JZ, Laden G, Madden LA, Gri n S, et al. Hyperbaric oxygen: a new drug in myocardial revascularization and protection? *Cardiovasc Revasc Med.* 2006 Jul-Sep;7(3):146-154.
48. Shandling AH, Ellestad MH, Hart GB, et al. Hyperbaric oxygen and thrombolysis in myocardial infarction: The hot MI pilot study. *Am Heart J.* 1997;134:544-550.
49. Sharifi M, Fares W, Abdel-Karim I, Koch JM, Sopko J, Adler D. Hyperbaric oxygen therapy in percutaneous coronary interventions investigators. Usefulness of hyperbaric oxygen therapy to inhibit restenosis after percutaneous coronary intervention for acute myocardial infarction or unstable angina pectoris. *Am J Cardiol.* 2004 Jun 15;93(12):1533-1535.
50. Thomas MP, Brown LA, Sponseller DR, et al. Myocardial infarct size reduction by synergistic effect of hyperbaric oxygen and recombinant tissue plasminogen activator. *Am Heart J.* 1990 Oct;120(4):791-800.
51. Xu N, Li Z, Luo X. Effects of hyperbaric oxygen therapy on the changes in serum sIL-2R and Fn in severe burn patients. *Zhonghua Zheng Xing Shao Shang Wai Ke Za Zhi.* 1999;15(3):220-223.
52. Zamboni WA, Stephenson LL, Roth AC, Suchy H, Russell RC. Ischemia-reperfusion injury in skeletal muscle: CD18 dependent neutrophil-endothelial adhesion. *Undersea Hyperb Med.* 1994;21(Suppl):53.
53. Wasiak J, Bennett M, Cleland H. Hyperbaric oxygen as adjuvant therapy in the management of burns: can evidence guide clinical practice? *Burns.* 2006;32:650-652.
54. Buras JA, Stahl GL, Svoboda KK, Weenstra WR. Hyperbaric oxygen down regulates ICAM-1 expression induced by hypoxia and hypoglycemia: the role of NOS. *Am J Physiol Cell Physiol.* 2000;278:C292-302.
55. Ueno S, Tanabe G, Kihara K et al. Early post-operative hyperbaric oxygen therapy modifies neutrophil activation. *Hepatology.* 1999;46:1798-1799.
56. Miljkovic-Lolic M, Silbergleit R, Fiskum G, Rosenthal RE. Neuroprotective effects of hyperbaric oxygen treatment in experimental focal cerebral ischemia are associated with reduced brain leukocyte myeloperoxidase activity. *Brain Res.* 2003 May 2;971(1):90-94.

57. Tenenhaus M, Hansbrough JF, Zapata-Sirvent R, Neumann T. Treatment of burned mice with hyperbaric oxygen reduces mesenteric bacteria but not pulmonary neutrophil deposition. *Arch Surg.* 1994;129:1338-1342.
58. Magnotti LJ, Deitch EA. Burns, bacterial translocation, gut barrier function, and failure. *J Burn Care Rehab.* 2005;26(5):383-391.
59. Deitch EA, Xu DZ, Franko L, et al. Evidence favoring the role of the gut as a cytokine generating organ in rats subjected to hemorrhagic shock. *Shock.* 1994;1:141-146.
60. Deitch EA. Role of the gut lymphatic system in multiple organ failure. *Current Opin Crit Care.* 2001;7:92-98.
61. Hohn DC, McKay RD, Halliday B, Hunt TK. Effect of oxygen tension on the microbicidal function of leukocytes in wounds and in vitro. *Surg Forum.* 1976;27:18-20.
62. Allen DB, Maguire JJ, Mahdavian M, et al. Wound hypoxia and acidosis limit neutrophil bacterial killing mechanisms. *Arch Surg.* 1997;132:991-996.
63. Mader JT, Brown GL, Guckian JC, et al. A mechanism for the amelioration by hyperbaric oxygen of experimental staphylococcal osteomyelitis in rabbits. *J Infect Dis.* 1980;142:915-922.
64. Hussman J, Hebebrand D, Erdmann D, Moticka J. Lymphocyte subpopulations in spleen and blood after early wound debridement and acute/chronic treatment with hyperbaric oxygen. *Hanchir Mikrochir Plast Chir.* 1996;28(2):103-107.
65. Bilic I, Petri NM, Bota B. Effects of hyperbaric oxygen therapy on experimental burn wound healing in rats: A randomized controlled study. *Undersea Hyperb Med.* 2005;32(1):1-9.
66. Turkaslan T, Yogum N, Cimsit M, Solakoglu S, Ozdemir C, Ozsoy Z. Is HBOT treatment effective in recovering zone of stasis? An experimental immunohistochemical study. *Burns.* 2010;36(4):539-544.
67. Gallagher KA, Goldstein LJ, Thom SR, Velazquez OC. Hyperbaric oxygen and bone marrow-derived endothelial progenitor cells in diabetic wound healing. *Vascular.* 2006;14(6):328-337.
68. Gallagher KA, Liu ZJ, Xiao M, Chen H, Goldstein LJ, Buerk DG, Nedeau A, Thom SR, Velazquez OC. Diabetic impairments in NO-mediated endothelial progenitor cell mobilization and homing are reversed by hyperoxia and SDF-1 alpha. *J Clin Invest.* 2007;117:1249-1259.
69. Thom SR, Bhopale VM, Velazquez OC, Goldstein LJ, Thom LH, Buerk DG. Stem cell mobilization by hyperbaric oxygen. *Am J Physiol Heart Circ Physiol.* 2006;290:H1378-1386.
70. Goldstein LJ, Gallagher KA, Bauer SM et al. Endothelial progenitor cell release into circulation is triggered by hyperoxia-induced increases in bone marrow nitric oxide. *Stem Cells.* 2006;24:2309-2318.
71. Thom SR, Milovanova TN, Yang M, Bhopale VM, Sorokina EM, Uzun G, Malay DS, Troiano MA, Hardy KR, Lambert DS, Logue CJ, Margolis DJ. Vasculogenic stem cell mobilization and wound recruitment in diabetic patients: increased cell number and intracellular regulatory protein content associated with hyperbaric oxygen therapy. *Wound Repair Regen.* 2011;19(2):149-161.
72. Milovanova TN, Bhopale VM, Sorokina EM, Moore JS, Hunt TK, Hauer-Jensen M, Velazquez OC, Thom SR. Hyperbaric oxygen stimulates vasculogenic stem cell growth and differentiation in vivo. *J Appl Physiol.* 2009;106:711-728.
73. Milovanova TN, Bhopale VM, Sorokina EM, Moore JS, Hunt TK, Hauer-Jensen M, Velazquez OC, Thom SR. Lactate stimulates vasculogenic stem cells via the thioredoxin system and engages an autocrine activation loop involving hypoxia-inducible factor 1. *Mol Cell Biol.* 2008;28:6248-6261.
74. Wada J, Ikeda T, Kamata K, Ebuoka M. Oxygen hyperbaric treatment for carbon monoxide poisoning and severe burn in coal mine (hokutanyubari) gas explosion. *Igakunoaymi (Japan).* 1965;5:53.
75. Ikeda K, Ajiki H, Kamiyama T, Wada J. Clinical application of oxygen hyperbaric treatment. *Geka (Japan).* 1967;29:1279.
76. Wada J, Ikeda K, Kagaya H, Ajiki H. Oxygen hyperbaric treatment and severe burn. *Jap Med J.* 1966;13:2203.
77. Lamy ML, Hanquet MM. Application opportunity for OHP in a general hospital - a two year experience with a monoplace hyperbaric oxygen chamber. In: Wada J, Iwa JT, editors. *Proceedings of the Fourth International Congress on Hyperbaric Medicine.* Tokyo: Igaku Shoin Ltd.; 1970. 517.
78. Tabor CG. Hyperbaric oxygenation in the treatment of burns of less than forty percent. *Korean J Intern Med.* 1967;10(4):267-275.
79. Grossman AR, Grossman AJ. Update on hyperbaric oxygen and treatment of burns. *Hyperbaric Oxygen Review.* 1982;3:51.
80. Grossman AR, Hart GB, Yanda RL. Thermal burns. Hyperbaric oxygen therapy. Chapter 19; *Undersea Medical Society.* 1977;268.
81. Niu AKC, Yang C, Lee HC, Chen SH, Chang LP. Burns treated with adjunctive hyperbaric oxygen therapy: A comparative study in humans. *J Hyperbar Med.* 1987;2:75.

82. Cianci P, Lueders H, Lee H, Shapiro R, Sexton J, Williams C, Green B. Adjunctive hyperbaric oxygen reduces the need for surgery in 40-80% burns. *J Hyperbar Med.* 1988;3:97.
83. Hart GB, O'Reilly RR, Broussard ND, Cave RH, Goodman DB, Yanda RL. Treatment of burns with hyperbaric oxygen. *Surg Gynecol Obstet.* 1974 Nov;139(5):693-696.
84. Grossman A. Hyperbaric oxygen and the treatment of burns. *Ann Plast Surg.* 1978 Mar;1(2):163-171.
85. Daniel Wiseman, MD. Grossman, MD. Hyperbaric oxygen in the treatment of burns, *Crit Care Clin.* Vol 1, No. 1, March 1985 Mar;1(1):129-145.
86. Waisbren BA, Schutz D, Collentine G, Banaszak E. Hyperbaric oxygen in severe burns. *Burns.* 1982;8:176-179.
87. Merola L, Piscitelli F. Considerations on the use of HBO in the treatment of burns. *Ann Med Nav.* 1978;83:515.
88. Cianci P, Lueders HW, Lee H, Shapiro RL, Sexton J, Williams C, Sato R. Adjunctive hyperbaric oxygen therapy reduces length of hospitalization in thermal burns. *J Burn Care Rehabil.* 1989;10:432-435.
89. Cianci P, Lueders H, Lee H, Shapiro R, Green B, Williams C. Hyperbaric oxygen and burn fluid requirements: Observations in 16 patients with 40-80% TBSA burns. *Undersea Biomed Res.* 1988;15(Suppl):14.
90. Cianci P, Williams C, Lueders H, Lee H, Shapiro R, Sexton J, Sato R. Adjunctive hyperbaric oxygen in the treatment of thermal burns - an economic analysis. *J Burn Care Rehabil.* 1990;11:140-143.
91. Cianci P, Sato R, Green B. Adjunctive hyperbaric oxygen reduces the length of hospital stay, surgery and cost of care in severe burns. *Undersea Biomed Res Suppl.* 1991; 18:108.
92. Cianci P, Sato R. Adjunctive hyperbaric oxygen therapy in the treatment of thermal burns: A review. *Burns.* 1994 Feb;20(1):5-14. *Printed in Great Britain.*
93. Cianci P, Sato R, Green B. Adjunctive hyperbaric oxygen reduces length of hospital stay, surgery, and the cost of care in severe burns. *Undersea Biomed Research Suppl.* 1991;18:108.
94. Maxwell G, Meites H, Silverstein P. Cost effectiveness of hyperbaric oxygen therapy in burn care. Presented at: Winter Symposium on Baromedicine; 1991; Aspen, CO.
95. Hammarlund C, Svedman C, Svedman P. Hyperbaric oxygen treatment of healthy volunteers with UV-irradiated blister wounds. *Burns.* 1991;17:296-301.
96. Niezgoda JA, Cianci P, Folden BW, Ortega RL, Slade JB, Storrow AB. The effect of hyperbaric oxygen therapy on a burn wound model in human volunteers. *Plast Reconstr Surg.* 1997;99(6):1620-1625.
97. Brannen AL, Still J, Haynes M, Orlet H, Rosemblum F, Law E, ompson WO. A randomized prospective trial of hyperbaric oxygen in a referral burn center population. *Am Surg.* 1997;63:205-208.
98. Presented at the fourth annual Advanced Training Seminar University of South Carolina and the Richland Memorial Hospital, Columbia S.C. March 20-22, 1995.
99. Jones LM, Rubadue C, Brown NV, Khandelwal S, Co ey RA. Evaluation of TCOM/HBOT practice guideline for the treatment of foot burns occurring in diabetic patients. *Burns.* 2015;41:536-541.
100. Ronald P Mlcak, PhD, MBA, RRT, FAARC, Inhalation injury from heat, smoke, or chemical irritants. [www.uptodate.com](http://www.uptodate.com), April 2023
101. Kadri SS, Miller AC, Hohmann S, et al. Risk Factors for In-Hospital Mortality in Smoke Inhalation-Associated Acute Lung Injury: Data From 68 United States Hospitals. *Chest* 2016; 150:1260.
102. [www.ameriburn.org/NBR.php](http://www.ameriburn.org/NBR.php) (Accessed on November 23, 2015).
103. Dries DJ, Endorf FW. Inhalation injury: epidemiology, pathology, treatment strategies. *Scand J Trauma Resusc Emerg Med* 2013; 21:31.
104. You K, Yang HT, Kym D, et al. Inhalation injury in burn patients: establishing the link between diagnosis and prognosis. *Burns* 2014; 40:1470.
105. Shirani K, Pruitt B, Mason A. The influence of inhalation injury and pneumonia on burn mortality. *Ann Surg.* 1986;205:82-87.
106. Balkissoon R, Shusterman DJ. Occupational upper airway disorders. *Semin Respir Crit Care Med.* 1999;20:569-580.
107. Rabinowitz, PM, Siegel MD. Acute inhalation injury. *Clin Chest Med.* 2002;23(4):707.
108. Grim PS, Nahum A, Gottlieb L, Wilbert C, Hawe E, Sznajder J. Lack of measurable oxidative stress during HBO therapy in burn patients. *Undersea Biomed Res.* 1989;16(Suppl):22.
109. Ray CS, Green G, Cianci P. Hyperbaric oxygen therapy in burn patients: Cost effective adjuvant therapy (abstract). *Undersea Biomed Res.* 1991;18(Suppl):77.
110. Sutherland AM, Clarke HA, Katz J, Katznelson R. Hyperbaric Oxygen therapy: A new treatment for chronic pain? *Pain Practice.* 2015;2(1):1-9.
111. Ramussen VM, Borgen AE, Jansen EC, Rotboll Nielsen PH, Werner MU. Hyperbaric oxygen therapy attenuates central sensitization induced by a thermal injury in humans. *Acta Anaesthesiologica Scandinavica.* 2015;59:749-762.

112. Gibbons CR, Liu S, Zhang Y, Sayre CL, Levitch BR, Moehlmann SB, Shirachi DY, Quock RM. Involvement of brain opioid receptors in the antiallodynic effect of hyperbaric oxygen in rats with sciatic nerve crush-induced neuropathic pain. *Brain Res.* 2013 Nov 6;1537:111-6. doi: 10.1016/j.brainres.2013.08.050. Epub 2013 Aug 30.
113. Ding Y, Yao P, Hong T, et al. The analgesic effect of early hyperbaric oxygen treatment in chronic constriction injury rats and its influence on nNOS and iNOS expression and inflammatory factor productions. *Mol Pain.* 2018 Jan-Dec;14:1744806918765837.
114. Chen CA, Huang YC, Lo JJ, Wang SH, Huang SH, Wu SH. Hyperbaric oxygen therapy attenuates burn-induced denervated muscle atrophy. *Int J Med Sci* 2021 Oct 25;18(16):3821-3830. doi: 10.7150/ijms.65976. eCollection 2021.
115. Thompson CD, Uhelski M L, Wilson JR, Fuchs PN. Hyperbaric oxygen treatment decreases pain in two nerve injury models. *Neurosci Res.* 2010;66(3):279-283.
116. Zhang Q, Chang Q, Cox RA, Gong X, Gould LJ. Hyperbaric oxygen attenuates apoptosis and decreases inflammation in an ischemic wound model. *J Invest Dermatol.* 2008;128(8):2102-2112.
117. Fosen KM, Thom SR. Hyperbaric oxygen, vasculogenic stem cells, and wound healing. *Antioxid Redox Signal.* 2014;21(11):1634-1646.
118. Thom SR, Bhopale VM, Velazquez OC, Goldstein LJ, Thom LH, Buerk DG. Stem cell mobilization by hyperbaric oxygen. *Am J Physiol Heart Circ. Physiol.* 2006;290:H1378-H1386.
119. Thom SR, Milovanova TN, Yang M, Bhopale VM, Sorokina EM, Uzun G, Malay DS, Troiano MA, Hardy KR, Lambert DW, Logue CJ, Margolis DJ. Vasculogenic stem cell mobilization and wound recruitment in diabetic patients: Increased cell number and intracellular protein content associated with hyperbaric oxygen therapy. *Wound Rep Reg.* 2011;19:149-161.
120. Stewart RJ, Yamaguchi KT, Cianci PE, Knost PM, Samadani S, Mason SW, Roshdieh B. Effects of hyperbaric oxygen on adenosine triphosphate in thermally injured skin. *Surg Forum.* 1988;39:87.
121. Stewart RJ, Yamaguchi KT, Cianci PE, Mason WW, Roshdieh BB, Dabbassi N. Burn wound Levels of ATP after exposure to elevated levels of oxygen. *Proceedings of the American Burn Association, New Orleans.* 1989:67.
122. Sureda A, Batle JM, Martorell M, Capo X, Tejada S, Tur JA, Pons A. Antioxidant response of chronic wounds to hyperbaric oxygen therapy. *PLoS One* 2016;11(9):e0163371.
123. Hunt JL, Sato RM, Baxter CR. Early tangential excision and immediate mesh auto-grafting of deep dermal hand burns. *Annals Surg.* 1979;189(2):147-151. (Orig paper)
124. Sato RM, Beesinger DE, Hunt JL, Baxter CR. Early excision and closure of the burn wound. *Current Topics in Burn Care.* TL Wachtel et al.(eds) Rockville, Aspen Publication;1983. Pp.65-76.(Orig paper)
125. Sato RM, Baxter CT. Tangential excision of the burn wound. *Recent advances in emergency and definitive burn wound care. Proceedings of a Symposium Sponsored by Valley Medical Center (Fresno, CA).* March 1977:16-24. CV2.
126. Sato R, Beesinger D, Hunt J, Baxter C. Early excision and closure of the burn wound. *Crit Care Q.* 1978;1(3):51-62. CV4.
127. Hunt JL, Sato RM. *Acute electrical burns. Uncommon problems in emergency medicine.* Miahcel I. Greenberg (ed). Philadelphia, F. A. Davis Company; 1982. Pp:183-195. CV11.
128. Hunt JL, Sato RM. Early Excision of Full-thickness hand and digit burns: Factors affecting morbidity. *J Trauma.* 1982;22(5):414-419. CV12.
129. Nichter LS, Morwood DT, Williams GS, Spence RJ. Expanding the limits of composite grafting: A case report of successful nose replantation assisted by hyperbaric oxygen therapy. *Plast Reconstr Surg.* 1991;87:337-340.
130. I-Han Chiang , Shyi-Gen Chen, Kun-Lun Huang, Yu-Ching Chou, Niann-Tzyy Dai, Chung-Kan Peng. Adjunctive hyperbaric oxygen therapy in severe burns: Experience in Taiwan Formosa Water Park dust explosion disaster. *Burns* 2017 Jun;43(4):852-857 doi: 10.1016/j.burns.2016.10.016. Epub 2016 Dec 27.
131. Oley MH, Oley MC, Aling DMR, Kalangi JA, Islam AA, Hatta M, IJ Patellongi Josh F, Faruk M. Effects of hyperbaric oxygen therapy on the healing of thermal burns and its relationship with ICAM-1: A case-control study. *Ann Med Surg (Lond).* 2020 Dec 25;61:104-109. doi: 10.1016/j.amsu.2020.12.025.eCollection 2021 Jan.
132. Jensen PO, Møller SA, Lerche CJ, Moser C, Bjarnsholt T, Ciofu O, Faurholt-Jepsen D, N Høiby N, Kolpen M. Improving antibiotic treatment of bacterial biofilm by hyperbaric oxygen therapy: Not just hot air. *Biofilm.* 2019 Nov 4;1:100008. doi: 10.1016/j.bioflm.2019.100008. eCollection 2019 Dec.
133. Radford EP. Fire death and casualties. Presented at the symposium on Physiological and Toxicological Aspects of Combustion Products. Committee on Fire Research, University of Utah, March 18-20, 1974.
134. Kindwall EP. The use of drugs under pressure. In: Kindwall EP, Whelan HT, editors. *Hyperbaric medicine practice.* 2nd ed. Flagstaff, AZ: Best Publishing Co.; 1999. P. 326.
135. Personal experience of the authors in a regional burn center.

136. Grube BJ, Marvin JA, Heimbach DM. Therapeutic hyperbaric oxygen: Help or hindrance in burn patients with carbon monoxide poisoning? *J Burn Care Rehabil.* 1988;9.
137. Kowalczyk L. Catastrophic costs: hospitals, insurers, some R.I. fire victims face huge medical bills. *The Boston Globe.* 2003 Feb 28.
138. Cost statistics (1997-98) from hospital patient accounts, home facility of the authors
139. Ozdemir U, Akin M, Sozen İ, Erkent M, Tatar S, Yasti AC. Effects of hyperbaric oxygen therapy on clinical and economic outcomes in patients with deep second-degree burns. *Undersea Hyperb Med.* 2023 First Quarter; 50(1):29-37.
140. Smolle C, Lindenmann J, Kamolz L, F-M. The history and development of hyperbaric oxygenation (HBO) in thermal burn injury. *Medicina (Kaunas)* 2021 Jan 8;57(1):49. doi: 10.3390/medicina57010049.
141. Weitgasser L, Ihra G, Schäfer B, Markstaller K, Radtke C. Update on hyperbaric oxygen therapy in burn treatment. *Wien Klin Wochenschr.* 2021 Feb;133(3-4):137-143.
142. Villanueva E, Bennett MH, Wasiaak J, Lehm JP. Hyperbaric oxygen therapy for thermal burns (Review). *Cochrane Database Syst Rev.* 2004;(3):CD004727.
143. Ong YS, Samuel M, Song C. Meta-analysis of early excision of burns. *Burns.* 2006;32(2):145-150.
144. Engrav LH, Heimbach DM, Rivara FP et al. Harborview burns 1974-2009. *PlosOne.* 2012;7(7):1-23.
145. Blaisdell LL, Chace R, Hallagan LD, Clark DE. A half century of burn epidemiology and burn care in a rural state. *J Burn Care Res.* 2012 May-Jun;33(3):347-353.
146. Rowan MP, Cancio LC, Elster EA, Burmeister DM, Rose LF, Natesan S, Chan RK, Christy RJ, Chung KK. Burn wound healing and treatment: Review and advancements. *Critical Care.* 2015; doi 10.1186/s13054-01509861-2.
147. McCann C, Watson A, Barnes D. Major burns: Part 1. Epidemiology, pathophysiology and initial management. *BJA Education* 2022. 22(3): 94e103.
148. Boykin JV Jr. Letter to the Editor, *Undersea Hyperb Med.* 2013 Mar-Apr;40(2):212.
149. Jeschke, Marc G. *Nature Reviews, Disease Primer, Article Citation,* 2026:11.

## References

1. George G, Lane JM. Osteonecrosis of the Femoral Head. *J Am Acad Orthop Surg Glob Res Rev.* 2022;6(5).
2. Mayers W, Schwartz B, Schwartz A, Moretti V, Goldstein W, Shah R. National trends and in hospital outcomes for total hip arthroplasty in avascular necrosis in the United States. *Int Orthop.* 2016;40(9):1787-1792.
3. Mankin HJ. Nontraumatic necrosis of bone (osteonecrosis). *N Engl J Med.* 1992;326(22):1473-1479.
4. Ludwig J, Lauber S, Lauber HJ, Dreisilker U, Raedel R, Hotzinger H. High-energy shock wave treatment of femoral head necrosis in adults. *Clin Orthop Relat Res.* 2001(387):119-126.
5. Sansone V, Ravier D, Pascale V, Applefield R, Del Fabbro M, Martinelli N. Extracorporeal Shockwave Therapy in the Treatment of Nonunion in Long Bones: A Systematic Review and Meta-Analysis. *J Clin Med.* 2022;11(7).
6. Massari L, Fini M, Cadossi R, Setti S, Traina GC. Biophysical stimulation with pulsed electromagnetic fields in osteonecrosis of the femoral head. *J Bone Joint Surg Am.* 2006;88 Suppl 3:56-60.
7. Zhang GL, Zhang YZ, Zhang XS, Gao L. Preliminary research of bi-planar fluoroscopic positioning robot-assisted core decompression for osteonecrosis of the femoral head. *Asian J Surg.* 2022;45(1):529-530.
8. Bisht R, Pariyar D, Joshi P. Single Stage Simultaneous Core Decompression for Ficat Stage I and II Bilateral Femoral Head Osteonecrosis among Hip Surgeries done in a Tertiary Care Centre: A Descriptive Cross-sectional Study. *JNMA J Nepal Med Assoc.* 2021;59(236):356-360.
9. Bozkurt I, Yalcin N, Uluyardimci E, Akgul EA. Combination of hyperbaric oxygen and core decompression therapies improve outcomes in the treatment of hip osteonecrosis. *Hip Int.* 2022;32(6):759-765.
10. Griffith MS, Shaw KA, Hattaway JK, Schrader T. Core Decompression and Bone Marrow Aspirate Concentrate in the Treatment of Femoral Head Avascular Necrosis in Pediatric Sickle Cell Disease: Can We Improve Natural History? *J Pediatr Orthop.* 2021;41(10):604-609.
11. Li Q, Liao W, Fu G, et al. Combining autologous bone marrow buffy coat and angioconductive bioceramic rod grafting with advanced core decompression improves short-term outcomes in early avascular necrosis of the femoral head: a prospective, randomized, comparative study. *Stem Cell Res Ther.* 2021;12(1):354.
12. Ma HY, Ma N, Liu YF, et al. Core Decompression with Local Administration of Zoledronate and Enriched Bone Marrow Mononuclear Cells for Treatment of Non-Traumatic Osteonecrosis of Femoral Head. *Orthop Surg.* 2021;13(6):1843-1852.
13. Pawar N, Vaish A, Vaishya R. Core decompression and bone marrow aspirate concentrate injection for Avascular Necrosis (AVN) of the femoral head: A scoping review. *J Clin Orthop Trauma.* 2022;24:101691.
14. Roth A, Beckmann J, Smolenski U, et al. [S3 guideline. Part 2: Non-Traumatic Avascular Femoral Head Necrosis in Adults - Untreated Course and Conservative Treatment]. *Z Orthop Unfall.* 2015;153(5):488-497.
15. Liu Q, Guo W, Li R, Lee JH. Efficacy of various core decompression techniques versus non-operative treatment for osteonecrosis of the femoral head: a systemic review and network meta-analysis of randomized controlled trials. *BMC Musculoskelet Disord.* 2021;22(1):948.
16. Assaf E, Bdeir M, Mohs E, et al. Singleton-Merten syndrome: A rare cause of femoral head necrosis. *Am J Med Genet A.* 2021;185(10):3170-3175.
17. Biddeci G, Bosco G, Varotto E, et al. Osteonecrosis in Children and Adolescents With Acute Lymphoblastic Leukemia: Early Diagnosis and New Treatment Strategies. *Anticancer Res.* 2019;39(3):1259-1266.
18. Uzun G, Mutluoglu M, Ersen O, Yildiz S. Hyperbaric oxygen therapy in the treatment of osteonecrosis of the femoral head: a review of the current literature. *Undersea Hyperb Med.* 2016;43(3):189-199.
19. Camporesi EM, Bosco G. Mechanisms of action of hyperbaric oxygen therapy. *Undersea Hyperb Med.* 2014;41(3):247-252.
20. Chandrinou A, Korompeli A, Grammatopoulou E, Gaitanou K, Tsoumakas K, Fildissis G. Avascular necrosis of the femoral head: Evaluation of hyperbaric oxygen therapy and quality of life. *Undersea Hyperb Med.* 2020;47(4):561-569.
21. Salameh M, Moghamis IS, Kokash O, Ahmed GO. Hyperbaric oxygen therapy for the treatment of Steinberg I and II avascular necrosis of the femoral head: a report of fifteen cases and literature review. *Int Orthop.* 2021;45(10):2519-2523.
22. Camporesi E, Vezzani G, Zanon V, et al. Review on hyperbaric oxygen treatment in femoral head necrosis. *Undersea Hyperb Med.* 2017;44(6):497-508.
23. Camporesi EM, Vezzani G, Bosco G, Mangar D, Bernasek TL. Hyperbaric oxygen therapy in femoral head necrosis. *J Arthroplasty.* 2010;25(6 Suppl):118-123.
24. Koren L, Ginesin E, Melamed Y, Norman D, Levin D, Peled E. Hyperbaric oxygen for stage I and II femoral head osteonecrosis. *Orthopedics.* 2015;38(3):e200-205.

25. Reis ND, Schwartz O, Militianu D, et al. Hyperbaric oxygen therapy as a treatment for stage-I avascular necrosis of the femoral head. *J Bone Joint Surg Br.* 2003;85(3):371-375.
26. Strauss MB, Dvorak T, Y M, Reis D. Femoral head necrosis and hyperbaric oxygen therapy. In: *Hyperbaric medicine practice.* Flagstaff (AZ): Best Publishing; 2008:943-944.
27. Bosco G, Vezzani G, Mrakic Sposta S, et al. Hyperbaric oxygen therapy ameliorates osteonecrosis in patients by modulating inflammation and oxidative stress. *J Enzyme Inhib Med Chem.* 2018;33(1):1501-1505.
28. Vezzani G, Quartesan S, Cancellara P, et al. Hyperbaric oxygen therapy modulates serum OPG/RANKL in femoral head necrosis patients. *J Enzyme Inhib Med Chem.* 2017;32(1):707-711.
29. Wang J, Wang K, Shi Z, Zhang M. [Osteoprotegerin mRNA/receptor activator of NF-kappaB ligand mRNA expressions in bone tissues of glucocorticoid-induced osteonecrosis of the femoral head]. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi.* 2008;22(10):1161-1164.
30. Al Hadi H, Smerdon GR, Fox SW. Hyperbaric oxygen therapy accelerates osteoblast differentiation and promotes bone formation. *J Dent.* 2015;43(3):382-388.
31. Hadi HA, Smerdon G, Fox SW. Osteoclastic resorptive capacity is suppressed in patients receiving hyperbaric oxygen therapy. *Acta Orthop.* 2015;86(2):264-269.
32. Al Hadi H, Smerdon GR, Fox SW. Hyperbaric oxygen therapy suppresses osteoclast formation and bone resorption. *J Orthop Res.* 2013;31(11):1839-1844.
33. Li W, Ye Z, Wang W, Wang K, Li L, Zhao D. Clinical effect of hyperbaric oxygen therapy in the treatment of femoral head necrosis : A systematic review and meta-analysis. *Orthopade.* 2017;46(5):440-446.
34. Vezzani G, Camporesi E, Mangar D, et al. Beneficial effect of hyperbaric oxygenation in avascular necrosis of the femoral head. *Gazz Med Ital.* 2018;177(3):72-78.
35. Mathieu D, Marroni A, Kot J. Tenth European Consensus Conference on Hyperbaric Medicine: recommendations for accepted and non-accepted clinical indications and practice of hyperbaric oxygen treatment. *Diving Hyperb Med.* 2017;47(1):24-32.
36. Bosco G, Vezzani G, Enten G, Manelli D, Rao N, Camporesi EM. Femoral condylar necrosis: treatment with hyperbaric oxygen therapy. *Arthroplast Today.* 2018;4(4):510-515.
37. Moghamis I, Alhammoud AA, Kokash O, Alhaneedi GA. The outcome of hyperbaric oxygen therapy versus core decompression in the non-traumatic avascular necrosis of the femoral head: Retrospective Cohort Study. *Ann Med Surg (Lond).* 2021;62:450-454.
38. Paderno E, Zanon V, Vezzani G, et al. Evidence-Supported HBO Therapy in Femoral Head Necrosis: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health.* 2021;18(6).
39. Zhang Y, Wang Y, Chen J, et al. The Top 100 Cited Articles in Osteonecrosis of the Femoral Head: A Bibliometric Analysis. *Biomed Res Int.* 2021;2021:1433684.



## References

1. Yarbrough O, Behnke A. The treatment of compressed air illness. *J Ind Hyg Toxicol*. 1939;21:213–8.
2. Churchill-Davidson I, Sanger C, Thomlinson R. High-pressure oxygen and radiotherapy. *Lancet (London, England)*. 1955 May 28;268(6874):1091–5.
3. Boerema I, Huiskes J, Kroll J, Kroon B, Lokin E, Meyne N. High atmospheric pressure as an aid to cardiac surgery. *Arch Chir Neerl*. 1956;8(3):193–211.
4. Brummelkamp WH, Hogendijk J, Boerema I. Treatment of anaerobic infections (clostridial myositis) by drenching the tissues with oxygen under high atmospheric pressure. *Surgery*. 1961 Mar 1;49(3):299–302.
5. Smith G, Ledingham IM, Sharp GR, Norman JN, Bates EH. Treatment of coal-gas poisoning with oxygen at 2 atmospheres pressure. *Lancet*. 1962 Apr 21 [cited 2019 Feb 22];279(7234):816–9.
6. Muth CM, Shank ES. Gas Embolism. *N Engl J Med [Internet]*. 2000 Feb 17;342(7):476–82.
7. Thom SR. Oxidative stress is fundamental to hyperbaric oxygen therapy. *J Appl Physiol*. 2009 Mar;106(3):988–95.
8. Vorosmarti J. Hyperbaric oxygen therapy. *Am Fam Physician*. 1981 Jan;23(1):169–73.
9. Clark J, Whelan HT. Hyperbaric medicine practice. In: Kindwall & H.T. Whelan, editor. Best Publishing Company; 1994.
10. Davis JC. Hyperbaric oxygen therapy. *J Intensive Care Med*. 1989 Mar 30;4(2):55–7.
11. Camporesi EM, Bosco G. Mechanisms of action of hyperbaric oxygen therapy. *Undersea Hyperb Med*. 2014;41(3):247–52.
12. Thom SR. Hyperbaric oxygen: its mechanisms and efficacy. *Plast Reconstr Surg*. 2011 Jan;127:131S–141S.
13. Falanga V. Wound healing and its impairment in the diabetic foot. *Lancet*. 2005 Nov 12;366(9498):1736–43.
14. Marx RE. Osteoradionecrosis: a new concept of its pathophysiology. *J Oral Maxillofac Surg*. 1983 May;41(5):283–8.
15. Hunt TK, Aslam RS, Beckert S, Wagner S, Ghani QP, Hussain MZ, et al. Aerobically derived lactate stimulates revascularization and tissue repair via redox mechanisms. *Antioxid Redox Signal*. 2007 Aug;9(8):1115–24.
16. Milovanova TN, Bhopale VM, Sorokina EM, Moore JS, Hunt TK, Hauer-Jensen M, et al. Lactate stimulates vasculogenic stem cells via the thioredoxin system and engages an autocrine activation loop involving hypoxia-inducible factor 1. *Mol Cell Biol*. 2008 Oct 15;28(20):6248–61.
17. Bosco G, Yang Z, Nandi J, Wang J, Chen C, Camporesi EM. Effects of hyperbaric oxygen on glucose, lactate, glycerol, and antioxidant enzymes in the skeletal muscle of rats during ischemia and reperfusion. *Clin Exp Pharmacol Physiol*. 2007 Jan;34(1–2):70–6.
18. Sharifi M, Fares W, Abdel-Karim I, Petrea D, Koch JM, Adler D, et al. Inhibition of restenosis by hyperbaric oxygen: a novel indication for an old modality. *Cardiovasc Radiat Med*. 2002;3(3–4):124–6.
19. Sharifi M, Fares W, Abdel-Karim I, Koch JM, Sopko J, Adler D, et al. Usefulness of hyperbaric oxygen therapy to inhibit restenosis after percutaneous coronary intervention for acute myocardial infarction or unstable angina pectoris. *Am J Cardiol*. 2004 Jun 15;93(12):1533–5.
20. Yang ZJ, Bosco G, Montante A, Ou XI, Camporesi EM. Hyperbaric O<sub>2</sub> reduces intestinal ischemia-reperfusion induced TNF- $\alpha$  production and lung neutrophil sequestration. *Eur J Appl Physiol*. 2001 Jul 5;85(1–2):96–103.
21. Yang Z, Nandi J, Wang J, Bosco G, Gregory M, Chung C, et al. Hyperbaric oxygenation ameliorates indomethacin-induced enteropathy in rats by modulating TNF- and IL-1 production. *Dig Dis Sci*. 2006 Aug 13;51(8):1426–33.
22. Baynosa RC, Naig AL, Murphy PS, Fang XH, Stephenson LL, Khiabani KT, et al. The effect of hyperbaric oxygen on nitric oxide synthase activity and expression in ischemia-reperfusion injury. *J Surg Res*. 2013 Jul;183(1):355–61.
23. Hampson NB, Piantadosi CA, Thom SR, Weaver LK. Practice recommendations in diagnosing, managing, and preventing carbon monoxide poisoning. *Am J Respir Crit Care Med*. 2012 Dec 1;186(11):1095–101.
24. Vann RD, Butler FK, Mitchell SJ, Moon RE. Decompression illness. In: *The Lancet*. Elsevier; 2011. Pp: 153–64.
25. Moon RE. Hyperbaric oxygen treatment for air or gas embolism. *Undersea Hyperb Med*. 2014;41(2):159–66.
26. Thom SR, Bhopale VM, Mancini DJ, Milovanova TN. Actin S-nitrosylation inhibits neutrophil beta2 integrin function. *J Biol Chem*. 2008 Apr 18;283(16):10822–34.
27. Mori H, Shinohara H, Arakawa Y, Kanemura H, Ikemoto T, Imura S, et al. Beneficial effects of hyperbaric oxygen pretreatment on massive hepatectomy model in rats. *Transplantation [Internet]*. 2007 Dec 27 [cited 2019 Feb 22];84(12):1656–61.
28. Yang ZJ, Xie Y, Bosco GM, Chen C, Camporesi EM. Hyperbaric oxygenation alleviates MCAO-induced brain injury and reduces hydroxyl radical formation and glutamate release. *Eur J Appl Physiol*. 2010 Feb 23;108(3):513–22.

29. Bosco G, Vezzani G, Mrakic Sposta S, Rizzato A, Enten G, Abou-Samra A, et al. Hyperbaric oxygen therapy ameliorates osteonecrosis in patients by modulating inflammation and oxidative stress. *J Enzyme Inhib Med Chem*. 2018 Dec;33(1):1501–5.
30. Gorbach SL, Bartlett JG. Anaerobic Infections. *N Engl J Med*. 1974 May 23;290(21):1177–84.
31. Zanon V, Rossi L, Castellani E, Camporesi EM, Palù G, Bosco G. Oxybiotest project: microorganisms under pressure. Hyperbaric oxygen (HBO) and simple pressure interaction on selected bacteria. *Med Gas Res*. 2012 Sep 11;2(1):24.
32. Mader JT, Brown GL, Guckian JC, Wells CH, Reinartz JA. A mechanism for the amelioration by hyperbaric oxygen of experimental staphylococcal osteomyelitis in rabbits. *J Infect Dis*. 1980 Dec;142(6):915–22.
33. Almzaiel AJ, Billington R, Smerdon G, Moody AJ. Effects of hyperbaric oxygen treatment on antimicrobial function and apoptosis of differentiated HL-60 (neutrophil-like) cells. *Life Sci*. 2013 Jul 30;93(2–3):125–31.
34. Wu Y, Klapper I, Stewart PS. Hypoxia arises from concerted oxygen consumption by neutrophils and microorganisms in biofilms. *Pathog Dis*. 2018 Jun 1;76(4).
35. Kolpen M, Lerche CJ, Kragh KN, Sams T, Koren K, Jensen AS, et al. Hyperbaric oxygen sensitizes anoxic *Pseudomonas aeruginosa* biofilm to ciprofloxacin. *Antimicrob Agents Chemother*. 2017 Nov;61(11).
36. Lerche CJ, Christophersen LJ, Kolpen M, Nielsen PR, Trøstrup H, Thomsen K, et al. Hyperbaric oxygen therapy augments tobramycin efficacy in experimental *Staphylococcus aureus* endocarditis. *Int J Antimicrob Agents*. 2017 Sep;50(3):406–12.
37. Sanford NE, Wilkinson JE, Nguyen H, Diaz G, Wolcott R. Efficacy of hyperbaric oxygen therapy in bacterial biofilm eradication. *J Wound Care*. 2018 Jan 1;27(Sup1):S20–8.
38. Ishii Y, Miyanaga Y, Shimojo H, Ushida T, Tateishi T. Effects of hyperbaric oxygen on procollagen messenger RNA levels and collagen synthesis in the healing of rat tendon laceration. *Tissue Eng*. 1999 Jun;5(3):279–86.
39. Weisz G, Lavy A, Adir Y, Melamed Y, Rubin D, Eidelman S, et al. Modification of in vivo and in vitro TNF-alpha, IL-1, and IL-6 secretion by circulating monocytes during hyperbaric oxygen treatment in patients with perianal Crohn's disease. *J Clin Immunol*. 1997 Mar;17(2):154–9.
40. Tsai H-M, Gao C-J, Li W-X, Lin M-T, Niu K-C. Resuscitation from experimental heatstroke by hyperbaric oxygen therapy. *Crit Care Med*. 2005 Apr;33(4):813–8.
41. Zhao LL, Davidson JD, Wee SC, Roth SI, Mustoe TA. Effect of hyperbaric oxygen and growth factors on rabbit ear ischemic ulcers. *Arch Surg*. 1994 Oct 1;129(10):1043.
42. Gleadle JM, Ratcliffe PJ. Hypoxia and the regulation of gene expression. *Mol Med Today*. 1998 Mar 1;4(3):122–9.
43. Haroon ZA, Raleigh JA, Greenberg CS, Dewhirst MW. Early wound healing exhibits cytokine surge without evidence of hypoxia. *Ann Surg*. 2000 Jan;231(1):137–47.
44. Thom SR, Bhopale V, Fisher D, Manevich Y, Huang PL, Buerk DG. Stimulation of nitric oxide synthase in cerebral cortex due to elevated partial pressures of oxygen: an oxidative stress response. *J Neurobiol*. 2002 May;51(2):85–100.
45. Thom SR, Fisher D, Zhang J, Bhopale VM, Ohnishi ST, Kotake Y, et al. Stimulation of perivascular nitric oxide synthesis by oxygen. *Am J Physiol Circ Physiol*. 2003 Apr;284(4):H1230–9.
46. Boykin J V, Baylis C. Hyperbaric oxygen therapy mediates increased nitric oxide production associated with wound healing: a preliminary study. *Adv Skin Wound Care*. 2007 Jul;20(7):382–8.
47. Kendall AC, Whatmore JL, Harries LW, Winyard PG, Smerdon GR, Eggleton P. Changes in inflammatory gene expression induced by hyperbaric oxygen treatment in human endothelial cells under chronic wound conditions. *Exp Cell Res*. 2012 Feb 1;318(3):207–16.
48. Oter S, Korkmaz A, Topal T, Ozcan O, Sadir S, Ozler M, et al. Correlation between hyperbaric oxygen exposure pressures and oxidative parameters in rat lung, brain, and erythrocytes. *Clin Biochem*. 2005 Aug;38(8):706–11.
49. Palzur E, Zaaroor M, Vlodavsky E, Milman F, Soustiel JF. Neuroprotective effect of hyperbaric oxygen therapy in brain injury is mediated by preservation of mitochondrial membrane properties. *Brain Res*. 2008 Jul 24;1221:126–33.
50. Brentnall M, Rodriguez-Menocal L, De Guevara R, Cepero E, Boise LH. Caspase-9, caspase-3 and caspase-7 have distinct roles during intrinsic apoptosis. *BMC Cell Biol*. 2013 Jul 9;14(1):32.
51. Hink J, Jansen E. Are superoxide and/or hydrogen peroxide responsible for some of the beneficial effects of hyperbaric oxygen therapy? *Med Hypotheses*. 2001 Dec;57(6):764–9.
52. Vlodavsky E, Palzur E, Soustiel JF. Hyperbaric oxygen therapy reduces neuroinflammation and expression of matrix metalloproteinase-9 in the rat model of traumatic brain injury. *Neuropathol Appl Neurobiol*. 2006 Feb;32(1):40–50.
53. Tracey DJ, Walker JS. Pain due to nerve damage: are inflammatory mediators involved? *Inflamm Res*. 1995 Oct;44(10):407–11.

54. Zhang J-M, An J. Cytokines, inflammation, and pain. *Int Anesthesiol Clin.* 2007;45(2):27–37.
55. Ren K, Torres R. Role of interleukin-1beta during pain and inflammation. *Brain Res Rev.* 2009 Apr;60(1):57–64.
56. Thompson CD, Uhelski ML, Wilson JR, Fuchs PN. Hyperbaric oxygen treatment decreases pain in two nerve injury models. *Neurosci Res.* 2010 Mar;66(3):279–83.
57. Gu N, Niu J-Y, Liu W-T, Sun Y-Y, Liu S, Lv Y, et al. Hyperbaric oxygen therapy attenuates neuropathic hyperalgesia in rats and idiopathic trigeminal neuralgia in patients. *Eur J Pain.* 2012 Sep;16(8):1094–105.
58. Inamoto Y, Okuno F, Saito K, Tanaka Y, Watanabe K, Morimoto I, et al. Effect of hyperbaric oxygenation on macrophage function in mice. *Biochem Biophys Res Commun.* 1991 Sep 16;179(2):886–91.
59. Li F, Fang L, Huang S, Yang Z, Nandi J, Thomas S, et al. Hyperbaric oxygenation therapy alleviates chronic constrictive injury-induced neuropathic pain and reduces tumor necrosis factor-alpha production. *Anesth Analg.* 2011 Sep;113(3):626–33.
60. Ohgami Y, Zylstra CC, Quock LP, Chung E, Shirachi DY, Quock RM. Nitric oxide in hyperbaric oxygen-induced acute antinociception in mice. *Neuroreport.* 2009 Oct 7;20(15):1325–9.
61. Zelinski LM, Ohgami Y, Chung E, Shirachi DY, Quock RM. A prolonged nitric oxide-dependent, opioid-mediated antinociceptive effect of hyperbaric oxygen in mice. *J Pain.* 2009 Feb;10(2):167–72.
62. Camporesi EM, Vezzani G, Bosco G, Mangar D, Bernasek TL. Hyperbaric oxygen therapy in femoral head necrosis. *J Arthroplasty.* 2010 Sep 1;25(6):118–23.
63. Bosco G, Vezzani G, Enten G, Manelli D, Rao N, Camporesi EM. Femoral condylar necrosis: treatment with hyperbaric oxygen therapy. *Arthroplasty today.* 2018 Dec;4(4):510–5.
64. Camporesi EM, Vezzani G, Zanon V, Manelli D, Enten G, Quartesan S, et al. Review on hyperbaric oxygen treatment in femoral head necrosis. *Undersea Hyperb Med.* 2017;44(6):497–508.
65. Hadi H Al, Smerdon GR, Fox SW. Hyperbaric oxygen therapy suppresses osteoclast formation and bone resorption. *J Orthop Res.* 2013 Jul;31(11).
66. Vezzani G, Quartesan S, Cancellara P, Camporesi EM, Mangar D, Bernasek T, et al. Hyperbaric oxygen therapy modulates serum OPG/RANKL in femoral head necrosis patients. *J Enzyme Inhib Med Chem.* 2017;32(1):707–11.
67. Hayakawa, K.; Esposito, E.; Wang, X.; Terasaki, Y.; Liu, Y.; Xing, C.; Ji, X.; Lo, E.H. Transfer of mitochondria from astrocytes to neurons after stroke. *Nature* 2016, 535, 551–555.
68. Fairley, L.H.; Grimm, A.; Eckert, A. Mitochondria Transfer in Brain Injury and Disease. *Cells* 2022, 11,3603. <https://doi.org/10.3390/cells11223603>
69. Chen, W., Huang, J., Hu, Y. et al. Mitochondrial Transfer as a Therapeutic Strategy Against Ischemic Stroke. *Transl. Stroke Res.* 11, 1214–1228 (2020). <https://doi.org/10.1007/s12975-020-00828-7>
70. Paola Pizzo, Tullio Pozzan, Mitochondrialand: What Will Come Next?, *Function*, Volume 3, Issue 1, 2022, zqab073, <https://doi.org/10.1093/function/zqab073>
71. Cheng Li, Marco K.H. Cheung, Shuo Han, Zhao Zhang, Ling Chen, Junhui Chen, Hui Zeng, Jianxiang Qiu; Mesenchymal stem cells and their mitochondrial transfer: a double-edged sword. *Biosci Rep* 1 May 2019; 39 (5): BSR20182417. doi: <https://doi.org/10.1042/BSR20182417>
72. Clair Crewe, Jan-Bernd Funcke, Shujuan Li, Nolwenn Joffin, Christy M. Gliniak, Alexandra L. Ghaben, Yu A. An, Hesham A. Sadek, Ruth Gordillo, Yucel Akgul, Shiuhwei Chen, Dmitri Samovski, Pamela Fischer-Posovszky, Christine M. Kusminski, Samuel Klein, Philipp E. Scherer. Extracellular vesicle-based interorgan transport of mitochondria from energetically stressed adipocytes. *Cell Metabolism.* Volume 33, Issue 9, 2021, pp 1853-1868. e11. doi:<https://doi.org/10.1016/j.cmet.2021.08.002>.
73. Liu, D., Gao, Y., Liu, J. et al. Intercellular mitochondrial transfer as a means of tissue revitalization. *Sig Transduct Target Ther* 6, 65 (2021). <https://doi.org/10.1038/s41392-020-00440-z>.
74. Russo E, Nguyen H, Lippert T, Tuazon J, Borlongan CV, Napoli E. Mitochondrial targeting as a novel therapy for stroke. *Brain Circ.* 2018 Jul-Sep;4(3):84-94. doi: 10.4103/bc.bc\_14\_18. Epub 2018 Oct 9. PMID: 30450413; PMCID: PMC6187947.
75. Russo E, Napoli E, Borlongan CV. Healthy mitochondria for stroke cells. *Brain Circ.* 2018 Jul-Sep;4(3):95-98. doi: 10.4103/bc.bc\_20\_18. Epub 2018 Oct 9. PMID: 30450414; PMCID: PMC6187944.
76. Lippert T, Borlongan CV. Prophylactic treatment of hyperbaric oxygen treatment mitigates inflammatory response via mitochondria transfer. *CNS Neurosci Ther.* 2019 Aug;25(8):815-823. doi: 10.1111/cns.13124. Epub 2019 Apr 11. PMID: 30972972; PMCID: PMC6630002.

## References

1. Thom, S.R., *Analytic reviews: hyperbaric oxygen therapy*. Journal of Intensive Care Medicine, 1989. **4**(2): p. 58-74.
2. Thom, S.R., *Hyperbaric oxygen: its mechanisms and efficacy*. Wound Healing Supplement, 2011. **127**: p. 131S-41S.
3. Heyboer, M., 3rd, et al., *Seizure incidence by treatment pressure in patients undergoing hyperbaric oxygen therapy*. Undersea & Hyperbaric Medicine, 2014. **41**(5): p. 379-85.
4. Shupak A, G.P., *Effects of Pressure*, in *Physiology and Medicine of Hyperbaric Oxygen Therapy*, T.S. Neuman TS, Editor. 2008, Saunders Elsevier: Philadelphia, PA. p. 513-526.
5. Beuerlein, M., R.N. Nelson, and D.B. Welling, *Inner and middle ear hyperbaric oxygen-induced barotrauma*. Laryngoscope, 1997. **107**(10): p. 1350-6.
6. O'Neill, O.J. and E.D. Weitzner, *The O'Neill grading system for evaluation of the tympanic membrane: A practical approach for clinical hyperbaric patients*. Undersea & Hyperbaric Medicine, 2015. **42**(3): p. 265-71.
7. Heyboer, M., 3rd, et al., *Hyperbaric Oxygen Therapy: Side Effects Defined and Quantified*. Adv Wound Care (New Rochelle), 2017. **6**(6): p. 210-224.
8. Commons, K.H., D.F. Blake, and L.H. Brown, *A prospective analysis of independent patient risk factors for middle ear barotrauma in a multiplace hyperbaric chamber*. Diving & Hyperbaric Medicine, 2013. **43**(3): p. 143-7.
9. Fitzpatrick, D.T., et al., *Risk factors for symptomatic otic and sinus barotrauma in a multiplace hyperbaric chamber*. Undersea & Hyperbaric Medicine, 1999. **26**(4): p. 243-7.
10. Heyboer, M., 3rd, et al., *Middle ear barotrauma in hyperbaric oxygen therapy*. Undersea & Hyperbaric Medicine, 2014. **41**(5): p. 393-97.
11. Presswood, G., et al., *Effect of artificial airway on ear complications from hyperbaric oxygen*. Laryngoscope, 1994. **104**(11 Pt 1): p. 1383-4.
12. Mozdzanowski, C. and G.A. Perdrizet, *Peripheral neuropathy may increase the risk for asymptomatic otic barotrauma during hyperbaric oxygen therapy: research report*. Undersea & Hyperbaric Medicine, 2014. **41**(4): p. 267-72.
13. Vahidova, D., et al., *Does the slow compression technique of hyperbaric oxygen therapy decrease the incidence of middle-ear barotrauma?* Journal of Laryngology & Otology, 2006. **120**(6): p. 446-9.
14. Bessereau, J., et al., *Middle-ear barotrauma after hyperbaric oxygen therapy*. Undersea & Hyperbaric Medicine, 2010. **37**(4): p. 203-8.
15. Edinguele, W., et al., *Middle-ear barotrauma after hyperbaric oxygen therapy: a five-year retrospective analysis on 2,610 patients*. Undersea & Hyperbaric Medicine, 2020. **47**(2): p. 217-228.
16. Nasole, E., et al., *Middle ear barotrauma during hyperbaric oxygen therapy; a review of occurrences in 5,962 patients*. Undersea & Hyperbaric Medicine, 2019. **46**(2): p. 101-106.
17. Saxena, N. and D. Raghavan, *A study to determine the incidence of otitic barotrauma during hyperbaric oxygen therapy*. Indian Journal of Otology, 2020. **26**(4): p. 254.
18. Fiessler, F.W., et al., *Indication for hyperbaric oxygen treatment as a predictor of tympanostomy tube placement*. Undersea & Hyperbaric Medicine, 2006. **33**(4): p. 231-5.
19. Karahatay, S., et al., *Middle ear barotrauma with hyperbaric oxygen therapy: incidence and the predictive value of the nine-step inflation/deflation test and otoscopy*. Ear, Nose, & Throat Journal, 2008. **87**(12): p. 684-8.
20. O'Neill, O.J., et al., *The effect of total compression time and rate (slope) of compression on the incidence of symptomatic Eustachian tube dysfunction and middle ear barotrauma: a Phase II prospective study*. Undersea & Hyperbaric Medicine, 2021. **48**(3): p. 209-219.
21. Varughese, L., et al., *The effect of compression rate and slope on the incidence of symptomatic Eustachian tube dysfunction leading to middle ear barotrauma: a Phase I prospective study*. Undersea & Hyperbaric Medicine, 2019. **46**(2): p. 95-100.
22. Carlson, S., et al., *Prevention of hyperbaric-associated middle ear barotrauma*. Annals of Emergency Medicine, 1992. **21**(12): p. 1468-71.
23. Millan, S.B., et al., *Prevention of middle ear barotrauma with oxymetazoline/fluticasone treatment*. Undersea & Hyperbaric Medicine, 2021. **48**(2): p. 149-152.
24. Brown, M., J. Jones, and J. Krohmer, *Pseudoephedrine for the prevention of barotitis media: a controlled clinical trial in underwater divers*. Annals of Emergency Medicine, 1992. **21**(7): p. 849-52.
25. O'Neill, O.J., et al., *Proof of concept study using a modified Politzer inflation device as a rescue modality for treating Eustachian tube dysfunction during hyperbaric oxygen treatment in a multiplace (Class A) chamber*. Undersea & Hyperbaric Medicine, 2019. **46**(1): p. 55-61.
26. Wolf, E.G., et al., *Hyperbaric side effects in a traumatic brain injury randomized clinical trial*. Undersea Hyperb Med, 2012. **39**(6): p. 1075-82.

27. Taylor, D.M., K.S. O'Toole, and C.M. Ryan, *Experienced scuba divers in Australia and the United States suffer considerable injury and morbidity*. Wilderness Environ Med, 2003. **14**(2): p. 83-8.
28. Carlson, O.G., B.A. Halverson, and R.G. Triplett, *Dentin permeability under hyperbaric conditions as a possible cause of barodontalgia*. Undersea Biomedical Research, 1983. **10**(1): p. 23-8.
29. Robichaud, R. and M.E. McNally, *Barodontalgia as a differential diagnosis: symptoms and findings*. Journal (Canadian Dental Association), 2005. **71**(1): p. 39-42.
30. Stoetzer, M., et al., *Pathophysiology of Barodontalgia: A Case Report and Review of the Literature*. Case Reports in Dentistry, 2012. **2012**: p. 453415.
31. Macklin, C., *TRANSPORT OF AIR ALONG SHEATHS OF PULMONIC BLOOD VESSELS FROM ALVEOLI TO MEDIASTINUM: CLINICAL IMPLICATIONS*. Archives of internal medicine, 1939. **64**(5): p. 913-926.
32. Sahni, S., et al., *Spontaneous pneumomediastinum: time for consensus*. N Am J Med Sci, 2013. **5**(8): p. 460-4.
33. Kaneki, T., et al., *Spontaneous pneumomediastinum in 33 patients: yield of chest computed tomography for the diagnosis of the mild type*. Respiration, 2000. **67**(4): p. 408-11.
34. Cakmak, T., et al., *A case of tension pneumothorax during hyperbaric oxygen therapy in an earthquake survivor with crush injury complicated by ARDS (adult respiratory distress syndrome)*. Undersea Hyperb Med, 2015. **42**(1): p. 9-13.
35. Unsworth, I.P., *Case report. Pulmonary barotrauma in a hyperbaric chamber*. Anaesthesia, 1973. **28**(6): p. 675-8.
36. Wolf, H.K., et al., *Barotrauma and air embolism in hyperbaric oxygen therapy*. Am J Forensic Med Pathol, 1990. **11**(2): p. 149-53.
37. Rivalland, G., S.J. Mitchell, and J.M. Van Schalkwyk, *Pulmonary barotrauma and cerebral arterial gas embolism during hyperbaric oxygen therapy*. Aviation, space, and environmental medicine, 2010. **81**(9): p. 888-890.
38. Buschmann, D.K., *Arterial Gas Embolism During Pressure Tolerance Testing in a Hyperbaric Chamber: A Report of Two Cases*. Aviation, space, and environmental medicine, 2010. **81**(12): p. 1133-1136.
39. Brenna, C.T., et al., *The role of routine pulmonary imaging before hyperbaric oxygen treatment*. Diving and hyperbaric medicine, 2022. **52**(3): p. 197-207.
40. Heyboer, M., et al., *Use of in-chamber transcutaneous oxygen measurement to determine optimal treatment pressure in patients undergoing hyperbaric oxygen therapy*. Undersea Hyperb Med, 2018. **45**(4): p. 389-394.
41. Lambertsen, C.J., et al., *Oxygen toxicity; effects in man of oxygen inhalation at 1 and 3.5 atmospheres upon blood gas transport, cerebral circulation and cerebral metabolism*. Journal of Applied Physiology, 1953. **5**(9): p. 471-86.
42. Torbati, D., et al., *Free radical generation in the brain precedes hyperbaric oxygen-induced convulsions*. Free Radical Biology & Medicine, 1992. **13**(2): p. 101-6.
43. Bitterman, N., *CNS oxygen toxicity*. Undersea & Hyperbaric Medicine, 2004. **31**(1): p. 63-72.
44. Chavko, M., C.R. Aufer, and R.M. McCarron, *Relationship between protein nitration and oxidation and development of hyperoxic seizures*. Nitric Oxide, 2003. **9**(1): p. 18-23.
45. Clark, J., *Oxygen Toxicity*, in *Physiology and Medicine of Hyperbaric Oxygen Therapy*, T.S. Neuman TS, Editor. 2008, Saunders Elsevier: Philadelphia, PA. p. 527-564.
46. Kellogg, R.H., *"La Pression barometrique": Paul Bert's hypoxia theory and its critics*. Respiration Physiology, 1978. **34**(1): p. 1-28.
47. Donald, K.W., *Oxygen poisoning in man; signs and symptoms of oxygen poisoning*. Br Med J, 1947. **1**(4507): p. 712-7.
48. Donald, K.W., *Oxygen poisoning in man*. Br Med J, 1947. **1**(4506): p. 667; passim.
49. Davis, J.C., *Hyperbaric Oxygen Therapy*. Journal of Intensive Care Medicine, 1989. **4**(2): p. 55-57.
50. Welslau, W. and M. Almeling, *Toxicity of hyperbaric oxygen (HBO)--incidence of major CNS-intoxications*. Strahlentherapie und Onkologie, 1996. **172 Suppl 2**: p. 10-2.
51. Hadanny, A., et al., *Seizures during hyperbaric oxygen therapy: retrospective analysis of 62,614 treatment sessions*. Undersea & Hyperbaric Medicine, 2016. **43**(1): p. 21-8.
52. Jokinen-Gordon, H., et al., *A retrospective analysis of adverse events in hyperbaric oxygen therapy (2012-2015): lessons learned from 1.5 million treatments*. Advances in Skin & Wound Care, 2017. **30**(3): p. 125-129.
53. Costa, D.A., et al., *Seizure frequency in more than 180,000 treatment sessions with hyperbaric oxygen therapy - a single centre 20-year analysis*. Diving & Hyperbaric Medicine, 2019. **49**(3): p. 167-174.
54. Yildiz, S., et al., *Seizure incidence in 80,000 patient treatments with hyperbaric oxygen*. Aviation Space & Environmental Medicine, 2004. **75**(11): p. 992-4.
55. Lee, C.H., et al., *Seizure during hyperbaric oxygen therapy: experience at a single academic hospital in Korea*. Undersea & Hyperbaric Medicine, 2021. **48**(1): p. 43-51.
56. Sherlock, S., M. Way, and A. Tabah, *Audit of practice in Australasian hyperbaric units on the incidence of central nervous system oxygen toxicity*. Diving & Hyperbaric Medicine, 2018. **48**(2): p. 73-78.
57. Banham, N.D., *Oxygen toxicity seizures: 20 years' experience from a single hyperbaric unit*. Diving & Hyperbaric Medicine, 2011. **41**(4): p. 202-10.

58. Hampson, N. and D. Atik, *Central nervous system oxygen toxicity during routine hyperbaric oxygen therapy*. Undersea & Hyperbaric Medicine, 2003. **30**(2): p. 147-53.
59. Plafki, C., et al., *Complications and side effects of hyperbaric oxygen therapy*. Aviat Space Environ Med, 2000. **71**(2): p. 119-24.
60. Sloan, E.P., et al., *Complications and protocol considerations in carbon monoxide-poisoned patients who require hyperbaric oxygen therapy: Report from a ten-year experience*. Annals of Emergency Medicine, 1989. **18**(6): p. 629-634.
61. Hampson, N.B., et al., *Central nervous system oxygen toxicity during hyperbaric treatment of patients with carbon monoxide poisoning*. Undersea & Hyperbaric Medicine, 1996. **23**(4): p. 215-9.
62. Keenan, H.T., et al., *Delivery of hyperbaric oxygen therapy to critically ill, mechanically ventilated children*. J Crit Care, 1998. **13**(1): p. 7-12.
63. Sanders, R.W., et al., *Seizure during hyperbaric oxygen therapy for carbon monoxide toxicity: a case series and five-year experience*. Journal of Emergency Medicine, 2012. **42**(4): p. e69-72.
64. Clark, J. and C. Lambertsen, *Rate of development of pulmonary O<sub>2</sub> toxicity in man during O<sub>2</sub> breathing at 2.0 Ata*. Journal of Applied Physiology, 1971. **30**(5): p. 739-752.
65. Caldwell, P.R., et al., *Changes in lung volume, diffusing capacity, and blood gases in men breathing oxygen*. J Appl Physiol, 1966. **21**(5): p. 1477-83.
66. Clark, J., et al., *Effects of prolonged oxygen exposure at 1.5, 2.0, or 2.5 ATA on pulmonary function in men (Predictive Studies V)*. Journal of applied physiology, 1999. **86**(1): p. 243-259.
67. Clark, J.M. and C.J. Lambertsen, *Pulmonary oxygen toxicity: a review*. Pharmacological reviews, 1971. **23**(2): p. 37-133.
68. COMROE, J.H., et al., *Oxygen toxicity: the effect of inhalation of high concentrations of oxygen for twenty-four hours on normal men at sea level and at a simulated altitude of 18,000 feet*. Journal of the American Medical Association, 1945. **128**(10): p. 710-717.
69. EL, M., L. RW, and G. CF, *Effect of continuous human exposure to oxygen tension of 418 mmHg for 168 hours*. Aerosp Med, 1960. **31**: p. 138-144.
70. Herlocher, J.E., et al., *Physiologic response to increased oxygen partial pressure. I. Clinical observations*. Aerospace Med, 1964. **35**: p. 613-618.
71. Thorsen, E., L. Aanderud, and T. Aasen, *Effects of a standard hyperbaric oxygen treatment protocol on pulmonary function*. European Respiratory Journal, 1998. **12**(6): p. 1442-1445.
72. Evanger, K., et al., *Phakic and pseudophakic eyes in patients during hyperbaric oxygen therapy*. Optom Vis Sci, 2011. **88**(6): p. 691-6.
73. Evanger, K., et al., *Myopic shift during hyperbaric oxygenation attributed to lens index changes*. Optometry and Vision Science, 2015. **92**(11): p. 1076-1084.
74. Fledelius, H.C., E.C. Jansen, and J. Thorn, *Refractive change during hyperbaric oxygen therapy. A clinical trial including ultrasound ophthalmometry*. Acta Ophthalmologica Scandinavica, 2002. **80**(2): p. 188-190.
75. Anderson Jr, B. and J. Farmer Jr, *Hyperoxic myopia*. Transactions of the American Ophthalmological Society, 1978. **76**: p. 116.
76. Evanger, K., et al., *Posterior segment changes of the eye during hyperbaric oxygen therapy*. Undersea Hyperb Med, 2014. **41**(6): p. 589-596.
77. Lyne, A.J., *Ocular effects of hyperbaric oxygen*. Trans Ophthalmol Soc U K (1962), 1978. **98**(1): p. 66-8.
78. Ross, M.E., et al., *Myopia associated with hyperbaric oxygen therapy*. Optom Vis Sci, 1996. **73**(7): p. 487-94.
79. Bennett, M.H., et al., *The myopic shift associated with hyperbaric oxygen administration is reduced when using a mask delivery system compared to a hood—a randomised controlled trial*. Diving and hyperbaric medicine, 2019. **49**(4): p. 245.
80. Evanger, K., et al., *Ocular refractive changes in patients receiving hyperbaric oxygen administered by oronasal mask or hood*. Acta Ophthalmologica Scandinavica, 2004. **82**(4): p. 449-453.
81. Churchill, S., et al., *Rates of visual acuity change in patients receiving hyperbaric oxygen in monoplace and multiplace chambers*. Undersea & Hyperbaric Medicine: Journal of the Undersea and Hyperbaric Medical Society, Inc, 2016. **43**(3): p. 217-223.
82. Evanger, K., G. Vaagbo, and O.H. Haugen, *Short-term effects on ocular variables immediately after hyperbaric oxygen exposures*. Undersea and Hyperbaric Medicine, 2018. **45**(4): p. 395-402.
83. McMonnies, C.W., *Hyperbaric oxygen therapy and the possibility of ocular complications or contraindications*. Clinical and Experimental Optometry, 2015. **98**(2): p. 122-125.
84. Beiran, I., et al., *Early hyperbaric oxygen therapy for retinal artery occlusion*. Eur J Ophthalmol, 2001. **11**(4): p. 345-50.
85. Riedl, P., et al., *Myopic shift and lens turbidity following hyperbaric oxygen therapy—a prospective, longitudinal, observational cohort study*. Acta Ophthalmologica, 2019. **97**(6): p. 596-602.
86. Giblin, F.J., *Glutathione: a vital lens antioxidant*. J Ocul Pharmacol Ther, 2000. **16**(2): p. 121-35.

87. Palmquist, B.M., B. Philipson, and P.O. Barr, *Nuclear cataract and myopia during hyperbaric oxygen therapy*. Br J Ophthalmol, 1984. **68**(2): p. 113-7.
88. Gesell, L. and A. Trott, *De novo cataract development following a standard course of hyperbaric oxygen therapy*. Undersea & Hyperbaric Medicine, 2007. **34**(6): p. 389.
89. Sola, A., L. Chow, and M. Rogido, [*Retinopathy of prematurity and oxygen therapy: a changing relationship*]. An Pediatr (Barc), 2005. **62**(1): p. 48-63.
90. Cummings, J.J., R.A. Polin, and C.O.F.A. NEWBORN, *Oxygen Targeting in Extremely Low Birth Weight Infants*. Pediatrics, 2016. **138**(2).
91. Tin, W., et al., *Pulse oximetry, severe retinopathy, and outcome at one year in babies of less than 28 weeks gestation*. Arch Dis Child Fetal Neonatal Ed, 2001. **84**(2): p. F106-10.
92. Meléndez, J.C. and E. McCrank, *Anxiety-related reactions associated with magnetic resonance imaging examinations*. JAMA, 1993. **270**(6): p. 745-7.
93. Hadanny, A., et al., *The safety of hyperbaric oxygen treatment--retrospective analysis in 2,334 patients*. Undersea & Hyperbaric Medicine, 2016. **43**(2): p. 113-22.
94. Weaver, L.K., *Monoplace hyperbaric chamber use of U.S. Navy Table 6: a 20-year experience*. Undersea Hyperb Med, 2006. **33**(2): p. 85-8.
95. Clark, C., D. Rock, and K. Tackett, *Assessment of the magnitude of anxiety in adults undergoing first oxygen treatment in a hyperbaric chamber*. Mil Med, 1994. **159**(5): p. 412-5.
96. Jackson, W.F., *Arteriolar oxygen reactivity: where is the sensor?* Am J Physiol, 1987. **253**(5 Pt 2): p. H1120-6.
97. Lund, V., et al., *Effect of hyperbaric conditions on plasma stress hormone levels and endothelin-1*. Undersea Hyperb Med, 1999. **26**(2): p. 87-92.
98. Walker, B.R., et al., *Antidiuresis and inhibition of PGE2 excretion by hyperoxia in the conscious dog*. Undersea Biomed Res, 1980. **7**(2): p. 113-26.
99. Al-Waili, N.S., et al., *Influences of hyperbaric oxygen on blood pressure, heart rate and blood glucose levels in patients with diabetes mellitus and hypertension*. Archives of medical research, 2006. **37**(8): p. 991-997.
100. Heyboer III M, et al., *Effect of hyperbaric oxygen therapy on blood pressure in patients undergoing treatment*. Undersea & Hyperbaric Medicine: Journal of the Undersea and Hyperbaric Medical Society, Inc, 2017. **44**(2): p. 93-99.
101. Schiavo, S., et al., *Magnitude and clinical predictors of blood pressure changes in patients undergoing hyperbaric oxygen therapy: a retrospective study*. International journal of environmental research and public health, 2020. **17**(20): p. 7586.
102. Schipke, J.D., et al., *Hyperoxia and the cardiovascular system: experiences with hyperbaric oxygen therapy*. Medical Gas Research, 2022. **12**(4): p. 153-157.
103. Weaver, L.K. and S. Churchill, *Pulmonary edema associated with hyperbaric oxygen therapy*. Chest, 2001. **120**(4): p. 1407-1409.
104. Abel, F.L., et al., *Effects of hyperbaric oxygen on ventricular performance, pulmonary blood volume, and systemic and pulmonary vascular resistance*. Undersea Hyperb Med, 2000. **27**(2): p. 67-73.
105. Whalen, R.E., et al., *Cardiovascular and Blood Gas Responses to Hyperbaric Oxygenation*. Am J Cardiol, 1965. **15**: p. 638-46.
106. Gawthrope, I.C., et al., *The cardiac effects of hyperbaric oxygen at 243 kPa using in-chamber echocardiography*. Diving Hyperb Med, 2014. **44**(3): p. 141-5.
107. Obiagwu, C., et al., *Acute pulmonary edema secondary to hyperbaric oxygen therapy*. Oxford Medical Case Reports, 2015. **2015**(2): p. 183-184.
108. Fan, D., et al., *Severe pulmonary edema following hyperbaric oxygen therapy for acute carbon monoxide poisoning: a case report and clinical experience*. Undersea & hyperbaric medicine : journal of the Undersea and Hyperbaric Medical Society, Inc, 2017. **44**(3): p. 287-291.
109. Dassan, M., et al., *Acute Pulmonary Edema Due to Hyperbaric Oxygen Therapy*. Chest, 2014. **145**(3): p. 74A.
110. Leelasinjaroen, P., et al., *Pulmonary edema induced by hyperbaric oxygen therapy*. Chest, 2014. **146**(4): p. 456A.
111. Stevens, S.L., et al., *The incidence of hypoglycemia during HBO2 therapy: A retrospective review*. Undersea & Hyperbaric Medicine: Journal of the Undersea and Hyperbaric Medical Society, Inc, 2015. **42**(3): p. 191-196.
112. Stevens, S.L., et al., *Applying quality improvement methods in a hyperbaric oxygen program: reducing unnecessary glucose testing*. Undersea & Hyperbaric Medicine: Journal of the Undersea and Hyperbaric Medical Society, Inc, 2016. **43**(4): p. 427-435.
113. Heyboer III M, W., SM, J. Swaby, and T. Boes, *Blood glucose levels in diabetic patients undergoing hyperbaric oxygen therapy*. Undersea & Hyperbaric Medicine: Journal of the Undersea and Hyperbaric Medical Society, Inc, 2019. **46**(4): p. 437-445.

114. George, K., D. Ross, and L. Rowe, *Integration of Data to Establish a Standard Operating Procedure for the Diabetic Patient Undergoing Hyperbaric Oxygen Therapy*. Journal of Wound Ostomy & Continence Nursing, 2017. **44**(6): p. 546-549.
115. Torbati, D. and A. Torbati, *Blood glucose as a predictive measure for central nervous system oxygen toxicity in conscious rats*. Undersea biomedical research, 1986. **13**(2): p. 147-154.
116. Torbati, D., *Central nervous system glucose utilization rate during oxygen-induced respiratory changes at 2 atmospheres oxygen in the rat*. Journal of the neurological sciences, 1986. **76**(2-3): p. 231-237.
117. Contreras, F.L., M. Kadekaro, and H.M. Eisenberg, *The effect of hyperbaric oxygen on glucose utilization in a freeze-traumatized rat brain*. Journal of neurosurgery, 1988. **68**(1): p. 137-141.
118. Dedov, I., et al., *Effect of hyperbaric oxygenation on residual insulin secretion in patients with diabetes mellitus type 1*. Problemy Endokrinologii, 1987. **33**(4): p. 10-15.
119. Berend, N., *The effect of bleomycin and oxygen on rat lung*. Pathology, 1984. **16**(2): p. 136-139.
120. Rinaldo, J., R.H. Goldstein, and G.L. Snider, *Modification of oxygen toxicity after lung injury by bleomycin in hamsters*. American Review of Respiratory Disease, 1982. **126**(6): p. 1030-1033.
121. Goldiner, P.L., et al., *Factors influencing postoperative morbidity and mortality in patients treated with bleomycin*. Br Med J, 1978. **1**(6128): p. 1664-1667.
122. Donat, S.M. and D.A. Levy, *Bleomycin associated pulmonary toxicity: is perioperative oxygen restriction necessary?* The Journal of urology, 1998. **160**(4): p. 1347-1352.
123. Torp, K.D., et al., *Safe administration of hyperbaric oxygen after bleomycin: a case series of 15 patients*. Undersea and Hyperbaric Medicine, 2012. **39**(5): p. 873.
124. Upton, P., et al., *Effects of antioxidants and hyperbaric oxygen in ameliorating experimental doxorubicin skin toxicity in the rat*. Cancer treatment reports, 1986. **70**(4): p. 503-507.



## References

1. Cook C, Sheets C. Clinical equipoise and personal equipoise: two necessary ingredients for reducing bias in manual therapy trials. *J Man Manip Ther.* 2011;19(1):55-57.
2. Hampson N, Dunford RG, Norkool DM. Treatment of carbon monoxide poisonings in multiplace hyperbaric chambers. *Journal of Hyperbaric Medicine.* 1992;7(3):7.
3. Wreford-Brown CE, Hampson NB. Hyperbaric oxygen treatment protocols for mandibular osteoradionecrosis. *Undersea Hyperb Med.* 2003;30(3):175-179.
4. Clarke RE, Tenorio LM, Hussey JR, et al. Hyperbaric oxygen treatment of chronic refractory radiation proctitis: a randomized and controlled double-blind crossover trial with long-term follow-up. *Int J Radiat Oncol Biol Phys.* 2008;72(1):134-143.
5. Brouwer RJ, Laliu RC, Hoencamp R, van Hulst RA, Ubbink DT. A systematic review and meta-analysis of hyperbaric oxygen therapy for diabetic foot ulcers with arterial insufficiency. *J Vasc Surg.* 2020;71(2):682-692 e681.
6. Laliu RC, Brouwer RJ, Ubbink DT, Hoencamp R, Bol Raap R, van Hulst RA. Hyperbaric oxygen therapy for nonischemic diabetic ulcers: A systematic review. *Wound Repair Regen.* 2020;28(2):266-275.
7. Huang E, Heyboer M. Adjunctive Hyperbaric Oxygen Therapy for Diabetic Foot Ulcers. In: Whelan H, Kindwall E, eds. *Hyperbaric Medicine Practice.* 4th ed. North Palm Beach, Florida: Best Publishing; 2018.
8. Huang ET, Mansouri J, Murad MH, et al. A clinical practice guideline for the use of hyperbaric oxygen therapy in the treatment of diabetic foot ulcers. *Undersea Hyperb Med.* 2015;42(3):205-247.
9. Sheffield PJ. How the Davis 2.36 ATA wound healing enhancement treatment table was established. *Undersea Hyperb Med.* 2004;31(2):193-194.
10. "Dose." Merriam-Webster.com Dictionary, Merriam-Webster, <https://www.merriam-webster.com/dictionary/dose>. Accessed 4 Jun. 2023.
11. "Dosage." Merriam-Webster.com Dictionary, Merriam-Webster, <https://www.merriam-webster.com/dictionary/dosage>. Accessed 4 Jun. 2023. Accessed.
12. Cifu DX, Hart BB, West SL, Walker W, Carne W. The effect of hyperbaric oxygen on persistent postconcussion symptoms. *J Head Trauma Rehabil.* 2014;29(1):11-20.
13. Medical Use Oxygen. World Health Organization. <https://www.who.int/teams/health-product-policy-and-standards/assistive-and-medical-technology/medical-devices/oxygen#:~:text=Depending%20on%20the%20source%20and,%25%20v%2Fv%20of%20O2>. Accessed June 4, 2023.
14. Weaver L, Churchill S, Deru K, Haberstock D. Hyperbaric oxygen for chronic stable brain injury (HYBOBI): Interval to achieve 100% oxygen of monoplace chamber pressurization to 1.5 ATA. *Undersea and Hyperbaric Medicine.* 2001;38(5):462.
15. The Engineering ToolBox (2003). Atmospheric Pressure vs. Elevation above Sea Level. [online] Available at: [https://www.engineeringtoolbox.com/air-altitude-pressure-d\\_462.html](https://www.engineeringtoolbox.com/air-altitude-pressure-d_462.html). Accessed June 9, 2023.
16. Tompach PC, Lew D, Stoll JL. Cell response to hyperbaric oxygen treatment. *Int J Oral Maxillofac Surg.* 1997;26(2):82-86.
17. Hart GB, Wells CH, Strauss MB. Human Skeletal Muscle and Subcutaneous Tissue Carbon Dioxide, Nitrogen, and Oxygen Gas Tension Measurements Under Ambient and Hyperbaric Conditions. *Journal of Applied Research.* 2003;3(2):187-200.
18. Hendricks DM, Kraft KL, Moon RE, Piantadosi CA, Stolp BW. Dose-response of hyperbaric oxygen treatment of radiation cystitis (RC). *Undersea and Hyperbaric Medicine.* 2000;27:39.
19. Baik AH, Jain IH. Turning the Oxygen Dial: Balancing the Highs and Lows. *Trends Cell Biol.* 2020;30(7):516-536.
20. Brenckmann V, Ventrillard I, Romanini D, Jaulin K, Calabrese P, Briot R. High inhaled oxygen concentration quadruples exhaled CO in healthy volunteers monitored by a highly sensitive laser spectrometer. *Sci Rep.* 2019;9(1):12259.
21. Van Liew HD, Conkin J, Burkard ME. The oxygen window and decompression bubbles: estimates and significance. *Aviat Space Environ Med.* 1993;64(9 Pt 1):859-865.
22. Balestra C, Germonpre P, Poortmans J, et al. Erythropoietin production can be enhanced by normobaric oxygen breathing in healthy humans. *Undersea Hyperb Med.* 2004;31(1):53-57.
23. Donati A, Damiani E, Zuccari S, et al. Effects of short-term hyperoxia on erythropoietin levels and microcirculation in critically ill patients: a prospective observational pilot study. *BMC Anesthesiol.* 2017;17(1):49.
24. Balestra C, Germonpre P, Poortmans JR, Marroni A. Serum erythropoietin levels in healthy humans after a short period of normobaric and hyperbaric oxygen breathing: the "normobaric oxygen paradox". *J Appl Physiol (1985).* 2006;100(2):512-518.

25. MacLaughlin KJ, Barton GP, Braun RK, Eldridge MW. Effect of intermittent hyperoxia on stem cell mobilization and cytokine expression. *Med Gas Res.* 2019;9(3):139-144.
26. Leveque C, Mrakic Sposta S, Theunissen S, et al. Oxidative Stress Response Kinetics after 60 Minutes at Different Levels (10% or 15%) of Normobaric Hypoxia Exposure. *Int J Mol Sci.* 2023;24(12).
27. Leveque C, Mrakic-Sposta S, Lafere P, et al. Oxidative Stress Response's Kinetics after 60 Minutes at Different (30% or 100%) Normobaric Hyperoxia Exposures. *Int J Mol Sci.* 2022;24(1).
28. Balestra C. Personal Communication. In:2023.
29. Leveque C, Mrakic-Sposta S, Lafere P, et al. Oxidative Stress Response's Kinetics after 60 Minutes at Different (30% or 100%) Normobaric Hyperoxia Exposures. *Int J Mol Sci.* 2022;24(1):664.
30. Balestra C, Arya AK, Leveque C, et al. Varying Oxygen Partial Pressure Elicits Blood-Borne Microparticles Expressing Different Cell-Specific Proteins-Toward a Targeted Use of Oxygen? *Int J Mol Sci.* 2022;23(14):7888.
31. MacLaughlin KJ, Barton GP, Braun RK, et al. Hyperbaric air mobilizes stem cells in humans; a new perspective on the hormetic dose curve. *Frontiers in Neurology.* 2023;14.
32. Fratantonio D, Virgili F, Zucchi A, et al. Increasing Oxygen Partial Pressures Induce a Distinct Transcriptional Response in Human PBMC: A Pilot Study on the "Normobaric Oxygen Paradox". *Int J Mol Sci.* 2021;22(1):458.
33. Rossignol DA, Rossignol LW, Smith S, et al. Hyperbaric treatment for children with autism: a multicenter, randomized, double-blind, controlled trial. *BMC Pediatr.* 2009;9:21.
34. Sampanthavivat M, Singkhwa W, Chaiyakul T, Karoonyawanich S, Ajpru H. Hyperbaric oxygen in the treatment of childhood autism: a randomised controlled trial. *Diving Hyperb Med.* 2012;42(3):128-133.
35. Collet JP, Vanasse M, Marois P, et al. Hyperbaric oxygen for children with cerebral palsy: a randomised multicentre trial. HBO-CP Research Group. *Lancet.* 2001;357(9256):582-586.
36. Wolf G, Cifu D, Baugh L, Carne W, Profenna L. The effect of hyperbaric oxygen on symptoms after mild traumatic brain injury. *J Neurotrauma.* 2012;29(17):2606-2612.
37. Miller RS, Weaver LK, Bahraini N, et al. Effects of hyperbaric oxygen on symptoms and quality of life among service members with persistent postconcussion symptoms: a randomized clinical trial. *JAMA Intern Med.* 2015;175(1):43-52.
38. Weaver LK, Wilson SH, Lindblad AS, et al. Hyperbaric oxygen for post-concussive symptoms in United States military service members: a randomized clinical trial. *Undersea Hyperb Med.* 2018;45(2):129-156.
39. Weaver LK. Personal Communication. In:2023.
40. MacLaughlin KJ, Lamers L, Marcou MD, Braun RK, Eldridge MW. Oxygen dose: A new perspective. *Undersea and Hyperbaric Medicine.* 2022;49(1):103-104.
41. Macdonald AG, Fraser PJ. The transduction of very small hydrostatic pressures. *Comp Biochem Physiol A Mol Integr Physiol.* 1999;122(1):13-36.
42. Clarke RE. History of Hyperbaric Therapy. In: Neuman TS, Thom SR, eds. *Physiology and Medicine of Hyperbaric Oxygen Therapy.* Elsevier Inc.; 2008:3-23.
43. De Wolde SD, Hulskes RH, Weenink RP, Hollmann MW, Van Hulst RA. The Effects of Hyperbaric Oxygenation on Oxidative Stress, Inflammation and Angiogenesis. *Biomolecules.* 2021;11(8).
44. Brismar K, Lind F, Kratz G. Dose-dependent hyperbaric oxygen stimulation of human fibroblast proliferation. *Wound Repair Regen.* 1997;5(2):147-150.
45. Buras JA, Stahl GL, Svoboda KK, Reenstra WR. Hyperbaric oxygen downregulates ICAM-1 expression induced by hypoxia and hypoglycemia: the role of NOS. *Am J Physiol Cell Physiol.* 2000;278(2):C292-302.
46. Thom SR, Mendiguren I, Hardy K, et al. Inhibition of human neutrophil beta2-integrin-dependent adherence by hyperbaric O<sub>2</sub>. *Am J Physiol.* 1997;272(3 Pt 1):C770-777.
47. Thom SR, Bhopale VM, Velazquez OC, Goldstein LJ, Thom LH, Buerk DG. Stem cell mobilization by hyperbaric oxygen. *Am J Physiol Heart Circ Physiol.* 2006;290(4):H1378-1386.
48. Heyboer M, 3rd, Milovanova TN, Wojcik S, et al. CD34+/CD45-dim stem cell mobilization by hyperbaric oxygen - changes with oxygen dosage. *Stem Cell Res.* 2014;12(3):638-645.
49. Marx RE, Ehler WJ, Tayapongsak P, Pierce LW. Relationship of oxygen dose to angiogenesis induction in irradiated tissue. *Am J Surg.* 1990;160(5):519-524.
50. Ehler WJ, Marx RE, Peleg M. Oxygen as a drug: A dose response curve for radiation necrosis. *Undersea Baromedical Research.* 1993;20(Supplement):44-45.
51. Fife C, Smith L, Warriner R, et al. Is there an ideal treatment pressure? Treatment at 2.0 vs 2.4 ATA: the effect of treatment pressure on transcutaneous oximetry (TCOM) *Undersea and Hyperbaric Medicine.* 2004;33(3):335.
52. Heyboer M, Byrne J, Pons P, Wolner E, Seargent S, Wojcik SM. Use of in-chamber transcutaneous oxygen measurement to determine optimal treatment pressure in patients undergoing hyperbaric oxygen therapy. *Undersea Hyperb Med.* 2018;45(4):389-394.

53. Hampson NB, Dunford RG, Ross DE, Wreford-Brown CE. A prospective, randomized clinical trial comparing two hyperbaric treatment protocols for carbon monoxide poisoning. *Undersea Hyperb Med.* 2006;33(1):27-32.
54. Heytman M, Wilkinson D. Hyperbaric oxygen for osteoradionecrosis prophylaxis – treat at 203 or 243 kPal In. Australian and New Zealand College of Anaesthetists Annual Scientific Meeting 2006.
55. Ajayi OD, Gaskill Z, Kelly M, Logue CJ, Hendricksen SM. A comparison of two hyperbaric oxygen regimens: 2.0 ATA for 120 minutes to 2.4 ATA for 90 minutes in treating radiation-induced cystitis Are these regimens equivalent? *Undersea Hyperb Med.* 2020;47(4):581-589.
56. Camporesi EM, Bosco G. Hyperbaric oxygen pretreatment and preconditioning. *Undersea Hyperb Med.* 2014;41(3):259-263.
57. Hadanny A, Efrati S. The Hyperoxic-Hypoxic Paradox. *Biomolecules.* 2020;10(6).
58. Marx RE, Johnson RP, Kline SN. Prevention of osteoradionecrosis: a randomized prospective clinical trial of hyperbaric oxygen versus penicillin. *J Am Dent Assoc.* 1985;111(1):49-54.
59. Dulai PS, Raffals LE, Hudesman D, et al. A phase 2B randomised trial of hyperbaric oxygen therapy for ulcerative colitis patients hospitalised for moderate to severe flares. *Aliment Pharmacol Ther.* 2020;52(6):955-963.
60. Weaver LK, Hopkins RO, Chan KJ, et al. Hyperbaric oxygen for acute carbon monoxide poisoning. *N Engl J Med.* 2002;347(14):1057-1067.
61. Lee JS, Cha YS, Lim J. Association between number of hyperbaric oxygen therapy sessions and neurocognitive outcomes of acute carbon monoxide poisoning. *Front Med (Lausanne).* 2023;10:1127978.
62. Hampson NB, Corman JM. Rate of delivery of hyperbaric oxygen treatments does not affect response in soft tissue radionecrosis. *Undersea Hyperb Med.* 2007;34(5):329-334.
63. Fife CE, Buyukcakilir C, Otto GH, et al. The predictive value of transcutaneous oxygen tension measurement in diabetic lower extremity ulcers treated with hyperbaric oxygen therapy: a retrospective analysis of 1,144 patients. *Wound Repair Regen.* 2002;10(4):198-207.
64. Ennis WJ, Huang ET, Gordon H. Impact of Hyperbaric Oxygen on More Advanced Wagner Grades 3 and 4 Diabetic Foot Ulcers: Matching Therapy to Specific Wound Conditions. *Adv Wound Care (New Rochelle).* 2018;7(12):397-407.
65. Santema KTB, Stoekenbroek RM, Koelemay MJW, et al. Hyperbaric Oxygen Therapy in the Treatment of Ischemic Lower- Extremity Ulcers in Patients With Diabetes: Results of the DAMO(2)CLES Multicenter Randomized Clinical Trial. *Diabetes Care.* 2018;41(1):112-119.

## References

1. Murry CE, Jennings RB, Reimer KA. Preconditioning with ischemia: a delay of lethal cell injury in ischemic myocardium. *Circulation*. 1986;74(5):1124-36.
2. Bouroche G, Bourgain JL. Preoxygenation and general anesthesia: a review. *Minerva Anesthesiol*. 2015;81(8):910-20.
3. Otis AB, Rahn H, Fenn WO. Alveolar gas changes during breath holding. *Am J Physiol*. 1948;152(3):674-86.
4. Waring WS, Thomson AJ, Adwani SH, Rosseel AJ, Potter JF, Webb DJ, Maxwell SR. Cardiovascular effects of acute oxygen administration in healthy adults. *J Cardiovasc Pharmacol*. 2003;42:245-250.
5. Thomson AJ, Drummond GB, Waring WS, Webb DJ, Maxwell SR. Effects of short-term isocapnic hyperoxia and hypoxia on cardiovascular function. *J Appl Physiol*. 2006;101:809-816.
6. Castagna O, Gempp E, Blatteau JE. Pre-dive normobaric oxygen reduces bubble formation in scuba divers. *Eur J Appl Physiol*. 2009;106:167-172.
7. Piepho T, Ehrmann U, Werner C, Muth CM. Oxygen therapy in diving accidents. *Anaesthesist*. 2007;56:44-52.
8. Vann RD, Denoble PJ, Howle LE, Weber PW, Freiburger JJ, Pieper CF. Resolution and severity in decompression illness. *Aviat Space Environ Med*. 2009;80:466-471.
9. Bosco G, Yang ZJ, Di Tano G, Camporesi EM, Faralli F, Savini F, Landolfi A, Doria C, Fano G. Effect of in-water oxygen prebreathing at different depths on decompression-induced bubble formation and platelet activation. *J Appl Physiol*. 2010;108:1077-1083.
10. Evans A, Walder DN. Significance of gas micronuclei in the aetiology of decompression sickness. *Nature*. 1969;222(5190):251-2.
11. Arieli R, Boaron E, Arieli Y, Abramovich A, Katsenelson K. Oxygen pretreatment as protection against decompression sickness in rats: pressure and time necessary for hypothesized denucleation and renucleation. *Eur J Appl Physiol*. 2011;111:997-1005.
12. Landolfi A, Yang Z, Savini F, Camporesi E, Faralli F, Bosco G. Pretreatment with hyperbaric oxygenation reduces bubble formation and platelet activation. *Sport Sciences for Health*. 2006;1:122-128.
13. Arieli Y, Arieli R, Marx A. Hyperbaric oxygen may reduce gas bubbles in decompressed prawns by eliminating gas nuclei. *J Appl Physiol*. 2002;92:2596-2599.
14. Butler BD, Little T, Cogan V, Powell M. Hyperbaric oxygen pre-breathe modifies the outcome of decompression sickness. *Undersea Hyperb Med*. 2006;33:407-417.
15. Katsenelson K, Arieli Y, Abramovich A, Feinsod M, Arieli R. Hyperbaric oxygen pretreatment reduces the incidence of decompression sickness in rats. *Eur J Appl Physiol*. 2007;101:571-576.
16. Behnke AR. The isobaric (oxygen window) principle of decompression. In: *The new thrust seaward*. Transactions of the third annual conference of marine technology society. San Diego, CA: Marine Technology Society; 1967.
17. Balestra C, Germonpre P, Snoeck T, Ezquer M, Leduc O, Leduc A, Willeput F, Marroni A, Cali Corleo R, Vann R. Normobaric oxygen can enhance protein caption by the lymphatic system in healthy humans. *Undersea Hyperb Med*. 2004;31:59-62.
18. Webb JT, Pilmanis AA. Preoxygenation time versus decompression sickness incidence. *SAFE J*. 1999;29:75-78.
19. Younth DE. On the evolution, generation, and regeneration of gas cavitation nuclei. *J Acoust Soc Am*. 1982;71:1473-1481.
20. Dunford RG, Vann RD, Gerth WA, Pieper CF, Huggins K, Wacholtz C, Bennett PB. The incidence of venous gas emboli in recreational diving. *Undersea Hyperb Med*. 2002;29:247-259.
21. Hamilton RW, Thalmann ED. Decompression practice. In: Brubakk AO, Neuman TS, editors. *Bennett & Elliott's Physiology and Medicine of Diving*. 5th ed. New York, NY: Elsevier Science; 2003. Pp. 455-500.
22. Pontier JM, Gempp E, Ignatescu M. Blood platelet-derived microparticles release and bubble formation after an open-sea air dive. *Appl Physiol Nutr Metab*. 2012;37(5):888-92.
23. Morabito C, Bosco G, Pilla R, Corona C, Mancinelli R, Yang Z, Camporesi EM, Fano G, Mariggio MA. Effect of pre-breathing oxygen at different depth on oxidative status and calcium concentration in lymphocytes of scuba divers. *Acta Physiol (Oxf)*. 2011;202:69-78.
24. Gorsuch WB, Chrysanthou E, Schwaeble WJ, Stahl GL. The complement system in ischemia-reperfusion injuries. *Immunobiology*. 2012;217(11):1026-33.
25. Yu SY, Chiu JH, Yang SD, Yu HY, Hsieh CC, Chen PJ, Lui WY, Wu CW. Preconditioned hyperbaric oxygenation protects the liver against ischemia-reperfusion injury in rats. *J Surg Res*. 2005;128:28-36.
26. Grisotto PC, dos Santos AC, Coutinho-Netto J, Cherri J, Piccinato CE. Indicators of oxidative injury and alterations of the cell membrane in the skeletal muscle of rats submitted to ischemia and reperfusion. *J Surg Res*. 2000;92:1-6.

27. Yang ZJ, Bosco G, Montante A, Ou XI, Camporesi EM. Hyperbaric O<sub>2</sub> reduces intestinal ischemia-reperfusion induced TNF- $\alpha$  production and lung neutrophil sequestration. *Eur J Appl Physiol.* 2001;85(1-2):96-103.
28. Bosco G, Yang ZJ, Nandi J, Wang J, Chen C, Camporesi EM. Effects of hyperbaric oxygen on glucose, lactate, glycerol, and antioxidant enzymes in the skeletal muscle of rats during ischaemia and reperfusion. *Clin Exp Pharmacol Physiol.* 2007;34(1-2):70-6.
29. Yang ZJ, Xie Y, Bosco GM, Chen C, Camporesi EM. Hyperbaric oxygenation alleviates MCAO-induced brain injury and reduces hydroxyl radical formation and glutamate release. *Eur J Appl Physiol.* 2010;108(3):513-22.
30. Jadhav V, Ostrowski RP, Tong W, Matus B, Chang C, Zhang JH. Hyperbaric oxygen preconditioning reduces postoperative brain edema and improves neurological outcomes after surgical brain injury. *Acta Neurochir Suppl.* 2010;106:217-20.
31. Wang L, Li W, Kang Z, et al. Hyperbaric oxygen preconditioning attenuates early apoptosis after spinal cord ischemia in rats. *J Neurotrauma.* 2009;26(1):55-66.
32. Gu GJ, Li YB, Peng ZY, et al. Mechanism of ischemic tolerance induced by hyperbaric oxygen preconditioning involves upregulation of hypoxia-inducible factor-1  $\alpha$  and erythropoietin in rats. *J Appl Physiol.* 2008;104(4):1185-91.
33. Ozyurt H, Ozyurt B, Koca K, Ozgocmen S. Caffeic acid phenethyl ester (CAPE) protects rat skeletal muscle against ischemia-reperfusion-induced oxidative stress. *Vascul Pharmacol.* 2007;47:108-112.
34. Mebazaa A, Pitsis AA, Rudiger A, Toller W, Longrois D, Ricksten SE, Bobek I, De Hert S, Wieselthaler G, Schirmer U, von Segesser LK, Sander M, Poldermans D, Ranucci M, Karpati PC, Wouters P, Seeberger M, Schmid ER, Weder W, Follath F. Clinical review: practical recommendations on the management of perioperative heart failure in cardiac surgery. *Crit Care.* 2010;14(2):201.
35. Bolli R, Becker L, Gross G, Mentzer R Jr., Balshaw D, Lathrop DA. Myocardial protection at a crossroads: the need for translation into clinical therapy. *Circ Res.* 2004;95:125-134.
36. Hentia C, Rizzato A, Camporesi E, et al. An overview of protective strategies against ischemia/reperfusion injury: The role of hyperbaric oxygen preconditioning. *Brain Behav.* 2018;8:e00959.
37. Murry CE, Jennings RB, Reimer KA. Preconditioning with ischemia: a delay of lethal cell injury in ischemic myocardium. *Circulation.* 1986;74:1124-1136.
38. Hausenloy DJ, Mwamure PK, Venugopal V, Harris J, Barnard M, Grundy E, Ashley E, Vichare S, Di Salvo C, Kolvekar S, Hayward M, Keogh B, MacAllister RJ, Yellon DM. Effect of remote ischaemic preconditioning on myocardial injury in patients undergoing coronary artery bypass graft surgery: a randomised controlled trial. *Lancet.* 2007;370:575-579.
39. Wu ZK, Iivainen T, Pehkonen E, Laurikka J, Tarkka MR. Arrhythmias in off-pump coronary artery bypass grafting and the antiarrhythmic effect of regional ischemic preconditioning. *J Cardiothorac Vasc Anesth.* 2003;17:459-464.
40. Yellon DM, Alkhalafi AM, Pugsley WB. Preconditioning the human myocardium. *Lancet.* 1993;342:276-277.
41. Berger MM, Macholz F, Mairbäurl H, Bärtzsch P. Remote ischemic preconditioning for prevention of high-altitude diseases: fact or fiction?. *J Appl Physiol.* 2015;119(10):1143-51.
42. Yogaratnam JZ, Laden G, Guvendik L, Cowen M, Cale A, Griffin S. Hyperbaric oxygen preconditioning improves myocardial function, reduces length of intensive care stay, and limits complications post coronary artery bypass graft surgery. *Cardiovasc Revasc Med.* 2010;11:8-19.
43. Li Y, Dong H, Chen M, Liu J, Yang L, Chen S, Xiong L. Preconditioning with repeated hyperbaric oxygen induces myocardial and cerebral protection in patients undergoing coronary artery bypass graft surgery: a prospective, randomized, controlled clinical trial. *J Cardiothorac Vasc Anesth.* 2011 Dec;25(6):908-916.
44. Alex J, Laden G, Cale A, Bennett S, Flowers K, Madden L, Gardiner E, McCollum T, Griffin S. Pretreatment with hyperbaric oxygen and its effect on neuropsychometric dysfunction and systemic inflammatory response after cardiopulmonary bypass: A prospective randomised double-blind trial. *J Thorac Cardiovasc Surg.* 2005;130(6):1623-1630.
45. Jeysen ZY, Gerard L, Levant G, Cowen M, Cale A, Griffin S. Research report: the effects of hyperbaric oxygen preconditioning on myocardial biomarkers of cardioprotection in patients having coronary artery bypass graft surgery. *Undersea Hyperb Med.* 2011;38(3):175-85.
46. Li Q, Li J, Zhang L, Wang B, Xiong L. Preconditioning with hyperbaric oxygen induces tolerance against oxidative injury via increased expression of heme oxygenase-1 in primary cultured spinal cord neurons. *Life Sci.* 2007;80:1087-1093.
47. Sterling DL, Thornton JD, Swafford A, Gottlieb SF, Bishop SP, Stanley AW, Downey JM. Hyperbaric oxygen limits infarct size in ischemic rabbit myocardium in vivo. *Circulation.* 1993 Oct;88(4 Pt 1):1931-1936.
48. Wada K, Ito M, Miyazawa T, Katoh H, Nawashiro H, Shima K, Chigasaki H. Repeated hyperbaric oxygen induces ischemic tolerance in gerbil hippocampus. *Brain Res.* 1996;740:15-20.

49. Liska GM, Lippert T, Russo E, Nieves N, Borlongan CV. A dual role for hyperbaric oxygen in stroke neuroprotection: preconditioning of the brain and stem cells. *Cond Med.* 2018;1(4):151-166.
50. Gao L, Taha R, Gauvin D, Othmen LB, Wang Y, Blaise G. Postoperative cognitive dysfunction after cardiac surgery. *Chest.* 2005;128:3664-3670.
51. Sato Y, Laskowitz DT, Bennett ER, Newman MF, Warner DS, Grocott HP. Differential cerebral gene expression during cardiopulmonary bypass in the rat: evidence for apoptosis? *Anesth Analg.* 2002;94:1389-1394, table of contents.
52. Gao ZX, Rao J, Li YH (2017) Hyperbaric oxygen preconditioning improves postoperative cognitive dysfunction by reducing oxidant stress and inflammation. *Neural Regen Res* 12(2):329-336.
53. Liu Y, Sun XJ, Liu J, Kang ZM, Deng XM. Heme-oxygenase-1 could mediate the protective effects of hyperbaric oxygen preconditioning against hepatic ischemia-reperfusion injury in rats. *Clin Exp Pharmacol Physiol.* 2011;38:675-682.
54. Bosco G, Casarotto A, Nasole E, et al. Preconditioning with hyperbaric oxygen in pancreaticoduodenectomy: a randomized double-blind pilot study. *Anticancer Res.* 2014;34(6):2899-906.
55. Harel Jacoby MD<sup>1</sup>; Enrico M Camporesi, MD<sup>2</sup>; Sharona B Ross, MD, FACS<sup>1</sup>; Iswanto Sucandy, MD, FACS<sup>1</sup>; Gerardo Bosco MD, PhD<sup>3</sup>; Cameron Syblis BS<sup>1</sup>; Kaitlyn Crespo BS<sup>1</sup>; Alexander Rosemurgy, MD, FACS<sup>1</sup>: A Pilot Prospective Randomized Controlled Trial Comparing Short- and Long-Term Outcomes After Pancreaticoduodenectomy With or Without Preoperative Hyperbaric Oxygen Therapy (HBOT): UHM, 2023 In Publication
56. Rosemurgy AS, Ross SB, Espeut A, et al. Survival and Robotic Approach for Pancreaticoduodenectomy: A Propensity Score-Match Study. *J Am Coll Surg.* 2022;234:677-684. DOI: 10.1097/XCS.000000000000137.
57. Sharifi M, Fares W, Abdel-Karim I, Koch JM, Sopko J, Adler D; Hyperbaric Oxygen Therapy in Percutaneous Coronary Interventions Investigators. Usefulness of hyperbaric oxygen therapy to inhibit restenosis after percutaneous coronary intervention for acute myocardial infarction or unstable angina pectoris. *Am J Cardiol.* 2004 Jun 15;93(12):1533-1535.
58. Kang N, Hai Y, Liang F, Gao CJ, Liu XH. Preconditioned hyperbaric oxygenation protects skin flap grafts in rats against ischemia/reperfusion injury. *Mol Med Rep.* 2014;9(6):2124-30.
59. Yang Z, Nandi J, Wang J, et al. Hyperbaric oxygenation ameliorates indomethacin-induced enteropathy in rats by modulating TNF-alpha and IL-1beta production. *Dig Dis Sci.* 2006;51(8):1426-33.

## References

1. Medicare Services Advisory Committee. Review of interim funded service: Hyperbaric oxygen therapy for the treatment of chronic non-diabetic wounds and non-neurological soft tissue radiation injuries. MSAC Application 1054.1 Assessment Report, Commonwealth Government of Australia. ISBN 978-1-74241-605-2, 18 July 2016. <http://www.msac.gov.au/internet/msac/publishing.nsf/Content/1054.1-public>
2. Health Quality Ontario. Hyperbaric oxygen therapy for the treatment of diabetic foot ulcers: a health technology assessment. Ontario health technology assessment series. 2017;17(5):1.
3. Health Technology Assessment Program, Washington State Health Care Authority. Hyperbaric oxygen therapy (HBOT) for tissue damage, including wound care and treatment of central nervous system (CNS) conditions. Final Evidence Report. 15 February 2013. [https://www.hca.wa.gov/assets/program/021513\\_hbot\\_final\\_report\[1\].pdf](https://www.hca.wa.gov/assets/program/021513_hbot_final_report[1].pdf)
4. Wittes J, ed. (Special Design Issue). Controlled clinical trials. 1998;19(4):313-418.
5. Frieden TR. Evidence for health decision making—beyond randomized, controlled trials. *New England Journal of Medicine*. 2017 Aug 3;377(5):465-75.
6. Moher D, Hopewell S, Schulz KF, et al. CONSORT 2010 Explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *BMJ* 2010;340:c869.
7. Machin D, Campbell MJ, Fayers PM, Pinol APY. *Sample size tables for clinical studies*, 2nd ed. Blackwell Science Ltd. Malden, MA. 1997.
8. Phillips B, Ball C, Sackett D, et al. Oxford Centre for Evidence-based Medicine <http://www.cebm.net/> (last accessed January 2013).
9. Ho PM, Peterson PN, Masoudi FA. Key issues in outcomes research Evaluating the evidence. Is there a rigid hierarchy? *Circulation*. 2008; 118: 1675-1684.
10. Hopewell S, Dutton S, Yu LM, Chan AW, Altman DG. The quality of reports of randomised trials in 2000 and 2006: comparative study of articles indexed in PubMed. *BMJ* 340: c723.
11. Treweek S, Zwarenstein M. What kind of randomised trials do patients and clinicians need? *Evidence Based Medicine* 2009;14:101-103.
12. Zwarenstein M, Treweek S, Gagnier JJ, et al. Improving the reporting of pragmatic trials: an extension of the CONSORT statement. *BMJ* 2008;337:a2390.
13. Foëx BA. The ethics of clinical trials. *Anaesthesia & Intensive Care Medicine*. 2009 Feb 1;10(2):98-101.
14. Sathyamala C. In the name of science: ethical violations in the ECHO randomised trial. *Global Public Health*. 2022 Dec 2;17(12):4014-29.
15. Freedman B. Equipose and the ethics of clinical research. *N Engl J Med* 1987;317:141-145.
16. Veatch R. The irrelevance of equipose. *Journal of Medical Philosophy* 2007;32:167-183.
17. Ubel PA, Silbergleit R. Behavioral equipose: A way to resolve ethical stalemates in clinical research. *The American Journal of Bioethics* 2008;11:1-8.
18. Kahneman D, Tversky A. The psychology of preferences. *Scientific American* 1982;246:160–173.
19. Truzzi M. On the extraordinary: an attempt at clarification. *Zetetic Scholar* 1978;1:11.
19. Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB (2000). *Evidence-based medicine: How to practice and teach EBM* (2nd ed.). Edinburgh: Churchill Livingstone, 2000:1.
20. Evidence-Based Medicine Working Group. Evidence-based medicine. A new approach to teaching the practice of medicine. *JAMA* 1992; 268:2420-2425.
21. Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB. Teaching methods relevant to the clinical application of the results of critical appraisals to individual patients. In: *Evidence-based medicine. How to practice and teach EBM* (2nd Ed). Churchill Livingstone London 2000.
22. Bennett MH, Connor D, Lehm JP. The database of randomized controlled trials in hyperbaric medicine (DORCTHIM). <http://hboevidence.unsw.wikispaces.net/>.
23. Morris AH. Randomized clinical trials (Editorial). *Trans Am Soc Artif Intern Organs* 1991;27:41-42.
22. The Oxford Centre for Evidence-based Medicine. <http://www.cebm.net/> (Accessed January 2013).
24. Turner JA, Deyo RA, Loeser JD, Korff MV, Fordyce WE. The importance of placebo effects in pain treatment and research. *JAMA* 1994;271:1609-1614.
25. UK Parliamentary Committee Science and Technology Committee. Evidence Check 2: Homeopathy 2010. February 2010:10-12. Evidence Check 2: Homeopathy 2010 (accessed January 2013).
26. McCarney R, Warner J, Iliffe S, van Haselen R, Griffin P, Fisher P. The Hawthorne effect: a randomised, controlled trial. *BMC Medical Research Methodology* 2007; 7:30.

27. Clarke RE, Catalina Tenorio LM, Hussey JR, Toklu AS, Cone DL, Hinojosa JG, et al. Hyperbaric oxygen treatment of chronic refractory radiation proctitis: a randomised and controlled double-blind crossover trial with long-term follow-up. *International Journal of Radiation Oncology, Biology, Physics* 2008;72:134-143.
28. Weaver LK, Hopkins RO, Churchill S, Haberstock D. Double-blinding is possible in hyperbaric oxygen (HBO<sub>2</sub>) randomized clinical trials (RCT) using a minimal chamber pressurization as control (abstract). *Undersea and Hyperbaric Med* 1997;24(Suppl):36.
29. Weaver LK, Churchill SK, Bell J, Deru K, Snow GL. A blinded trial to investigate whether 'pressure familiar' individuals can determine chamber pressure. *Undersea and Hyperbaric Medicine* 2012;39:801-5.
30. Jansen T, Mortensen CR, Tvede MF. It is possible to perform a double-blind hyperbaric session: a double-blinded randomized trial performed on healthy volunteers. *Undersea Hyperb Med.* 2009 Sep-Oct;36(5):347-51.
31. Boussi-Gross R, Golan H, Fishlev G, Bechor Y, Volkov O, Bergan J, Friedman M, Hoofien D, Shlamkovitch N, Ben-Jacob E, Efrati S. Hyperbaric oxygen therapy can improve post concussion syndrome years after mild traumatic brain injury-randomized prospective trial. *PloS one.* 2013 Nov 15;8(11):e79995.
32. Mitchell SJ, Bennett MH. Unestablished indications for hyperbaric oxygen therapy. *Diving Hyperb Med.* 2014 Dec 1;44(4):228-34.
33. Bennett MH. Hyperbaric medicine and the placebo effect. *Diving Hyperb Med.* 2014 Dec 1;44:235-40.
34. Bennett MH. The evidence basis of diving and hyperbaric medicine - a synthesis of the high level clinical evidence with meta-analysis. <http://trove.nla.gov.au/>.



## References

1. You JH, Jiang JL, He WB, Ma H, Zhou M, Chen XX, Liu QL, Huang C. Addition of hyperbaric oxygen therapy versus usual care alone for inflammatory bowel disease: A systematic review and meta-analysis. *Heliyon*. 2022;8(10):e11007. Epub 20221013. doi: 10.1016/j.heliyon.2022.e11007. PubMed PMID: 36276722; PMCID: PMC9583108.
2. Chen P, Li Y, Zhang X, Zhang Y. Systematic review with meta-analysis: effectiveness of hyperbaric oxygenation therapy for ulcerative colitis. *Therap Adv Gastroenterol*. 2021;14:17562848211023394. Epub 20210717. doi: 10.1177/17562848211023394. PubMed PMID: 34349835; PMCID: PMC8290506.
3. McCurdy J, Siw KCK, Kandel R, Larrigan S, Rosenfeld G, Boet S. The Effectiveness and Safety of Hyperbaric Oxygen Therapy in Various Phenotypes of Inflammatory Bowel Disease: Systematic Review With Meta-analysis. *Inflamm Bowel Dis*. 2022;28(4):611-21. doi: 10.1093/ibd/izab098. PubMed PMID: 34003289.
4. Singh AK, Jha DK, Jena A, Kumar MP, Sebastian S, Sharma V. Hyperbaric oxygen therapy in inflammatory bowel disease: a systematic review and meta-analysis. *Eur J Gastroenterol Hepatol*. 2021;33(1S Suppl 1):e564-e73. doi: 10.1097/MEG.0000000000002164. PubMed PMID: 33905214.
5. Wu X, Liang TY, Wang Z, Chen G. The role of hyperbaric oxygen therapy in inflammatory bowel disease: a narrative review. *Med Gas Res*. 2021;11(2):66-71. doi: 10.4103/2045-9912.311497. PubMed PMID: 33818446; PMCID: PMC8130665.
6. Dulai PS, Buckey JC, Jr., Raffals LE, Swoger JM, Claus PL, O'Toole K, Ptak JA, Gleeson MW, Widjaja CE, Chang JT, Adler JM, Patel N, Skinner LA, Haren SP, Goldby-Reffner K, Thompson KD, Siegel CA. Hyperbaric oxygen therapy is well tolerated and effective for ulcerative colitis patients hospitalized for moderate-severe flares: a phase 2A pilot multi-center, randomized, double-blind, sham-controlled trial. *Am J Gastroenterol*. 2018;113(10):1516-23. Epub 2018/02/18. doi: 10.1038/s41395-018-0005-z. PubMed PMID: 29453383.
7. Dulai PS, Raffals LE, Hudesman D, Chiorean M, Cross R, Ahmed T, Winter M, Chang S, Fudman D, Sadler C, Chiu EL, Ross FL, Toups G, Murad MH, Sethuraman K, Holm JR, Guilliod R, Levine B, Buckey JC, Jr., Siegel CA. A phase 2B randomised trial of hyperbaric oxygen therapy for ulcerative colitis patients hospitalised for moderate to severe flares. *Aliment Pharmacol Ther*. 2020;52(6):955-63. Epub 2020/08/04. doi: 10.1111/apt.15984. PubMed PMID: 32745306.
8. Lansdorp CA, Gecse KB, Buskens CJ, Lowenberg M, Stoker J, Bemelman WA, D'Haens G, van Hulst RA. Hyperbaric oxygen therapy for the treatment of perianal fistulas in 20 patients with Crohn's disease. *Aliment Pharmacol Ther*. 2021;53(5):587-97. Epub 2020/12/17. doi: 10.1111/apt.16228. PubMed PMID: 33326623; PMCID: PMC7898636.
9. Hasan B, Yim Y, Ur Rashid M, Khalid RA, Sarvepalli D, Castaneda D, Ur Rahman A, Palekar N, Charles R, Castro FJ, Shen B. Hyperbaric Oxygen Therapy in Chronic Inflammatory Conditions of the Pouch. *Inflamm Bowel Dis*. 2021;27(7):965-70. Epub 2020/09/19. doi: 10.1093/ibd/izaa245. PubMed PMID: 32944766.
10. Fahad H, Dulai PS, Shen B, Kochhar GS. Hyperbaric Oxygen Therapy Is Effective in the Treatment of Inflammatory and Fistulizing Pouch Complications. *Clin Gastroenterol Hepatol*. 2021;19(6):1288-91. Epub 2020/06/23. doi: 10.1016/j.cgh.2020.06.029. PubMed PMID: 32565291.
11. Nyabanga CT, Kulkarni G, Shen B. Hyperbaric oxygen therapy for chronic antibiotic-refractory ischemic pouchitis. *Gastroenterol Rep (Oxf)*. 2017;5(4):320-1. Epub 2015/09/01. doi: 10.1093/gastro/gov038. PubMed PMID: 26319238; PMCID: PMC5691825.
12. Hasan B, Yim Y, Ur Rashid M, Khalid RA, Sarvepalli D, Castaneda D, Ur Rahman A, Palekar N, Charles R, Castro FJ, Shen B. Hyperbaric Oxygen Therapy in Chronic Inflammatory Conditions of the Pouch. *Inflamm Bowel Dis*. 2020. Epub 2020/09/19. doi: 10.1093/ibd/izaa245. PubMed PMID: 32944766.
13. Feitosa MR, Feres Filho O, Tamaki CM, Perazzoli C, Bernardes MV, Parra RS, Rocha JJ, Feres O. Adjunctive Hyperbaric Oxygen Therapy promotes successful healing in patients with refractory Crohn's disease. *Acta Cir Bras*. 2016;31 Suppl 1:19-23. doi: 10.1590/S0102-86502016001300005. PubMed PMID: 27142900.
14. Zeina T, Levy AN. Adjunctive Hyperbaric Oxygen Therapy for High Risk Peristomal Pyoderma Gangrenosum. *Dig Dis Sci*. 2022;67(10):4597-8. Epub 20220822. doi: 10.1007/s10620-022-07646-x. PubMed PMID: 35989384.
15. Hill DS, O'Neill JK, Toms A, Watts AM. Pyoderma gangrenosum: a report of a rare complication after knee arthroplasty requiring muscle flap cover supplemented by negative pressure therapy and hyperbaric oxygen. *J Plast Reconstr Aesthet Surg*. 2011;64(11):1528-32. Epub 20110421. doi: 10.1016/j.bjps.2011.03.024. PubMed PMID: 21514259.

16. Harlan NP, Ptak JA, Rees JR, Cowan DR, Fellows AM, Kertis JA, Hannigan PM, Peacock JL, Buckey JC. Development of an International, Multicenter, Hyperbaric Oxygen Treatment Registry and Research Consortium: Protocol for Outcome Data Collection and Analysis. *JMIR Res Protoc.* 2020;9(8):e18857. Epub 2020/06/25. doi: 10.2196/18857. PubMed PMID: 32579537; PMCID: PMC7459436.
17. Harlan NP, Ptak JA, Rees JR, Cowan DR, Fellows AM, Moses RA, Kertis JA, Hannigan PM, Juggan SA, Peacock J, Bennett M, Buckey JC. International Multicenter Registry for Hyperbaric Oxygen Therapy: Results through June 2021. *Undersea Hyperb Med.* 2022;49(3):275-87. PubMed PMID: 36001560.
18. Harlan NP, Roberts J, Siegel C, Buckey JC. Hyperbaric Oxygen as Successful Monotherapy for a Severe Ulcerative Colitis Flare. *Inflamm Bowel Dis.* 2022;28(9):1474-5. doi: 10.1093/ibd/izac141. PubMed PMID: 35771656.
19. An J, Devaney B, Ooi KY, Ford S, Frawley G, Menahem S. Hyperbaric oxygen in the treatment of calciphylaxis: A case series and literature review. *Nephrology (Carlton).* 2015;20(7):444-50. doi: 10.1111/nep.12433. PubMed PMID: 25707425.
20. Nigwekar SU, Kroshinsky D, Nazarian RM, Goverman J, Malhotra R, Jackson VA, Kamdar MM, Steele DJ, Thadhani RI. Calciphylaxis: risk factors, diagnosis, and treatment. *Am J Kidney Dis.* 2015;66(1):133-46. Epub 2015/05/12. doi: 10.1053/j.ajkd.2015.01.034. PubMed PMID: 25960299; PMCID: PMC4696752.
21. Magnan MA, Gayet-Ageron A, Louge P, Champly F, Joffre T, Lovis C, Pignel R. Hyperbaric Oxygen Therapy with Iloprost Improves Digit Salvage in Severe Frostbite Compared to Iloprost Alone. *Medicina (Kaunas).* 2021;57(11). Epub 2021/11/28. doi: 10.3390/medicina57111284. PubMed PMID: 34833502; PMCID: PMC8620371.
22. Kemper TC, de Jong VM, Anema HA, van den Brink A, van Hulst RA. Frostbite of both first digits of the foot treated with delayed hyperbaric oxygen: a case report and review of literature. *Undersea Hyperb Med.* 2014;41(1):65-70. PubMed PMID: 24649719.
23. Force ADT, Ranieri VM, Rubenfeld GD, Thompson BT, Ferguson ND, Caldwell E, Fan E, Camporota L, Slutsky AS. Acute respiratory distress syndrome: the Berlin Definition. *JAMA.* 2012;307(23):2526-33. doi: 10.1001/jama.2012.5669. PubMed PMID: 22797452.
24. Varga Z, Flammer AJ, Steiger P, Haberecker M, Andermatt R, Zinkernagel AS, Mehra MR, Schuepbach RA, Ruschitzka F, Moch H. Endothelial cell infection and endotheliitis in COVID-19. *Lancet.* 2020;395(10234):1417-8. Epub 20200421. doi: 10.1016/S0140-6736(20)30937-5. PubMed PMID: 32325026; PMCID: PMC7172722.
25. Perdriet G, Hightower LE. On barring the vascular gateway against severe COVID-19 disease. *Cell Stress Chaperones.* 2020;25(5):721-3. doi: 10.1007/s12192-020-01122-z. PubMed PMID: 32458383; PMCID: PMC7250245.
26. Feldmeier JJ, Kirby JP, Buckey JC, Denham DW, Evangelista JS, Gelly HB, Harlan NP, Mirza ZK, Ray KL, Robins M, Savaser DJ, Wainwright S, Bird N, Huang ET, Moon RE, Thom SR, Weaver LK. Physiologic and biochemical rationale for treating COVID-19 patients with hyperbaric oxygen. *Undersea Hyperb Med.* 2021;48(1):1-12. doi: 10.22462/01.03.2021.1. PubMed PMID: 33648028.
27. Tsikala Vafea M, Zhang R, Kalligeros M, Mylonas EK, Shehadeh F, Mylonakis E. Mortality in mechanically ventilated patients with COVID-19: a systematic review. *Expert Rev Med Devices.* 2021;18(5):457-71. Epub 20210430. doi: 10.1080/17434440.2021.1915764. PubMed PMID: 33836621.
28. Thibodeaux K, Speyrer M, Raza A, Yaakov R, Serena TE. Hyperbaric oxygen therapy in preventing mechanical ventilation in COVID-19 patients: a retrospective case series. *J Wound Care.* 2020;29(Sup5a):S4-S8. Epub 2020/05/16. doi: 10.12968/jowc.2020.29.Sup5a.S4. PubMed PMID: 32412891.
29. Guo D, Pan S, Wang M, Guo Y. Hyperbaric oxygen therapy may be effective to improve hypoxemia in patients with severe COVID-2019 pneumonia: two case reports. *Undersea Hyperb Med.* 2020;47(2):181-7. doi: 10.22462/04.06.2020.2. PubMed PMID: 32574433.
30. Gorenstein SA, Castellano ML, Slone ES, Gillette B, Liu H, Alsamarraie C, Jacobson AM, Wall SP, Adhikari S, Swartz JL, McMullen JJS, Osorio M, Koziatka CA, Lee DC. Hyperbaric oxygen therapy for COVID-19 patients with respiratory distress: treated cases versus propensity-matched controls. *Undersea Hyperb Med.* 2020;47(3):405-13. doi: 10.22462/01.03.2020.1. PubMed PMID: 32931666.
31. Keller GA, Colaianni I, Coria J, Di Girolamo G, Miranda S. Clinical and biochemical short-term effects of hyperbaric oxygen therapy on SARS-Cov-2+ hospitalized patients with hypoxemic respiratory failure. *Respir Med.* 2023;209:107155. Epub 20230214. doi: 10.1016/j.rmed.2023.107155. PubMed PMID: 36796547; PMCID: PMC9927797.
32. Cannellotto M, Duarte M, Keller G, Larrea R, Cunto E, Chediack V, Mansur M, Brito DM, Garcia E, Di Salvo HE, Verdini F, Dominguez C, Jorda-Vargas L, Roberti J, Di Girolamo G, Estrada E. Hyperbaric oxygen as an adjuvant treatment for patients with COVID-19 severe hypoxaemia: a randomised controlled trial. *Emerg Med J.* 2022;39(2):88-93. Epub 20211214. doi: 10.1136/emermed-2021-211253. PubMed PMID: 34907003; PMCID: PMC8678559.

33. Siewiera J, Brodaczevska K, Jermakow N, Lubas A, Klos K, Majewska A, Kot J. Effectiveness of Hyperbaric Oxygen Therapy in SARS-CoV-2 Pneumonia: The Primary Results of a Randomised Clinical Trial. *J Clin Med*. 2022;12(1). Epub 20221220. doi: 10.3390/jcm12010008. PubMed PMID: 36614808; PMCID: PMC9820955.
34. Kjellberg A, Abdel-Halim L, Hassler A, El Gharbi S, Al-Ezerjawi S, Bostrom E, Sundberg CJ, Pernow J, Medson K, Kowalski JH, Rodriguez-Wallberg KA, Zheng X, Catrina S, Runold M, Stahlberg M, Bruchfeld J, Nygren-Bonnier M, Lindholm P. Hyperbaric oxygen for treatment of long COVID-19 syndrome (HOT-LoCO): protocol for a randomised, placebo-controlled, double-blind, phase II clinical trial. *BMJ Open*. 2022;12(11):e061870. Epub 20221102. doi: 10.1136/bmjopen-2022-061870. PubMed PMID: 36323462; PMCID: PMC9638753.
35. Kjellberg A, Douglas J, Pawlik MT, Kraus M, Oscarsson N, Zheng X, Bergman P, Franberg O, Kowalski JH, Nyren SP, Silvanus M, Skold M, Catrina SB, Rodriguez-Wallberg KA, Lindholm P. Randomised, controlled, open label, multicentre clinical trial to explore safety and efficacy of hyperbaric oxygen for preventing ICU admission, morbidity and mortality in adult patients with COVID-19. *BMJ Open*. 2021;11(7):e046738. Epub 20210705. doi: 10.1136/bmjopen-2020-046738. PubMed PMID: 34226219; PMCID: PMC8260306.
36. Huang E, Savaser D, Manulik B, Hoge J, Loeffelholz J, Wainwright S, Rony M, Lee D, Gorenstein S. U.S. multicenter randomized controlled trial of hyperbaric oxygen for COVID-19 patients with moderate to severe hypoxemia. *Undersea and Hyperbaric Medicine*. 2023;50(2):180-1.
37. Oliaei S, SeyedAlinaghi S, Mehrtak M, Karimi A, Noori T, Mirzapour P, Shojaei A, MohsseniPour M, Mirghaderi SP, Alilou S, Shobeiri P, Azadi Cheshmekabodi H, Mehraeen E, Dadras O. The effects of hyperbaric oxygen therapy (HBOT) on coronavirus disease-2019 (COVID-19): a systematic review. *Eur J Med Res*. 2021;26(1):96. Epub 20210819. doi: 10.1186/s40001-021-00570-2. PubMed PMID: 34412709; PMCID: PMC8374420.
38. Boet S, Etherington C, Ghanmi N, Ioudovski P, Tricco AC, Sikora L, Katznelson R. Efficacy and safety of hyperbaric oxygen treatment to treat COVID-19 pneumonia: a living systematic review update. *Diving Hyperb Med*. 2022;52(2):126-35. doi: 10.28920/dhm52.2.126-135. PubMed PMID: 35732285; PMCID: PMC9522603.
39. Raveendran AV, Jayadevan R, Sashidharan S. Long COVID: An overview. *Diabetes Metab Syndr*. 2021;15(3):869-75. Epub 20210420. doi: 10.1016/j.dsx.2021.04.007. PubMed PMID: 33892403; PMCID: PMC8056514.
40. Venkatesan P. NICE guideline on long COVID. *Lancet Respir Med*. 2021;9(2):129. Epub 20210113. doi: 10.1016/S2213-2600(21)00031-X. PubMed PMID: 33453162; PMCID: PMC7832375.
41. Krishna N, K PS, G KR. Identifying diseases associated with Post-COVID syndrome through an integrated network biology approach. *J Biomol Struct Dyn*. 2023:1-20. Epub 20230330. doi: 10.1080/07391102.2023.2195003. PubMed PMID: 36995291.
42. Lopez-Leon S, Wegman-Ostrosky T, Ayuzo Del Valle NC, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, Villapol S. Long-COVID in children and adolescents: a systematic review and meta-analyses. *Sci Rep*. 2022;12(1):9950. Epub 20220623. doi: 10.1038/s41598-022-13495-5. PubMed PMID: 35739136; PMCID: PMC9226045.
43. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, Villapol S. More than 50 long-term effects of COVID-19: a systematic review and meta-analysis. *Sci Rep*. 2021;11(1):16144. Epub 20210809. doi: 10.1038/s41598-021-95565-8. PubMed PMID: 34373540; PMCID: PMC8352980.
44. Wostyn P. COVID-19 and chronic fatigue syndrome: Is the worst yet to come? *Med Hypotheses*. 2021;146:110469. Epub 20210102. doi: 10.1016/j.mehy.2020.110469. PubMed PMID: 33401106; PMCID: PMC7836544.
45. Qanneta R. Long COVID-19 and myalgic encephalomyelitis/chronic fatigue syndrome: Similarities and differences of two peas in a pod. *Reumatol Clin (Engl Ed)*. 2022;18(10):626-8. doi: 10.1016/j.reumae.2022.05.001. PubMed PMID: 36435560; PMCID: PMC9683473.
46. Bhaiyat AM, Sasson E, Wang Z, Khairy S, Ginzarly M, Qureshi U, Fikree M, Efrati S. Hyperbaric oxygen treatment for long coronavirus disease-19: a case report. *J Med Case Rep*. 2022;16(1):80. Epub 20220215. doi: 10.1186/s13256-022-03287-w. PubMed PMID: 35168680; PMCID: PMC8848789.
47. Robbins T, Gonevski M, Clark C, Baitule S, Sharma K, Magar A, Patel K, Sankar S, Kyrou I, Ali A, Randeva HS. Hyperbaric oxygen therapy for the treatment of long COVID: early evaluation of a highly promising intervention. *Clin Med (Lond)*. 2021;21(6):e629-e32. doi: 10.7861/clinmed.2021-0462. PubMed PMID: 34862223; PMCID: PMC8806311.
48. Wilmshurst P, Bewley S, Murray P. Hyperbaric oxygen therapy for the treatment of long COVID. *Clin Med (Lond)*. 2023;23(1):99-100. doi: 10.7861/clinmed.Let.23.1.2. PubMed PMID: 36697009.
49. Zilberman-Itskovich S, Catalogna M, Sasson E, Elman-Shina K, Hadanny A, Lang E, Finci S, Polak N, Fishlev G, Korin C, Shorer R, Parag Y, Sova M, Efrati S. Hyperbaric oxygen therapy improves neurocognitive functions and symptoms of post-COVID condition: randomized controlled trial. *Sci Rep*. 2022;12(1):11252. Epub 2022/07/14. doi: 10.1038/s41598-022-15565-0. PubMed PMID: 35821512; PMCID: PMC9276805 shareholder at AVIV Scientific LTD. LTD. SZI, MC, KES, EL, SF, NP, GF, CK, RS, YP, MS have no competing interests.

50. Lamm K, Arnold W. Successful treatment of noise-induced cochlear ischemia, hypoxia, and hearing loss. *Annals of the New York Academy of Sciences*. 1999;884:233-48. Epub 2000/06/08. PubMed PMID: 10842597.
51. Shi X. Pathophysiology of the cochlear intrastrial fluid-blood barrier (review). *Hear Res*. 2016;338:52-63. Epub 2016/01/24. doi: 10.1016/j.heares.2016.01.010. PubMed PMID: 26802581; PMCID: PMC5322264.
52. Bayoumy AB, van der Veen EL, van Ooij PAM, Besseling-Hansen FS, Koch DAA, Stegeman I, de Ru JA. Effect of hyperbaric oxygen therapy and corticosteroid therapy in military personnel with acute acoustic trauma. *J R Army Med Corps*. 2019. Epub 2019/01/07. doi: 10.1136/jramc-2018-001117. PubMed PMID: 30612101.
53. Fakhry N, Rostain JC, Cazals Y. Hyperbaric oxygenation with corticoid in experimental acoustic trauma. *Hear Res*. 2007;230(1-2):88-92. Epub 2007/06/26. doi: 10.1016/j.heares.2007.05.005. PubMed PMID: 17590548.
54. Lamm K, Lamm C, Arnold W. Effect of isobaric oxygen versus hyperbaric oxygen on the normal and noise-damaged hypoxic and ischemic guinea pig inner ear. *Adv Otorhinolaryngol*. 1998;54:59-85. Epub 1998/04/21. PubMed PMID: 9547878.
55. Lamm K, Lamm H, Arnold W. Effect of hyperbaric oxygen therapy in comparison to conventional or placebo therapy or no treatment in idiopathic sudden hearing loss, acoustic trauma, noise-induced hearing loss and tinnitus. A literature survey. *Adv Otorhinolaryngol*. 1998;54:86-99. Epub 1998/04/21. PubMed PMID: 9547879.
56. Kuokkanen J, Virkkala J, Zhai S, Ylikoski J. Effect of hyperbaric oxygen treatment on permanent threshold shift in acoustic trauma among rats. *Acta Otolaryngol Suppl*. 1997;529:80-2. Epub 1997/01/01. PubMed PMID: 9288276.
57. van der Veen EL, van Hulst RA, de Ru JA. Hyperbaric Oxygen Therapy in Acute Acoustic Trauma: A Rapid Systematic Review. *Otolaryngol Head Neck Surg*. 2014;151(1):42-5. Epub 20140319. doi: 10.1177/0194599814526555. PubMed PMID: 24647641.
58. Holy R, Zavazalova S, Prochazkova K, Kalfert D, Younus T, Dosel P, Kovar D, Janouskova K, Oniscenko B, Fik Z, Astl J. The Use of Hyperbaric Oxygen Therapy and Corticosteroid Therapy in Acute Acoustic Trauma: 15 Years' Experience at the Czech Military Health Service. *Int J Environ Res Public Health*. 2021;18(9). Epub 20210422. doi: 10.3390/ijerph18094460. PubMed PMID: 33922296; PMCID: PMC8122777.
59. Denton CP, Khanna D. Systemic sclerosis. *Lancet*. 2017;390(10103):1685-99. Epub 2017/04/18. doi: 10.1016/S0140-6736(17)30933-9. PubMed PMID: 28413064.
60. Dowling GB, Copeman PW, Ashfield R. Raynaud's phenomenon in scleroderma treated with hyperbaric oxygen. *Proc R Soc Med*. 1967;60(12):1268-9. Epub 1967/12/01. PubMed PMID: 6066573; PMCID: PMC1901469.
61. Markus YM, Bell MJ, Evans AW. Ischemic scleroderma wounds successfully treated with hyperbaric oxygen therapy. *J Rheumatol*. 2006;33(8):1694-6. Epub 2006/08/02. PubMed PMID: 16881126.
62. Mirasoglu B, Bagli BS, Aktas S. Hyperbaric oxygen therapy for chronic ulcers in systemic sclerosis - case series. *Int J Dermatol*. 2017;56(6):636-40. Epub 2017/02/25. doi: 10.1111/ijd.13570. PubMed PMID: 28233289.
63. Poirier E, Wind H, Cordel N. [Efficacy of hyperbaric oxygen therapy in the treatment of ischemic toe ulcer in a patient presenting systemic sclerosis]. *Ann Dermatol Venereol*. 2017;144(1):55-9. Epub 2016/08/02. doi: 10.1016/j.annder.2016.06.007. PubMed PMID: 27476378.
64. Peleg RK, Fishlev G, Bechor Y, Bergan J, Friedman M, Koren S, Tirosch A, Efrati S. Effects of hyperbaric oxygen on blood glucose levels in patients with diabetes mellitus, stroke or traumatic brain injury and healthy volunteers: a prospective, crossover, controlled trial. *Diving Hyperb Med*. 2013;43(4):218-21. PubMed PMID: 24510327.
65. Baines C, Vicendese D, Cooper D, McGuinness W, Miller C. Comparison of venous, capillary and interstitial blood glucose data measured during hyperbaric oxygen treatment from patients with diabetes mellitus. *Diving Hyperb Med*. 2021;51(3):240-7. doi: 10.28920/dhm51.3.240-247. PubMed PMID: 34547774; PMCID: PMC8608443.
66. Wilkinson D, Szekely S, Gue B, Tam CS, Chapman I, Heilbronn LK. Assessment of insulin sensitivity during hyperbaric oxygen treatment. *Diving Hyperb Med*. 2020;50(3):238-43. doi: 10.28920/dhm50.3.238-243. PubMed PMID: 32957125; PMCID: PMC7819732.
67. Baitule S, Patel AH, Murthy N, Sankar S, Kyrou I, Ali A, Randeva HS, Robbins T. A Systematic Review to Assess the Impact of Hyperbaric Oxygen Therapy on Glycaemia in People with Diabetes Mellitus. *Medicina (Kaunas)*. 2021;57(10). Epub 20211019. doi: 10.3390/medicina57101134. PubMed PMID: 34684171; PMCID: PMC8541526.
68. Kahraman C, Yaman H. Hyperbaric oxygen therapy affects insulin sensitivity/resistance by increasing adiponectin, resistin, and plasminogen activator inhibitor-I in rats. *Turk J Med Sci*. 2021;51(3):1572-8. Epub 20210628. doi: 10.3906/sag-2011-76. PubMed PMID: 33705641; PMCID: PMC8283499.
69. Kitada S, Otsuka Y, Kokubu N, Kasahara Y, Kataoka Y, Noguchi T, Goto Y, Kimura G, Nonogi H. Post-load hyperglycemia as an important predictor of long-term adverse cardiac events after acute myocardial infarction: a scientific study. *Cardiovasc Diabetol*. 2010;9:75. Epub 20101111. doi: 10.1186/1475-2840-9-75. PubMed PMID: 21070650; PMCID: PMC2996353.

70. Fife CE, Buyukcakil C, Otto G, Sheffield P, Love T, Warriner R, 3rd. Factors influencing the outcome of lower-extremity diabetic ulcers treated with hyperbaric oxygen therapy. *Wound Repair Regen.* 2007;15(3):322-31. doi: 10.1111/j.1524-475X.2007.00234.x. PubMed PMID: 17537119.
71. Cardenas Urena KG, Ramirez Nava JC, Marquez Celedonio FG, Salas Nolasco OI, Villegas Dominguez JE, Crespo-Cortes CN. Clinical efficacy of adjuvant therapy with hyperbaric oxygen in diabetic nephropathy. *Undersea Hyperb Med.* 2020;47(3):415-22. doi: 10.22462/03.07.2020.2. PubMed PMID: 32931667.
72. Sedlacek M, Harlan NP, Buckey JC, Jr. Renal Effects of Hyperbaric Oxygen Therapy in Patients with Diabetes Mellitus: A Retrospective Study. *Int J Nephrol.* 2021;2021:9992352. Epub 20210612. doi: 10.1155/2021/9992352. PubMed PMID: 34234965; PMCID: PMC8216821.
73. Harrison LE, Giardina C, Hightower LE, Anderson C, Perdrizet GA. Might hyperbaric oxygen therapy (HBOT) reduce renal injury in diabetic people with diabetes mellitus? From preclinical models to human metabolomics. *Cell Stress Chaperones.* 2018;23(6):1143-52. Epub 20181030. doi: 10.1007/s12192-018-0944-8. PubMed PMID: 30374882; PMCID: PMC6237687.
74. Irawan H, Semadi IN, Widiana IGR. A Pilot Study of Short-Duration Hyperbaric Oxygen Therapy to Improve HbA1c, Leukocyte, and Serum Creatinine in Patients with Diabetic Foot Ulcer Wagner 3-4. *ScientificWorldJournal.* 2018;2018:6425857. Epub 20180812. doi: 10.1155/2018/6425857. PubMed PMID: 30158840; PMCID: PMC6109474.
75. Estrada EJ, Decima JL, Bortman G, Roberti J, Romero EB, Samaja G, Saavedra AR, Martinez G, Gutierrez S. Combination treatment of autologous bone marrow stem cell transplantation and hyperbaric oxygen therapy for type 2 diabetes mellitus: A randomized controlled trial. *Cell Transplant.* 2019;28(12):1632-40. Epub 20191030. doi: 10.1177/0963689719883813. PubMed PMID: 31665912; PMCID: PMC6923554.
76. Selassie AW, Wilson DA, Pickelsimer EE, Voronca DC, Williams NR, Edwards JC. Incidence of sport-related traumatic brain injury and risk factors of severity: a population-based epidemiologic study. *Ann Epidemiol.* 2013;23(12):750-6. Epub 2013/09/26. doi: 10.1016/j.annepidem.2013.07.022. PubMed PMID: 24060276; PMCID: PMC4021712.
77. Warden D. Military TBI during the Iraq and Afghanistan wars. *J Head Trauma Rehabil.* 2006;21(5):398-402. Epub 2006/09/20. doi: 10.1097/00001199-200609000-00004. PubMed PMID: 16983225.
78. Sosin DM, Sniezek JE, Thurman DJ. Incidence of mild and moderate brain injury in the United States, 1991. *Brain Inj.* 1996;10(1):47-54. Epub 1996/01/01. doi: 10.1080/026990596124719. PubMed PMID: 8680392.
79. Niklas A, Brock D, Schober R, Schulz A, Schneider D. Continuous measurements of cerebral tissue oxygen pressure during hyperbaric oxygenation--HBO effects on brain edema and necrosis after severe brain trauma in rabbits. *J Neurol Sci.* 2004;219(1-2):77-82. Epub 2004/03/31. doi: 10.1016/j.jns.2003.12.013. PubMed PMID: 15050441.
80. Calvert JW, Cahill J, Zhang JH. Hyperbaric oxygen and cerebral physiology. *Neurol Res.* 2007;29(2):132-41. Epub 2007/04/19. doi: 10.1179/016164107X174156. PubMed PMID: 17439697.
81. Reinert M, Barth A, Rothen HU, Schaller B, Takala J, Seiler RW. Effects of cerebral perfusion pressure and increased fraction of inspired oxygen on brain tissue oxygen, lactate and glucose in patients with severe head injury. *Acta Neurochir (Wien).* 2003;145(5):341-9; discussion 9-50. Epub 2003/06/24. doi: 10.1007/s00701-003-0027-0. PubMed PMID: 12820040.
82. Mu J, Ostrowski RP, Soejima Y, Rolland WB, Krafft PR, Tang J, Zhang JH. Delayed hyperbaric oxygen therapy induces cell proliferation through stabilization of cAMP responsive element binding protein in the rat model of MCAo-induced ischemic brain injury. *Neurobiol Dis.* 2013;51:133-43. Epub 2012/11/14. doi: 10.1016/j.nbd.2012.11.003. PubMed PMID: 23146993; PMCID: PMC3557601.
83. Yang YJ, Wang XL, Yu XH, Wang X, Xie M, Liu CT. Hyperbaric oxygen induces endogenous neural stem cells to proliferate and differentiate in hypoxic-ischemic brain damage in neonatal rats. *Undersea Hyperb Med.* 2008;35(2):113-29. Epub 2008/05/27. PubMed PMID: 18500076.
84. Chang CC, Lee YC, Chang WN, Chen SS, Lui CC, Chang HW, Liu WL, Wang YL. Damage of white matter tract correlated with neuropsychological deficits in carbon monoxide intoxication after hyperbaric oxygen therapy. *J Neurotrauma.* 2009;26(8):1263-70. Epub 2009/03/26. doi: 10.1089/neu.2008.0619. PubMed PMID: 19317622.
85. Vilela DS, Lazarini PR, Da Silva CF. Effects of hyperbaric oxygen therapy on facial nerve regeneration. *Acta Otolaryngol.* 2008;128(9):1048-52. Epub 2008/12/17. doi: 10.1080/00016480701827525. PubMed PMID: 19086199.
86. Haapaniemi T, Nylander G, Kanje M, Dahlin L. Hyperbaric oxygen treatment enhances regeneration of the rat sciatic nerve. *Exp Neurol.* 1998;149(2):433-8. Epub 1998/03/17. doi: 10.1006/exnr.1997.6745. PubMed PMID: 9500969.

87. Weaver LK, Wilson SH, Lindblad AS, Churchill S, Deru K, Price RC, Williams CS, Orrison WW, Walker JM, Meehan A, Mirow S. Hyperbaric oxygen for post-concussive symptoms in United States military service members: a randomized clinical trial. *Undersea Hyperb Med.* 2018;45(2):129-56. Epub 2018/05/08. PubMed PMID: 29734566.
88. Hadanny A, Catalogna M, Yaniv S, Stolar O, Rothstein L, Shabi A, Suzin G, Sasson E, Lang E, Finci S, Polak N, Fishlev G, Harpaz RT, Adler M, Goldman RE, Zemel Y, Bechor Y, Efrati S. Hyperbaric oxygen therapy in children with post-concussion syndrome improves cognitive and behavioral function: a randomized controlled trial. *Sci Rep.* 2022;12(1):15233. Epub 2022/09/24. doi: 10.1038/s41598-022-19395-y. PubMed PMID: 36151105; PMCID: PMC9508089 Scientific LTD. Other authors don't have any conflict of interest.
89. Daly S, Thorpe M, Rockswold S, Hubbard M, Bergman T, Samadani U, Rockswold G. Hyperbaric Oxygen Therapy in the Treatment of Acute Severe Traumatic Brain Injury: A Systematic Review. *J Neurotrauma.* 2018;35(4):623-9. Epub 2017/11/15. doi: 10.1089/neu.2017.5225. PubMed PMID: 29132229; PMCID: PMC6909681.
90. Hart BB, Weaver LK, Wilson SH, Lindblad AS, Churchill S, Deru K. Executive summary: Secondary analyses of DoD-sponsored studies examining hyperbaric oxygen for persistent post-concussive symptoms after mild traumatic brain injury. *Undersea Hyperb Med.* 2019;46(3):221-6. Epub 2019/08/09. PubMed PMID: 31394593.
91. Hadanny A, Rittblat M, Bitterman M, May-Raz I, Suzin G, Boussi-Gross R, Zemel Y, Bechor Y, Catalogna M, Efrati S. Hyperbaric oxygen therapy improves neurocognitive functions of post-stroke patients - a retrospective analysis. *Restor Neurol Neurosci.* 2020;38(1):93-107. Epub 2020/01/28. doi: 10.3233/RNN-190959. PubMed PMID: 31985478; PMCID: PMC7081098.
92. Hadanny A, Abbott S, Suzin G, Bechor Y, Efrati S. Effect of hyperbaric oxygen therapy on chronic neurocognitive deficits of post-traumatic brain injury patients: retrospective analysis. *BMJ Open.* 2018;8(9):e023387. Epub 2018/10/01. doi: 10.1136/bmjopen-2018-023387. PubMed PMID: 30269074; PMCID: PMC6169752.
93. McCrary BF, Weaver L, Marrs K, Miller RS, Dicks C, Deru K, Close N, DeJong M. Hyperbaric oxygen (HBO2) for post-concussive syndrome/chronic TBI--product summary. *Undersea Hyperb Med.* 2013;40(5):443-67. Epub 2013/11/15. PubMed PMID: 24224288.
94. Crawford C, Teo L, Yang E, Isbister C, Berry K. Is Hyperbaric Oxygen Therapy Effective for Traumatic Brain Injury? A Rapid Evidence Assessment of the Literature and Recommendations for the Field. *J Head Trauma Rehabil.* 2016.
95. Figueroa XA, Wright JK. Hyperbaric oxygen: B-level evidence in mild traumatic brain injury clinical trials. *Neurology.* 2016;87(13):1400-6. Epub 2016/09/02. doi: 10.1212/WNL.0000000000003146. PubMed PMID: 27581219.
96. Churchill S, Weaver LK, Deru K, Russo AA, Handrahan D, Orrison WW, Jr., Foley JF, Elwell HA. A prospective trial of hyperbaric oxygen for chronic sequelae after brain injury (HYBOBI). *Undersea Hyperb Med.* 2013;40(2):165-93. Epub 2013/05/21. PubMed PMID: 23682548.
97. Harch PG. Hyperbaric oxygen therapy for post-concussion syndrome: contradictory conclusions from a study mischaracterized as sham-controlled. *J Neurotrauma.* 2013;30(23):1995-9. Epub 2013/09/06. doi: 10.1089/neu.2012.2799. PubMed PMID: 24004322; PMCID: PMC3837504.
98. Harch PG, Andrews SR, Rowe CJ, Lischka JR, Townsend MH, Yu Q, Mercante DE. Hyperbaric oxygen therapy for mild traumatic brain injury persistent postconcussion syndrome: a randomized controlled trial. *Med Gas Res.* 2020;10(1):8-20. Epub 2020/03/20. doi: 10.4103/2045-9912.279978. PubMed PMID: 32189664; PMCID: PMC7871939.
99. Harch PG, Andrews SR, Fogarty EF, Amen D, Pezzullo JC, Lucarini J, Aubrey C, Taylor DV, Staab PK, Van Meter KW. A phase I study of low-pressure hyperbaric oxygen therapy for blast-induced post-concussion syndrome and post-traumatic stress disorder. *J Neurotrauma.* 2012;29(1):168-85. Epub 2011/10/27. doi: 10.1089/neu.2011.1895. PubMed PMID: 22026588.
100. Weaver LK, Chhoeu A, Lindblad AS, Churchill S, Deru K, Wilson SH. Executive summary: The Brain Injury and Mechanism of Action of Hyperbaric Oxygen for Persistent Post-Concussive Symptoms after Mild Traumatic Brain Injury (mTBI) (BIMA) Study. *Undersea Hyperb Med.* 2016;43(5):485-9. Epub 2017/08/03. PubMed PMID: 28768068.
101. Boussi-Gross R, Golan H, Fishlev G, Bechor Y, Volkov O, Bergan J, Friedman M, Hoofien D, Shlamkovitch N, Ben-Jacob E, Efrati S. Hyperbaric oxygen therapy can improve post concussion syndrome years after mild traumatic brain injury - randomized prospective trial. *PLoS One.* 2013;8(11):e79995. Epub 2013/11/22. doi: 10.1371/journal.pone.0079995. PubMed PMID: 24260334; PMCID: PMC3829860.
102. Tal S, Hadanny A, Sasson E, Suzin G, Efrati S. Hyperbaric Oxygen Therapy Can Induce Angiogenesis and Regeneration of Nerve Fibers in Traumatic Brain Injury Patients. *Front Hum Neurosci.* 2017;11:508. Epub 2017/11/04. doi: 10.3389/fnhum.2017.00508. PubMed PMID: 29097988; PMCID: PMC5654341.

103. Tal S, Hadanny A, Berkovitz N, Sasson E, Ben-Jacob E, Efrati S. Hyperbaric oxygen may induce angiogenesis in patients suffering from prolonged post-concussion syndrome due to traumatic brain injury. *Restor Neurol Neurosci*. 2015;33(6):943-51. Epub 2015/10/21. doi: 10.3233/RNN-150585. PubMed PMID: 26484702.
104. Doenyas-Barak K, Catalogna M, Kutz I, Levi G, Hadanny A, Tal S, Daphna-Tekoha S, Sasson E, Shechter Y, Efrati S. Hyperbaric oxygen therapy improves symptoms, brain's microstructure and functionality in veterans with treatment resistant post-traumatic stress disorder: A prospective, randomized, controlled trial. *PLoS One*. 2022;17(2):e0264161. Epub 2022/02/23. doi: 10.1371/journal.pone.0264161. PubMed PMID: 35192645; PMCID: PMC8863239.
105. Greenwald BD, Rigg JL. Neurorehabilitation in traumatic brain injury: does it make a difference? *The Mount Sinai journal of medicine, New York*. 2009;76(2):182-9.
106. deGuise E, leBlanc J, Feyz M, Meyer K, Duplantie J, Thomas H, et al. Long-term outcome after severe traumatic brain injury: the McGill interdisciplinary prospective study. *The Journal of head trauma rehabilitation*. 2008;23(5):294-303.
107. Arciniegas DB, Anderson CA, Topkoff J, McAllister TW. Mild traumatic brain injury: a neuropsychiatric approach to diagnosis, evaluation, and treatment. *Neuropsychiatric disease and treatment*. 2005;1(4):311-27.
108. Alderson P, Roberts I. Corticosteroids for acute traumatic brain injury. *The Cochrane database of systematic reviews*. 2005(1):CD000196.
109. Schierhout G, Roberts I. Hyperventilation therapy for acute traumatic brain injury. *The Cochrane database of systematic reviews*. 2000(2):CD000566.
110. Roberts I, Sydenham E. Barbiturates for acute traumatic brain injury. *The Cochrane database of systematic reviews*. 2012;12:CD000033.
111. Langham J, Goldfrad C, Teasdale G, Shaw D, Rowan K. Calcium channel blockers for acute traumatic brain injury. *The Cochrane database of systematic reviews*. 2003(4):CD000565.
112. Sydenham E, Roberts I, Alderson P. Hypothermia for traumatic head injury. *The Cochrane database of systematic reviews*. 2009(2):CD001048.
113. Bullock MR, Povlishock JT. Guidelines for the management of severe traumatic brain injury. Editor's Commentary. *Journal of neurotrauma*. 2007;24 Suppl 1:2 p preceding S1.
114. Bulger EM, Nathens AB, Rivara FP, Moore M, MacKenzie EJ, Jurkovich GJ, et al. Management of severe head injury: institutional variations in care and effect on outcome. *Critical care medicine*. 2002;30(8):1870-6.
115. Shafi S, Barnes SA, Millar D, Sobrino J, Kudyakov R, Berryman C, et al. Suboptimal compliance with evidence-based guidelines in patients with traumatic brain injuries. *Journal of neurosurgery*. 2014;120(3):773-7.