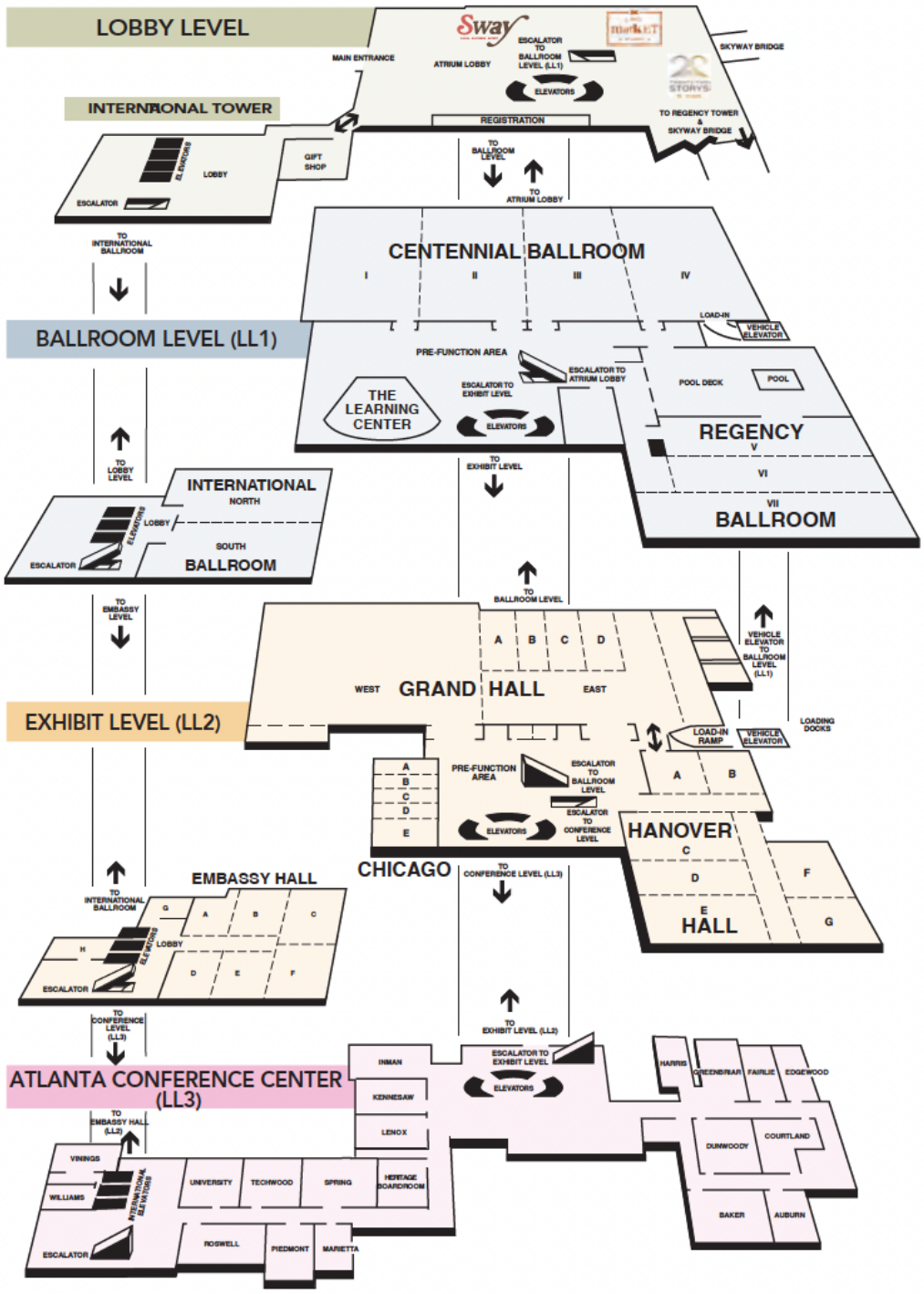
Aerospace Medical Association &
Undersea and Hyperbaric Medical Society

2025
UHMS TRACK
Program & Abstracts

June 1-5

Hyatt Regency Atlanta
Atlanta, Georgia



HYATT REGENCY ATLANTA

265 Peachtree Street, NE, Atlanta, Georgia 30303
TELEPHONE 404 577 1234 FACSIMILE 404 588 4137
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Sunday, June 1:

- Evaluating equipment for safe use in the hyperbaric or hypobaric environment 8am-5:30 pm: Regency VI
- Management of Decompression Illness in Remote Settings 8am-5pm: Courtland
- Welcome to Atlanta: Grand Hall West: 6:30pm–8:30pm

Monday, June 2

- AsMA-UHMS: Welcome/Keynote Addresses: Centennial Ballroom: 8am-12pm
- UHMS Track: Regency VI:
  - 2pm-3:30pm
  - 4pm-5:30pm
- Lunch (On Own), Special Luncheons and Meetings: See schedule: 12pm-2pm
- Posters: Grand Hall East:
  - 2pm-3:30pm
  - 4pm-5:30pm
- Exhibits / Breaks: Grand Hall West:
  - 10am-10:30am
  - 3:30pm-4pm

Tuesday, June 3

- AsMA-UHMS: Welcome/Keynote Addresses: Centennial Ballroom: 8am-12pm
- UHMS Track: Regency VI:
  - 2pm-3:30pm
  - 4pm-5:30pm
- Lunch (On Own), Special Luncheons and Meetings: See schedule: 12pm-2pm
- Posters: Grand Hall East:
  - 2pm-3:30pm
  - 4pm-5:30pm
- Exhibits / Breaks: Grand Hall West:
  - 10:15am-10:45am
  - 3:30pm-4pm

Wednesday, June 4

- UHMS Track: Regency VI:
  - 8:30am-10am
  - 10:30am-12pm
  - 2pm-3:30pm
- Ram Bowl: Centennial Ballroom: 4pm-5:30pm
- Lunch (On Own), Special Luncheons and Meetings: See schedule: 12pm-2pm
- Posters: Grand Hall East:
  - 8:30am-10am
  - 10:30am-12pm
  - 2pm-3:30pm
- Exhibits / Breaks: Grand Hall West:
  - 10am-10:30am
  - 3:30pm-4pm
- UHMS Honors Night Reception/Banquet: Grand Hall East A/B/C/D: 7pm-10pm

Thursday, June 5

- AsMA-UHMS: Keynote Address: Centennial Ballroom: 8am-9:30am
- UHMS Track: Regency VI:
  - 10am-11:30pm
  - 1:30pm-3pm
  - 3:30pm-5pm
- Lunch (On Own), Special Luncheons and Meetings: See schedule: 11:30ampm-1:30pm
- Posters: Grand Hall East:
  - 10am-11:30am
  - 1:30pm-3pm
  - 3:30-5pm (if needed)
- Breaks: Grand Hall West:
  - 9:30am-10am
  - 3pm-3:30pm
- AsMA Honors Night Reception/Banquet: Grand Hall East A/B/C/D: 7pm-9pm
- AsMA-UHMS After Party: Grand Hall East Foyer: 9pm-11pm

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Undersea & Hyperbaric Medical Society
Committees

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Owen O'Neill, President
Philip Bryson, Vice President
Sandra Wainwright, President-Elect
Pete Witucki, Immediate Past President
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* (non-voting)

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Virginie Papadopoulou, PhD
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Lisa Tidd, Meeting Planner
Stacy Harmon, CME Coordinator

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Lorrie Cote'
Derall Garrett

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Heinz R. Schreiner: 1970-1971
Earl H. Ninow: 1971-1972
David H. Elliott: 1972–1973
Johannes A. Kylstra: 1973–1974
Dennis N. Walder, 1974-1975
Peter B. Bennett: 1975-1976
Arthur J. Bachrach: 1976-1977
James Vorosmarti, Jr.: 1977-1978
Herbert A. Saltzman: 1978-1979
Jefferson C. Davis: 1979-1980
Paul Webb: 1980-1981
Eric P. Kindwall: 1981-1982
John Hallenbeck: 1982-1983
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Paul Cianci: 1991-1992
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James M. Clark: 1993-1994
Richard E. Moon: 1994-1996
Stephen R. Thom: 1996-1998
Caroline Fife: 1998-2000
Enrico Camporesi: 2000-2002
Neil Hampson: 2002-2004
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Bret Stolp: 2006-2008
Laurie Gesell: 2008-2010
Brett Hart: 2010-2012
John Feldmeier: 2012-2014
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Enoch Huang: 2016-2018
Nick Bird: 2018-2020
Marc Robins, 2020-2022
Pete Witucki: 2022-2024

Committee Chairpersons
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ASM Program: Owen O'Neill/Pete Witucki
Associates Council: Geness Koumandakis/Liz Smykowski
Awards: Phil Bryson
Audit/Finance: Helen Gelly
By-Laws: Owen O'Neill
DCI & Adjunctive Therapy: Richard Moon & Frank Butler
Diving: Charlotte Sadler/Jim Chimiak
Education: Tom Bozzuto/Owen O'Neill
FDA Liaison: John Feldmeier
FUHM: Marc Robins
GME: Tom Masters
Registry: John Kirby
QUARC: Helen Gelly/Stuart Miller
Safety: Andrew Melnyczenko
Hyperbaric Medicine Committee: Marvin Heyboer
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Gulf Coast: Philip Schell
Mid-West: Laurie Gesell
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Affiliate Organizations
Canadian Undersea and Hyperbaric Medical Association (CUHMA)
European Underwater and Baromedical Society (EUBS)
Sociedade Brasileira de Medicina Hiperbárica (SBMH)
Società Italiana di Medicina Subacquea ed Iperbarica (SIMSI)
South Pacific Underwater Medicine Society (SPUMS)

ASMA-UHMS ANNUAL SCIENTIFIC SCHEDULE-AT-A-GLANCE

SUNDAY, JUNE 1

7am-6pm	Registration open	
8am-5pm	Workshop: Management of decompression illness in remote settings	Courtland
8am-5:30pm	Workshop: Evaluating equipment for safe use in the hyperbaric or hypobaric environment	Regency VI
8am-5pm	Workshop: 4th Annual Aviation Mental Health: Progress, Challenges, Innovation & Evidence: Are Our Minds & Systems Getting Better?	The Learning Center
8am-5pm	Workshop: Aerospace Mishap Epidemiology - The Science of the Denominator	Hanover A

MONDAY, JUNE 2

7am-4pm	Registration open								
	Centennial Ballroom								
8am-8:45am	OPENING CEREMONIES								
8:45am-10am	LOUIS H. BAUER LECTURE: Open Innovation at NASA - good ideas can come from anywhere – Jeffrey R. Davis, MD								
10:30am-12pm	ERIC P. KINDWALL MEMORIAL LECTURE: The Sagol Center for Hyperbaric Medicine: Experience with Treating IDF Soldiers - Shai Efrati, MD								
12pm-2pm	LUNCH (ON OWN), SPECIAL LUNCHEONS AND MEETINGS (see event app for listing)								
	Centennial Ballroom I	Centennial Ballroom II	Centennial Ballroom III	Centennial Ballroom IV	Regency V	Regency VI	Regency VII	Hanover C/D/E	Hanover F/G	Grand Hall East (Posters)
2pm-3:30pm	Cardiovascular Screening for Aircrew	Intrinsically Photosensitive Retinal Ganglion Cells	NASA's Medical Capability & Technology Development Activities for Missions to Mars	Bringing a Research Project to Fruition	Aerospace Medicine Potpourri	UHMS -see breakout Schedule-	Biomechanics and Physiology	FAA	Aeromedical Capability and Performance	UHMS Poster Sessions: A4-A9; B10-B11; B13-B17; B19-B21; B23-B29; B31; B33; B35
4pm-5:30pm	Banish Neuro-Phobia: Aerospace Neurology for the Busy AME	The Necessity of an Aviation Psychology Specialty	Tooled for Space	Safety Centers: Year in Review 2024	Fast Beats and High Peaks	UHMS -see breakout Schedule-	G Factors	FAA	Aeromedical Operational and Clinical Psychology Branch Occupation Health Program 2024	UHMS Poster Sessions: A3; B34; B36-B50; B52-B59

TUESDAY, JUNE 3

8am-4pm	Registration open
	Centennial Ballroom
8:30am-9am	ANNOUNCEMENTS
9am-10:15am	11TH EUGEN G. REINARTZ MEMORIAL LECTURE: Commercial Space, Human Spaceflight, the I.S.S. and the U.S. Return to the Moon - Mark N. Sirangelo, PhD
10:45am-12pm	UHMS CHRISTIAN J. LAMBERTSEN MEMORIAL LECTURE: Last Breath - Reasoning with life and death at the bottom of the North Sea. - Chris Lemons
12pm-2pm	LUNCH (ON OWN), SPECIAL LUNCHEONS AND MEETINGS (see event app for listing)

ASMA-UHMS ANNUAL SCIENTIFIC SCHEDULE-AT-A-GLANCE

	Centennial Ballroom I	Centennial Ballroom II	Centennial Ballroom III	Centennial Ballroom IV	Regency V	Regency VI (UHMS)	Regency VII	Hanover C/D/E	Hanover F/G	Grand Hall East (Posters)
2pm-3:30pm	Celebrating Over 50 Yrs of Aerospace Medicine Education, Training, & Research in the UK	Evaluating the Neuro-Physiological Markers of Non-Standard Oxygen Delivery Pressure	Impact of Spaceflight on the Brain – a Decade of MRI Imaging	Update: Advanced Disease Defense & UV-C Disinfection in Aviation	Peer Support and Mental Health in Civil Aviation Across the Globe	UHMS -see breakout Schedule-	Physiological and Cognitive Monitoring	FAA	Sleep Disorders as a Fatigue Factor in Aviation	Constellation of Space
4pm-5:30pm	USAF Aerospace Medicine Waiver Guide: Key Insights on PTSD, AUD, and TBI Seizure Risk	Visual and Vestibular Physiology and Performance	Are PCMs Ready for Commercial Spaceflight?	Inflight Medical Emergency Response Capability. Current state, Learnings and Challenges	To Work or Not to Work?	UHMS -see breakout Schedule-	Training Factors	FAA	Sleep, Fatigue, and Cognition	UHMS Poster Sessions: B62; B65 C68-C71; C73; C133; D74; D77; D79-D93
WEDNESDAY, JUNE 4										
8am-4pm	Registration open									
	Centennial Ballroom I	Centennial Ballroom II	Centennial Ballroom III	Centennial Ballroom IV	Regency V	Regency VI (UHMS)	Regency VII	Hanover C/D/E	Hanover F/G	Grand Hall East (Posters)
8:30am-10am	Insulin Treated Diabetes – Regulatory & In-Flight Perspectives	Fatigue in Military Aviation	Fly Girls	Life Support Challenges	Pilot Spatial Disorientation Research, Modeling, and Training	UHMS -see breakout Schedule-	Simulator Sickness, Cybersickness, and the Vestibular System	FAA	Resident in Aerospace Medicine (RAM) Grand Rounds I	To Automate or Not
10:30am-12pm	Shorter Time on DNIF Status	What Goes on in the Mind?	Aviation Accident Injury Severity and Prevention	Under Pressure: DCS	Assessment of Pilot's SA Using Non-obtrusive & Real-Time Measures	UHMS -see breakout Schedule-	Measuring Physiological Stress	FAA	Resident in Aerospace Medicine (RAM) Grand Rounds II	UHMS Poster Sessions: D76; D95-D110 E114-E123
12pm-2pm	LUNCH (ON OWN), SPECIAL LUNCHEONS AND MEETINGS (see event app for listing)									
2pm-3:30pm	Blocked for the RAM Bowl Set-up	Blocked for the RAM Bowl Set-up	Above the Neck	Data 2 Decisions	Occurrences of Spatial Disorientation in Military Aviation	UHMS -see breakout Schedule-	Principles & Practices of Mary F Foley	FAA	Resident in Aerospace Medicine (RAM) Grand Rounds III	No, you can't fly
	Centennial Ballroom I & II									
4pm-5:30pm	15th RAM BOWL									

ASMA-UHMS ANNUAL SCIENTIFIC SCHEDULE-AT-A-GLANCE

THURSDAY, JUNE 5										
8am-2pm	**Registration open**									
	Centennial Ballroom I									
8am	**ANNOUNCEMENTS**									
8am-9:30am	**HARRY G. ARMSTRONG / GEORGE B. HART LECTURE: Pressure Perils from Undersea to Outer Space Panel - Jon Clark, MD; Joe Dervay, MD; Mitch Garber, MD; Michael Gernhardt, PhD; Richard Moon, MD**									
	Centennial Ballroom I	**Centennial Ballroom II**	**Centennial Ballroom III**	**Centennial Ballroom IV**	**Regency V**	**Regency VI (UHMS)**	**Regency VII**	**Hanover C/D/E**	**Hanover F/G**	**Grand Hall East (Posters)**
10am-11:30am	**The Fast & the Curious: Charting New Frontiers in Aviation Medicine**	**Brain, Back and Beyond**	**VSS Unity Suborbital Flight Experience: Medical Outcomes and Lessons Learned**	**Surgery in Space**	**The Good, the Bad, and the Ugly of Artificial Intelligence**	**UHMS -see breakout Schedule-**	**Utilization of Artificial Intelligence-Based Tools to Support Autonomous Medical Operations**	**FAA**	**Ventilation Blues**	**Can my Body Handle It** **UHMS Poster Sessions: B61 E111-E112 E124-E129 F130-F132**
11:30am-1:30pm	**LUNCH (ON OWN), SPECIAL LUNCHEONS AND MEETINGS (see event app for listing)**									
	Centennial Ballroom I	**Centennial Ballroom II**	**Centennial Ballroom III**	**Centennial Ballroom IV**	**Regency V**	**Regency VI (UHMS)**	**Regency VII**	**Hanover C/D/E**	**Hanover F/G**	**Grand Hall East (Posters)**
1:30pm-3pm	**Clinical Approaches to Complex Aeromedical Cases: Are They Safe for Duty?**	**AAMIMO Grand Rounds I- Cross Cultural Clinical Cases in Aerospace Medicine**	**Surveillance and Countermeasures for Space**	**Neuro and Biomechanics**	**Aviation Medicine in the New Nordic NATO Framework**	**UHMS -see breakout Schedule-**	**Applications of Artificial Intelligence to Combat Aviation Mishaps**	**Aeromedical Ethics Panel**	**ASAMS Board Review**	**Head, Shoulders, Knees & Toes for Space**
3:30pm-5pm	**Aerospace Medicine Advances in Ibero-America**	**Making Sense of Special Senses IV: Sensory Challenges**	**Super Models: Predicting Responses to Space**		**When Aviation Medicine is Going Beyond Care Medicine**	**UHMS -see breakout Schedule-**			**ASAMS Board Review**	
FRIDAY, JUNE 6										
7am-6pm	Workshop: Tropical and Subtropical Medicine: Operation Stone Mountain								Courtland	

COLOR CODE	**Clinical Medicine**	**Human Performance**	**Space Medicine**	**Safety & Survivability/ Travel**	**UHMS Track & Poster Sessions**

SCHEDULE

MONDAY, JUNE 2			
7am-4pm	Registration		
8am-8:45am	Opening Ceremony / Welcome Announcements / Keynote Introductions		
8:45am-10am	70th Louis H. Bauer Lecture: Open Innovation at NASA - good ideas can come from anywhere	Jeffrey R Davis, MD	
10am-10:30am	AsMA-UHMS Exhibits / Break		
10:30am-12pm	UHMS Kindwall Keynote: "The Sagol Center for Hyperbaric Medicine: Experience with Treating IDF Soldiers."	Shai Efrati, MD	
12pm-2pm	Lunch (on own)		
Session A - HBO_2 Theory and Mechanisms: Moderators: Lindell Weaver, MD; Laurie Gesell, MD			
2pm-2:30pm	Plenary: Chapter 16, UHMS Indications: Mechanisms of Action	Gerardo Bosco, MD, PhD	Posters: 2PM–3:30PM: **A4-A9; B10-B11; B13-B17; B19-B21; B23-B29; B31; B33; B35**
2:30pm-2:40pm	A1: Hyperbaric oxygen suppresses inflammatory microparticle production in carbon monoxide poisoned patients and in a murine model.	Stephen R. Thom, MD	
2:40pm-2:50pm	A2: Composition of Breathing Gas Impacts the Development of Noise Induced Hearing Loss in the Hyperbaric Environment	Elliott Dirr, PhD	
2:50pm-3pm	A3: Hyperbaric Oxygen Exposure Oppositely Affects Gene Expression of the SARS-CoV-2 Receptors, Toll-Like Receptor TLR3, Interleukins IL4 and IL10, IKKepsilon, and the transcription factors FOXO1 and NFATC1 via Inverse Regulation of NRF2 and miR-365b-5p Expression in Normal and COPD-Diseased Human Bronchial Epithelial Cells	Eva Yi-Hui Chen, PhD	
3pm-3:30pm	Plenary: UHM Fellows: Top articles in Hyperbaric Medicine	Samantha Ni, MD	
3:30pm-4pm	AsMA-UHMS Exhibits / Break		
Session B - Clinical HBO_2: Moderators: Brian Keuski, MD; John Feldmeier, DO			
4pm-5pm	Plenary Panel: Evaluation of patients for hyperbaric oxygen treatment, to treat or not to treat (Chest/Lung, EF…)	Lin Weaver, MD Owen O'Neill, MD, MPH Sandra Wainwright, MD	Posters: 4PM-5:30PM: **A3; B34; B36-B50; B52-B59**
5pm-5:10pm	B10: Ten sessions of Hyperbaric Oxygen versus sham treatment in patients with Long COVID (HOT-LoCO): A randomized, placebo controlled, double-blind, phase II trial.	Anders Kjellberg, MD	
5:10pm-5:20pm	B11: Hyperbaric oxygen therapy with and without sodium thiosulfate for treatment of wounds caused by calciphylaxis: A retrospective analysis of the past 20 years	Doris J. Armour, MD	
5:20pm-5:30pm	B12: Five-year chronic disease burden and mortality risk in carbon monoxide-poisoned patients, with and without hyperbaric oxygen, compared to patients with wrist fractures	Lindell K. Weaver, MD	
TUESDAY, JUNE 3			
8am-4pm	Registration		
8:30am-9am	Announcements / Keynote Introductions		
9am-10:15am	11th Eugen G. Reinartz Memorial Lecture: "Commercial Space, Human Spaceflight, the I.S.S. and the U.S. Return to the Moon	Mark N. Sirangelo, PhD	
10:15am-10:45am	AsMA-UHMS Exhibits / Break		
10:45am-12pm	UHMS Lambertsen Keynote: "Last Breath - Reasoning with life and death at the bottom of the North Sea." Chris Lemons	Chris Lemons	
12pm-2pm	Lunch (on own)		

Session C - Decompression Theory and Mechanisms: Moderators: Bruce Derrick, MD; Frauke Tillmans, PhD			
2pm-2:30pm	Plenary: Shunted venous bubbles: an update on behavior and pathogenicity	Simon Micthell, MD	
2:30pm-2:40pm	C66: Decompression to altitude and from high pressure – a common mechanism for microparticle production and putative site for bubble nucleation	Stephen R. Thom, MD	
2:40pm-2:50pm	C67: Neutrophil transcriptomic responses to hyperbaric stress using a human lung-on-a-chip model	Abigail G. Harrell, MS	
2:50pm-3pm	C68: Real-time automated detection of venous gas emboli: prospective evaluation of a deep learning pipeline after hyperbaric chamber dives	Arian Azarang, PhD	
3pm-3:30pm	Plenary: Engineering the academic pipeline for undersea medicine: A global strategy for next-gen STEM workforce development	Virginie Papadopoulou, PhD	
3:30pm-4pm	AsMA-UHMS Exhibits / Break		
Session D - Diving Medicine: Moderators: Pete Witucki, MD, Virginie Papadopoulou, PhD			
4pm-4:30pm	Plenary: Analyzing. Blood biomarkers that compare scuba divers to free divers	Tommaso Giacon, MD	Posters: 4PM-5:30PM: **B62; B65 C68-C71; C73; C133; D74; D77; D79-D93**
4:30pm-4:40pm	D78: Effect of pre-dive ketone food products on latency to CNS oxygen toxicity	Kyle Steinbock, BS	
4:40pm-4:50pm	D75: Whole-body nitrogen elimination after diving using an open-circuit indirect measurement method	Sven De Ridder	
4:50pm-5pm	D76: Central nervous system oxygen toxicity and core temperature responses to HBO_2 during immersion with hypercapnic O_2 at 3 ATA and pure O_2 at 5 ATA in rats	Courtney Wheelock, PhD	
5pm-5:30pm	Plenary: UHM Fellows: Top articles in Undersea Medicine	Jayanth Adusumalli, MD	
WEDNESDAY, JUNE 4			
8am-4pm	Registration		
8:30am-10am	Plenary: International panel: Vestibular DCI; DEEP; Saturation diving table reviews	Phil Bryson, MBBS Rosanna Stokes, MBBS Andrew Abercromby, PhD Jean-Pierre Imbert, PhD	
10am-10:30am	AsMA-UHMS Exhibits / Break		
Session E - HBO2 Operations, Chambers and Equipment: Moderators: Marc Robins, DO; Gus Gustavson, RN			
10:30am-11am	Plenary: Extremely Intensive Care – Successful delivery of Hyperbaric ECMO	Ian Millar, MD Bridget Devaney, MBChB	Posters: 10:30AM-12PM: **D76; D95-D110 E114-E123**
11am-11:10am	E111: Retrospective cohort study of Microvascular Fluorescence Angiography (MFA) use in hyperbaric oxygen therapy patients following lower extremity amputation complicated by flap ischemia	Benjamin R. Banks, MD	
11:10am-11:20am	E112: Additional information obtained from the CMS controlled study employing billing records to report effects and costs of hyperbaric oxygen for Radiation Cystitis	John J. Feldmeier, DO	
11:20am-11:30am	E113: Sharpened Romberg Test variability in a randomized, double-blind trial of hyperbaric oxygen for persistent symptoms after brain injury	Rosemary Ziemnik, MS	
Session F - Clinical Evaluations: Moderators: Sandra Wainwright, MD; Stephen Thom, MD			
11:30pm-11:40am	F130: Myopic changes persist 6 weeks after hyperbaric oxygen treatment course in monoplace chamber	Joan W Chou, MD	
11:40pm-11:50am	F131: Ultrasound muscle scans collected during decompression may predict post-dive venous gas emboli loads	Joshua Currens	
11:50am-12pm	F132: Divers tend to produce individually consistent venous gas emboli grades after conducting the same dive multiple times	Joshua Currens	
12pm-2pm	Lunch (on own)		
2pm-2:30pm	Plenary: Microparticle research– an international collaboration with South Korean physicians on carbon monoxide poisoning	Stephen Thom, MD	

2:30-3pm	Eustachian Tube Dysfunction & Middle Ear Barotrauma Diagnosis, Grading, Treatment, & Prevention	Owen O'Neill, MD, MPH	
3pm-3:30pm	Regulatory Oversight – Hyperbaric Medicine's Pandora Box	John Feldmeier, DO Tom Workman, CHT	
3:30pm-4pm	AsMA-UHMS Exhibits / Break		
4pm-5:30pm	RAM Bowl with AsMA		
7pm-7:30pm	UHMS Honors Night Reception		
7:30pm-10pm	UHMS HONORS NIGHT reception/banquet		
THURSDAY, JUNE 5			
8am-2pm	Registration		
7:30am-8am	UHMS Business Meeting	Regency VI	
8am	Announcements / Keynote Introductions with AsMA		
8am-9:30am	Armstrong-Hart Lecture: Pressure Perils from Undersea to Outer Space Panel	Jon Clark, MD Mitch A. Garber, MD Michael Gernhardt, PhD Richard Moon, MD	
9:30am-10am	Break		
Moderator: Owen O'Neill, MD, MPH			
10am-10:45am	Plenary: The most complicated monoplace chamber out of this world	Michael Harrison, MD	Posters: 10AM-11:30AM: **B61** **E111-E112** **E124-E129** **F130-F132**
10:45am-11:30am	Plenary: Update: engineering and pressure - saturation tunnel working in the extremes	Justin Costello	
11:30am-1:30am	Lunch (on own)		
ASSOCIATES BREAKOUT SESSION: Moderators: Geness Koumandakis, CHT; Liz Smykowski, RN			
1:30pm-2pm	Concepts of Human Factors in Diving	Jonathan Langham	
2pm-2:30pm	Decoding Hyperbaric Medicine with your AHJ	Gus Gustavson, RN	
2:30pm-3pm	Go No-Go survey	Marc Pullis, CHT	
3pm-3:30pm	break		
3:30pm-4:30pm	Common findings or common pitfalls for Hyperbaric Facility Accreditation Panel	Larry Chase, MD Monica Skarban, RN Holly Manchini, CHT	
4:30pm-5pm	Cultural sensitivity in healthcare related to providing hyperbaric care	Gus Gustavson, RN	
6pm-9pm	AsMA honors night		
9pm-11pm	AsMA / UHMS after party		

Overall Goal of the UHMS Annual Scientific Meeting

The primary goal of the Undersea and Hyperbaric Medical Society ASM is to provide a forum for professional scientific growth and development to the participants. The meeting provides a basis for exchange of ideas, both scientific and practical, among physicians, researchers, and other health professionals. It affords an opportunity for participants to meet and interact with past and present leaders of the Society, and to become active in societal affairs.

CONTINUING EDUCATION

Accreditation Statement:

The Undersea and Hyperbaric Medical Society is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

Designation Statements:

- **Physician CME:** The Undersea and Hyperbaric Medical Society designates this live activity for a maximum of **24.5** *AMA PRA Category 1 Credit(s)™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

- **Nursing/RRT Contact Hours:** This live activity is approved for **24.5** CE hours provided by the Florida Board of Registered Nursing/RRT Provider #50-10881. License types: RN, LPN, CNS, ARNP, CNA, CRT, RRT, RCP. Provided through the Florida State Board of Nursing, the CE credits are reciprocal and approved for nurses within all states. Receiving credit for Florida providers is simple; attend the course, and our staff will upload your credits directly to the Florida State database. For out-of-state credit, we provide this letter for you to file with the respective nursing board.
- **NBDHMT:** This live activity is approved for **14** Category A credit and **10.5** Category B hours by the National Board of Diving and Hyperbaric Medical Technology, P.O. Box 758, Pelion, South Carolina 29123.
    - **NBDHMT Accreditation Statement**: For CHT recertification purposes, the NBDHMT requires a minimum of nine of the minimum 12 required Category A credits relate directly to any combination of hyperbaric operations, related technical aspects and chamber safety.

Full Disclosure Statement: Individuals in control of content participating in continuing medical education activities sponsored by the Undersea and Hyperbaric Medical Society are expected to disclose to the participants any relevant financial relationships with ineligible companies. Full disclosure of faculty and planner relevant financial relationships will be made at the activity.

Disclosure:
The following individuals have disclosed a relevant financial relationship with ineligible companies. Financial relationships are relevant if the following three conditions are met for the individual who will control content of the education:
A financial relationship, in any amount, exists between the person in control of content and an ineligible company and;

1. The content of the education is related to the products of an ineligible company with whom the person has a financial relationship and;
2. The financial relationship existed during the past 24 months.
3. All of the relevant financial relationships listed for these individuals have been mitigated.

- None of the individuals in control of content (planners/faculty/reviewers/authors) for this educational activity have relevant financial relationship(s) to disclose with ineligible companies whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.
- The following commercial support was received for this activity.

Name of Company	Type of Commercial Support	Amount of Monetary Support	Use of Monetary Support
Environmental Tectonics Corporation	Monetary	$ 2,500.00	Armstrong Lecture Honorarium
Environmental Tectonics Corporation	Monetary	$ 5,000.00	International Reception Food & Beverage
Environmental Tectonics Corporation	Monetary	$ 3,500.00	Acceleration Interest Workshop Food & Beverage
Environmental Tectonics Corporation	Monetary	$ 1,000.00	Exhibit Hall Coffee & Tea Service
Environmental Tectonics Corporation	Monetary	$ 1,150.00	Spatial Disorientation Research Group Breakfast
DEEP	Monetary	$500	STEM Sponsorship
Wound Education Partners	Monetary	$500	STEM Sponsorship

Disclaimer: The information provided during this CME activity is for Continuing Medical Education purposes only. However, the lecture content, statements, or opinions expressed do not necessarily represent those of the Undersea and Hyperbaric Medical Society.

Note for ABMS Board Certified Physicians: Some ABMS boards will accept accredited CME towards their MOC requirements. As an accredited provider, the UHMS can now register educational activities as CME for MOC (Part II) for ACCME collaborating boards. Please review the learner instructions and submit the necessary requirements for your credit to be reported within 30 days of the course closing. Learner CME credit must be reported no later than December 1st of the reporting year. If your board is not collaborating yet with ACCME to report CME for MOC, please continue to submit your credits to your certifying board directly.

Successful completion of this CME activity, which includes participation in the evaluation component, enables the participant to earn up to:

- 24.5 MOC points in the American Board of Anesthesiology (ABA) Maintenance of Certification (MOC) program; and
- 24.5 MOC points in the American Board of Internal Medicine's (ABIM) Maintenance of Certification (MOC) program; and
- 24.5 MOC points in the American Board of Otolaryngology – Head and Neck Surgery (ABOHNS) Continuing Certification Program (CCP); and
- 24.5 MOC points in the American Board of Orthopedic Surgery (ABOS) Maintenance of Certification (MOC) program; and
- 24.5 MOC points in the American Board of Pathology (ABPath) Continuing Certification Program (CCP); and
- 24.5 MOC points in the American Board of Surgery (ABS) Maintenance of Certification (MOC) program; and
- 24.5 MOC points in the American Board of Pediatrics (ABP) Maintenance of Certification (MOC) program; and
- 24.5 MOC points in the American Board of Thoracic Surgery (ABTS) Maintenance of Certification (MOC) program.

*****Will require evaluation feedback**

Evaluation: The evaluation will be available at the conclusion of the meeting. To access it, you will need to log in to the ASM website with your username and password, which will be emailed to you from info@asma-uhms-asm.org before the meeting ends. Once logged in, you will be able to find the evaluation under your account.

Presentations:
Presentations will also be located on the ASM website under your account. This meeting is recorded to post as a future enduring material. You cannot claim CE credit for both live stream and enduring material programs.

MONDAY, JUNE 2

Centennial Ballroom

6am-8am	**Richard B. "Dick" Trumbo 5K Fun Run/Walk: Hotel Entrance Lobby**
7am-4pm	**Registration Open**
8am-8:45am	**Opening Ceremonies: Centennial Ballroom**
8:45am-10am	**70th Louis H. Bauer Lecture: Open Innovation at NASA: Good ideas can from anywhere: Jeffrey R. Davis, MD**

About the Lecture:
Dr. Jeff Davis will present the Bauer lecture entitled "Open Innovation at NASA - good ideas can come from anywhere" on June 2nd. In this address, Dr. Davis will describe the early use of open innovation to solve technical problems in the Human Health and Performance Directorate, the formation of a Center of Excellence for Collaborative Innovation (CoECI) to support problem solvers, highlight some remarkable successes, and showcase the growth of this innovation model over the past 16 years.

About the Speaker:
Dr. Davis has served aviation and space medicine for 20+ years. He is board certified in aerospace medicine and has served in the following roles: Branch Chief of Medical Operations at NASA; Corporate Medical Director of American Airlines; Professor and Residency Director of Aerospace Medicine at the University of Texas Medical Branch; and as Director of Space and Life Sciences at the NASA-Johnson Space Center. His awards include an Outstanding Leadership Medal and Silver Snoopy at NASA, and the Louis H Bauer Founder's Award from the Aerospace Medical Association. He has served as the Chair of the American Board of Preventive Medicine.

10am-10:30am	**Exhibits / Break: Grand Ballroom West**
10:30am-12pm	**Eric P. Kindwall Memorial Lecture: "The Sagol Center for Hyperbaric Medicine: Experience with Treating Israel Defense Forces (IDF) Soldiers." - Shai Efrati, MD**

About the Lecture:
In conventional medicine, we rely on surgical intervention and pharmacologic agents to achieve desired biological outcomes. Hyperbaric medicine, however, harnesses controlled environmental changes—specifically in pressure and gas concentration—to attain these goals. From a pharmacokinetic and pharmacodynamic perspective, hyperbaric interventions can be categorized into three primary mechanisms of action: (1) pressure as the active agent, (2) oxygen as the active agent, and (3) the induction of tissue repair via the hyperoxic-hypoxic paradox (HHP). Each of these categories includes various military-related injuries that are treated extensively at the Sagol Center for Hyperbaric Medicine and Research.

Examples include:

- Pressure as the active agent – Treatment of decompression sickness in divers and fighter pilots, as well as gas embolism in severe blast injuries.
- Oxygen as the active agent – Management of smoke inhalation, crush injuries, critical limb ischemia, and resistant fungal infections.
- Induction of tissue repair through HHP – Addressing non-healing limb wounds, blast and traumatic brain injuries (TBI), and PTSD.

In this lecture, we will trace the journey that led us to treat over 350 patients daily at the Sagol Center. We will examine the underlying pathophysiology and the application of hyperbaric medicine for each of these indications, with a particular focus on the unique challenges and outcomes associated with treating Israel Defense Forces (IDF) soldiers.

About the Speaker:
Dr. Shai Efrati is a professor at Tel Aviv University's Sackler School of Medicine and the Sagol School of Neuroscience. He also serves as the director of the Sagol Center for Hyperbaric Medicine and Research at Shamir Medical Center in Israel, where he leads the world's largest hyperbaric treatment center, treating over 350 patients daily.
Dr. Efrati's research extends the applications of Hyperbaric Oxygen Therapy (HBOT), viewing the brain as a tissue with repair potential like other healing processes in the body. His research program includes a unique HBOT protocol that leverages the Hyperoxic-Hypoxic Paradox (HHP), promoting tissue and brain repair through controlled fluctuations in oxygen and pressure. Clinical trials have shown this protocol to stimulate stem cell proliferation, neurogenesis, angiogenesis, and improve cellular metabolism through better mitochondrial function and enhance both neurocognitive and physical performance. The HHP protocol has demonstrated substantial benefits for patients suffering from post-concussion syndrome following traumatic brain injuries (TBI) or blast injuries, stroke, and PTSD, and has been successfully applied in life- and limb-saving treatments for soldiers with battlefield-related injuries.

ABOUT ERIC P. KINDWALL, MD
Dr. Kindwall is known by many as the "Father of Hyperbaric Medicine." Whether you knew him personally or simply by reputation, we have all benefited from his efforts, passion, wisdom, knowledge, energy and vision. Dr. Kindwall has played a great role in growing and shaping the specialty of Undersea and Hyperbaric Medicine. He was likewise instrumental in molding the UHMS into what it is today. Dr. Kindwall began diving in 1950. He cultivated his interest in the field and during the Vietnam War served as the Assistant Director of the U.S. Navy School of Submarine Medicine. He also was the Senior Officer responsible for the Diving Medicine Program. In 1969, after leaving the Navy, Dr. Kindwall became Chief of the Department of Hyperbaric Medicine at St. Luke's Medical Center, Milwaukee, Wis. Shortly after the Undersea Medical Society was created in the mid-1960s, Dr. Kindwall identified the need for standardized education in the field. He created the UMS Education and Standards Committee to help elevate course content and ensure instructor competence. This committee later became our Education Committee. When the AMA initiated its Continuing Medical Education program, Dr. Kindwall persuaded the organization to recognize the UMS as a grantor of CME credits. In 1972, Dr. Kindwall felt that the Society's members would benefit from improved communication. He created our first newsletter and was named editor. Dr. Kindwall chose the name Pressure because clinical hyperbaric medicine was rapidly developing. Even though the UHMS had not yet incorporated "Hyperbaric" into the Society's name, he wanted a title for the newsletter that would encompass all who worked with increased atmospheric pressure. He stated: "The Society's goal then, as it is now, is to serve all who deal with the effects of increased barometric pressure." That same year, Dr. Kindwall recognized the need to have a relationship with Medicare to help provide insight on reputable clinical management. The UMS followed this lead, and a Medicare Panel was created. The recommendations were presented to the U.S. Public Health Service. The challenge was that no reliable hyperbaric medicine clinical guidelines were available that addressed appropriate applications of Hyperbaric Medicine. To remedy this deficit, the UMS Executive Committee created an Ad Hoc Committee on hyperbaric oxygen therapy. Dr. Kindwall was named Chair. The committee created the first Hyperbaric Oxygen Therapy Committee Report. Again, this text was published 10 years before the UHMS incorporated "Hyperbaric" into its name. The report was sent to HCFA and the Blues and became their source document for reimbursement. Dr. Kindwall updated the text two more times and thus was the Editor and Chair of the Committee and text for three of its 12 editions. Dr. Kindwall later worked to expand the available information on the specialty by creating one of the first complete texts on the field. He created Hyperbaric Medicine Practice in 1994 and later updated and revised his text two more times. The Society's first journal, Hyperbaric Oxygen Review, has also been influenced by Dr. Kindwall. His love for research and education was clear: He became the initial editor, creating a journal that at first consisted of review articles and one original contribution. Over the years, it has grown to one full of original research. Dr. Kindwall's presence is felt in so many of the UHMS' activities and initiatives. Much of what we all take for granted – what is just "there" and "available" – has his touch and influence.

12pm-2pm Lunch (On Own), Special Luncheons and Meetings

UHMS Track: Regency VI

Session A - HBO_2 Theory and Mechanisms

2pm-2:30pm **Plenary: Chapter 16, UHMS Indications: Mechanisms of Action: Gerardo Bosco, MD, PhD**

About the Lecture:

Hyperbaric oxygen therapy (HBO_2) is a non-invasive method of O_2 delivery that induces systemic hyperoxia. Hyperbaric chamber consists of a pressure vessel and a compressed breathing gas supply, which can regulate internal pressure. The chamber delivers 100% O_2 to patients according to predetermined protocols and is monitored by trained personnel. HBO_2 causes hyperoxia that amplifies the tissue-cellular diffusion gradient of oxygen, which as a result raises plasma dissolved oxygen to a level that exceeds the physiological needs of many tissues at rest.

The practical clinical use of high-pressure oxygen was framed from commonly accepted physiological principles and the laws of Boyle, Dalton, and Henry. The latter leads to compression of all gas-filled spaces in the body and is helpful in treating diseases in which gas bubbles are present in the body, such as intravascular embolism and intravascular or intratissue bubbles in decompression sickness. An elevated O_2 partial pressure in certain tissues leads to increased production of reactive O_2 species (ROS) and reactive nitrogen species (RNS) due to hyperoxia. Some studies suggested a correlation between ROS levels and higher HBO_2 exposure time. HBO_2 also accelerates wound healing by promoting epithelialization and oxygen-dependent collagen matrix formations needed for angiogenesis. Furthermore, HBO_2 prevents leukocyte adhesion that contributes to the release of free radicals and proteases, thus protecting cells from pathologic vasoconstriction and cellular damage during reperfusion. HBO_2 also enhances neutrophil oxygen-dependent microbial killing, reduces edema and inhibits lipid peroxidation in hypoxic tissues. New insights have indicated HBO_2 potential mechanisms are related to its ability to preserve mitochondrial activities. In addition to that, Inflammation and immune mechanisms may play an important role in the development of neuropathic pain and hyperalgesia as well.
Currently, there are 15 indications for HBO_2 approved by the Undersea and Hyperbaric Medical Society, categorized into three groups: emergency medicine, wound healing acceleration, and antimicrobial effects. The present narrative review aims to elucidate the mechanisms of action underlying HBOT, particularly oxy-inflammation in various pathologies within these categories.

About the Speaker:

Dr. Bosco lab in Environmental Physiology & Medicine is a collaborative research facility housed in the Department of Biomedical Sciences (DSB), physiology section. He brought to the DSB dept established research and training programs in diving physiology and basic mechanisms of oxygen therapy (hyperbaric medicine). The lab utilizes two experimental hyperbaric chambers for cells and animals and two multiplace chambers for patients and volunteers provided by ATIP Medical Center of Padova, for conducting modern biomedical research and investigation on organisms ranging from unicellular to humans. It has been established in 2012 by the Trustees of the Dept of Biomedical Sciences, University of Padova and ATIP. The mission is to identify the molecular and cellular mechanisms involved in the body's response to artificial atmospheres and altered pressure environments; various cellular processes at the molecular level due to the effects of pressure per se, gas partial pressure alone, and/or the production of secondary reaction productions such as O2-induced free radicals. The Lab with the recruitments included students and junior faculty with research interests in molecular genetics, biochemical toxicology, pharmacology and sport sciences will maintain excellence in systems physiology and has established premier programs to study the pathophysiology of oxygen toxicity in neurology and pulmonary medicine, diving related stresses, and mechanisms of hypoxic response in humans.

Dr. Bosco organized a Master course II level in Hyperbaric Medicine (HBO_2) at the University of Padova and he is a director. He is actively involved in various collaborations, as attested by the various publications performed with different national and international groups.

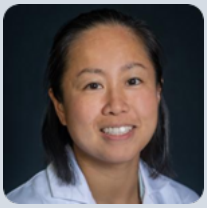
Furthermore, he a visiting professor for HBO_2 at Greiswald University-Gemany, for Diving physiology at SUNY Syracuse and USF Tampa USA; member of the international faculty at Duke Dive Medicine-Duke University USA, executive board of the Italian Society of Diving and Hyperbaric Medicine (SIMSI); member of Istituto Interuniversitario di Miologia (IIM), Italian Society of Physiology SIF, European and US societies of Diving and Hyperbaric Medicine (EUBS, UHMS).

2:30pm-2:40pm **A1:** Hyperbaric oxygen suppresses inflammatory microparticle production in carbon monoxide poisoned patients and in a murine model. Presenting Author: Stephen R. Thom, MD, PhD

2:40pm-2:50pm **A2:** Composition of Breathing Gas Impacts the Development of Noise Induced Hearing Loss in the Hyperbaric Environment. Presenting Author: Elliott Dirr, PhD

2:50pm-3pm **A3:** Hyperbaric oxygen exposure oppositely affects gene expression of the SARS-CoV-2 receptors, Toll-Like Receptor TLR3, Interleukins IL4 and IL10, IKKepsilon, and the transcription factors FOXO1 and NFATC1 via inverse regulation of NRF2 and miR-365b-5p expression in normal and copd-diseased human bronchial epithelial cells. Presenting Author: Eva Yi-Hui Chen, PhD

3pm-3:30pm **Plenary: UHM Fellows: Top articles in Hyperbaric Medicine: Samantha Ni, MD**



About the Lecture:
Reviewing pertinent articles from 2024-2025.

About the speaker:
Training

- **Duke University School of Medicine** Undersea and Hyperbaric Medicine Fellowship: **Durham, NC**

July 2024 - July 2025
The University of Tennessee Health Sciences Center Emergency Medicine Residency: **Memphis, TN**
July 2018 - July 2021
Stony Brook University Medical School Medical Student Stony Brook, NY
July 2014: June 2018
Publications

- Ni SA, Hawkins B, Brady MF. A Novel Approach to the Treatment of a Stingray Injury to the Abdomen.. R I Med J (2013). 2023 Sep 1;106(8):9-10.
- Ni SA, Carpenter RS, Walker JR 3rd, Holley J, Brady MF. Emergency Medical Services Responder Manual Ventilation Performance. Prehosp Emerg Care. 2022 Jun 9:1-5
- Brady MF, Weber NK, Walker III R, Holley JE, Ni SA, Young S, Monhollon ED, Carpenter RS, Tsao JW (2020). Feasibility of Manual Ventilation Replacing Mechanical Ventilation. *BMJ Innovations* 2021;**7:**297-301.
- Jenkins EC, Ye L, Gu H, Ni SA, Duncan CJ, Velinov M, Pang D, Krinsky-McHale SJ, Zigman WB, Schupf N, Silverman WP (2008). Increased "Absence" of telomeres may indicate AD/dementia status in older individuals with Down syn-drome. *Neurosci Letters* 440:340–343.
- Jenkins EC, Ye L, Gu H, Ni SA, Velinov M, Pang D, Krinsky-McHale SJ, Zigman WB, Schupf N, Silverman WP (2010). Shorter telomeres may indicate dementia status in older individuals with Down syndrome. *Neurobiology of Aging* 31:765-771.

Abstracts

- Wise AM, Glaspey LJ, Ni SA, et al (2011). Incidence of Clinical Deterioration in a Low Acuity Population of Emergency Department Sepsis Patients. *Annals of Emergency Medicine* 58:S283

Presentations

- Ni S, Hua B, Schabel J. **Myoclonus after Ephedrine Administration.** PGA 2017
- Ni S, Hua B, Schabel J. **Ephedrine-Induced Myoclonus in a Parturient.** ASA 2017

3:30pm-4pm **Exhibits / Break: Grand Ballroom West**

Session B - Clinical HBO_2

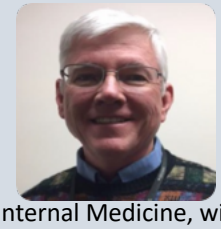
4pm-5pm **Plenary: Evaluation of patients for hyperbaric oxygen treatment, to treat or not to treat. Panel: Owen O'Neill, MD, MPH; Sandra Wainwright, MD; Lindell Weaver, MD**

About the Lecture:

About the Speakers:

Owen J. O'Neill, MD, MPH
Dr. Owen O'Neill is President and Medical Director of U.S. Hyperbaric Tunnel Medicine and Research Team and the medical director of the Department of Undersea & Hyperbaric Medicine at Phelps Hospital Northwell Health. He has been an active member of the UHMS for many years and currently serves as the co-chairman of the education committee and is a member of the Publications Committee and diving committees. He is the recipient of the UHMS commercial diving award and Excellence if hyperbaric medicine award. Owen is the current UHMS President.

Sandra Wainwright, MD
Sandra Wainwright, MD Medical Director of the Hyperbaric and Wound Healing Center Northeast Medical Group. Boarded in Internal Medicine, Pulmonary and Critical Care Medicine. Born in Georgia grew up all over the US and Japan as part of a military family. Graduated from Pacific Lutheran University in Tacoma, WA with a Chemistry degree. Pursued MD at St. Georges University School of Medicine in Grenada, West Indies.



Lindell Weaver, MD
Dr. Weaver received a BS in Engineering Science from Arizona State University followed by medical school from the University of Arizona. He served a rotating internship in the US Navy, then went through the medical officer's course in Undersea and Submarine medicine and was an Undersea Medical Officer on the USS Canopis (AS-34) for two years. After discharged he served in the Naval Reserves with SEAL Team 1-3-5 for a few years. After discharge from Active Duty he trained in Internal Medicine, with fellowship training in pulmonary and critical care at the University of Utah. After completion of fellowship, he became the Medical Director of Hyperbaric Medicine and Co-director of the Shock Trauma Respiratory ICU at the Level One trauma center, LDS Hospital, Salt Lake City, Utah for 20 years. He was a co-investigator for the ARDSnet of the NIH and was the principle investigator of a randomized controlled trial of hyperbaric oxygen for acute carbon monoxide poisoning, published by the New England Journal of Medicine. He is a former president of the Undersea and Hyperbaric Medical Society. He has authored and co-authored hundreds of papers, abstracts and book chapters. For 10 years he had a senior leadership role in the DoD effort to conduct blinded randomized trials of hyperbaric oxygen for post-concussive syndrome due to War-related mild traumatic brain injury. Research activities include study of neural auto-antibodies following carbon monoxide poisoning and a randomized trial of hyperbaric oxygen for sequelae months to years after brain injury. He enjoys off-road UTV and adventure motorcycle riding, SCUBA diving, and spending time with his family.

5pm-5:10pm **B10:** Ten sessions of Hyperbaric Oxygen versus sham treatment in patients with Long COVID (HOT-LoCO): a randomized, placebo controlled, double-blind, phase II trial. Presenting Author: Anders Kjellberg, MD, PhD

5:10pm-5:20pm **B11**: Hyperbaric oxygen therapy with and without sodium thiosulfate for treatment of wounds caused by calciphylaxis. A retrospective analysis of the past 20 years. Presenting Author: Doris J. Armour, MD MBA FACP CWS

5:20pm-5:30pm **B12**: Five-year chronic disease burden and mortality risk in carbon monoxide-poisoned patients, with and without hyperbaric oxygen, compared to patients with wrist fractures abstract. Presenting Author: Lindell K. Weaver, MD, FACP, FCCP, FCCM, FUHM

Session A - HBO_2 Theory and Mechanisms
ABSTRACTS

A 1: Hyperbaric oxygen suppresses inflammatory microparticle production in carbon monoxide poisoned patients and in a murine model

O: Monday, 6/2/2025, 2:30 PM - 2:40 PM
P: n/a
Thom SR, Arya AK, Sethuraman K, Bhat AR, Imtiyaz Z, Lee Y, Cha YS
University of Maryland School of Medicine, Baltimore, MD
Presenting Author: Stephen R. Thom, MD, PhD
E: sthom@som.umaryland.edu

Introduction/Background
A recent study (Sci. Advances 11:eado9751, 2025) demonstrated that CO poisoning triggers production of blood-borne inflammatory microparticles (MPs) in patients and these MPs cause neuroinflammation and neurological deficits in a murine model. These findings provide a new view on CO pathophysiology. We hypothesized that exposure to 2.8 ATA hyperbaric oxygen (HBO_2) would antagonize MPs-related events in the murine model and blood-borne changes in patients.

Materials and Methods
Mice were exposed CO (1000 ppm for 40 min, 3000 ppm for 20 min) and then some to HBO_2 for 45 minutes. Characteristics of CO patients were described in the 2025 citation and received 2.8 or 3.0 ATA O2 for 60 to 120 minutes. Flow cytometry was used to quantify MPs production and neutrophil activation in mice and human samples, and loss of blood-brain barrier in mice as uptake of fluorescent 2000 kDa rhodamine-dextran.

Results
CO-exposed mice had 2.9+/-1.1 (S.D., n=20, p post-CO+HBO_2 mice MPs were 0.9 +/- 0.3-fold (NS) versus control. Murine neutrophil activation by CO expressed as cell surface CD18 (β2 integrin) and myeloperoxidase (MPO) was shown as 13+/-9.2-fold (pe the post-CO+HBO value was 1.1+/-0.1 (NS). Similar blood changes occurred in patients. Neutrophils from CO patients (n=61) manifested lower activation post-HBO versus blood obtained pre-treatment. Cell surface CD18 was 0.5 +/-0.3-fold (p

Summary/Conclusion
A recent study demonstrated that MPs and activated neutrophils play a prominent role in CO pathophysiology. HBO_2 exerts a suppressive effect on neutrophil activation and MPs production, events that lead to neuroinflammation and functional neurological deficits in the murine model. Results extend mechanistic insight into therapeutic benefits of HBO_2 for CO poisoning.

A 2: Composition of breathing gas impacts the development of noise induced hearing loss in the hyperbaric environment

O: Monday, 6/2/2025, 2:40 PM - 2:50 PM
P: Monday, 6/2/2025, 4:00 PM - 5:30 PM
Dirr EW, Philips E, Sweeney B, Ethridge V, Gut C, Sharits B, Mumy K, Romer S
Naval Medical Research Unit Dayton, Environmental Health Effects Laboratory. 2729 R St., Bldg. 837, Wright Patterson AFB, Ohio 45433
Presenting Author: Elliott Dirr, PhD
E: elliott.dirr.ctr@us.af.mil

Introduction/Background
Military and commercial divers are at risk for developing hearing loss; however, the factors that contribute to developing this injury are not fully characterized. Noise-induced hearing loss (NIHL) is an injury in which high levels of sound irreversibly damage sensory cells resulting in the loss of hearing. NIHL in divers may be caused by exposure to loud boats/machinery above water or pneumatic tools underwater. The development of NIHL in divers may also be influenced by increased partial pressures of oxygen (pO_2) and nitrogen (pN_2), which produce oxidative stress and inflammation. The goal of this study was to identify whether there is a synergist effect between pO_2/pN_2 and noise exposure that should be considered in order to better protect divers from NIHL.

Materials and Methods
Male Long-Evans rats (n = 10/group) were assigned to one of three exposures: 1) 21% O_2, 78% N_2, 1 ATA; 2) 10.5% O_2, 88.5% N_2, 2 ATA; 3) 100% O_2, 2 ATA. A baseline auditory exam consisting of auditory brainstem response (ABR) and distortion product otoacoustic emissions (DPOAE) testing was used to evaluate auditory thresholds and outer hair cell function. Animals then underwent a four-hour exposure in which the first two hours were gas-only, followed by two hours of co-exposure to gas and 100 dB of 8 kHz octave band noise. Post-exposure auditory assessment was carried out approximately 24 hours following exposure to evaluate the induced injury.

Results
Animals exposed to noise at either 21% O_2 1 ATA or 10.5% O_2 2 ATA had significantly decreased DPOAE amplitude at 8 and 16 kHz compared to baseline and significantly increased auditory thresholds. Exposure to noise with 100% O_2 at 2 ATA did not produce a significant change in DPOAE amplitude or auditory threshold. Regression of ABR peak amplitude against the partial pressures of oxygen and nitrogen identified a significant positive coefficient for pO_2 and significant negative coefficient for pN_2 indicating a differential relationship between gasses on NIHL.

Summary/Conclusion
Exposure to increased pO_2 is associated with protection from NIHL and increased evoked ABR activity, while Exposure to increased pO_2 is associated with protection from NIHL and increased evoked ABR activity, while exposure to increased pN_2 may exacerbate noise-induced hair cell dysfunction, increasing auditory thresholds.

A 3: Hyperbaric oxygen exposure oppositely affects gene expression of the SARS-CoV-2 receptors, Toll-Like Receptor TLR3, Interleukins IL4 and IL10, IKKepsilon, and the transcription factors FOXO1 and NFATC1 via inverse regulation of NRF2 and miR-365b-5p expression in normal and copd-diseased human bronchial epithelial cells

O: Monday, 6/2/2025, 2:50 PM – 3:00 PM
P: n/a

Tsai YS[1], Wang CC[2], Chang Y[3], Chen CM[4], Lee SY[1], Chen YH[1,*]
[1]Graduate Institute of Aerospace and Undersea Medicine, National Defense Medical Center, Taipei City, TAIWAN; [2]Department of Chest Medicine, Fu Jen Catholic University Hospital, New Taipei City, TAIWAN; [3]Section of Respiratory Therapy, Cheng Hsin General Hospital, Taipei City, TAIWAN; [4]Graduate Institute of Microbiology and Immunology, National Defense Medical Center, Taipei City, TAIWAN
Presenting Author: Eva Yi-Hui Chen, Ph.D.
E: yihuichen@mail.ndmctsgh.edu.tw

Introduction/Background
Given that HBO2 has recently been reported to alleviate the toll-like receptor (TLR)-mediated inflammatory response and mitigate hypoxemia, prevent intubation and overexuberant immune response in patients with less severe COVID-19 symptoms, it is of interest to decipher the molecular mechanisms underlying the effects of HBO on both the healthy and chronic obstructive pulmonary diseased human airway epithelium.

Materials and Methods
The normal human bronchial epithelial cells (NHBEs) derived from three healthy Caucasian donors and diseased HBE cells (DHBEs) derived from three age-matched Caucasian COPD patients were all obtained from Lonza Biotechnology Company and respectively cultured at the air-liquid interface (ALI) under normoxia (21% O2) or daily 40-min HBO exposure to 100% O2 under 2.5 ATA for 28 days in total, followed by qPCR and immunostaining analyses for the expression of different marker genes/proteins.

Results
We found that HBO_2 exposure significantly increased expression of NRF2, miR-365b-5p, TLR3, IKKε, phosphorylated NF-κB1, and IκB, whereas it significantly decreased expression of the SARS-CoV-2 viral entry genes ACE2, TMPRSS2, FOXO1, NFATC1, IL4 and IL10 in NHBEs ($n = 9$, $p < 0.05$ by two-way ANOVA). The opposite significant results were observed in the DHBEs exposed to HBO ($n = 9$, $p < 0.05$). Transfection with the *NRF2* siRNA or cDNA showed that *NRF2* significantly down-regulated the mRNA levels of *FOXO1*, *IL4* and *IL10*, *ACE2* and *TMPRSS2* in NHBEs ($n = 9$, $p < 0.05$), whereas significantly up-regulated expression of miR-365b-5p, TLR3 and the IKKε gene IKBKE in NHBEs ($n = 9$, $p < 0.05$), while the significant inverse regulation of the aforementioned genes was noted in DHBEs transfected with the *NRF2* siRNA or cDNA ($n = 9$, $p < 0.05$).

Summary/Conclusion
We show for the first time that, after consecutive daily exposures to HBO_2, normal and COPD-diseased HBE cells show opposite changes in the gene expression of SARS-CoV-2 receptors, innate immune-modulatory factors, and airway lineage-specific markers, which are regulated by changes in the NRF2 mRNA levels. Hence, NRF2 may be a key therapeutic target in respiratory viral infections for both diminishing the viral susceptibility and mitigating the cytokine release syndrome associated with the viral infection.

A 4: Impact of hyperbaric oxygenation therapy (HBO_2) on renal function in human: A pilot study

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

Kanowski S[1], Yuanhao S[2], Klein T[3], Möller M[1], Lettau M[1], Theilig F[2], Koch A[4]
[1]Division of Nephrology and Clinical Immunology, RWTH Aachen University Hospital, Aachen, Germany; [2]Department of Anatomy, Kiel University; [3]EuRegio HBO-Center Aachen; [4]Section for Maritime Medicine, Kiel University
Presenting Author: Prof Dr. Andreas Koch
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Introduction/Background

Hyperbaric Oxygenation Therapy (HBO_2) is a widely used therapeutic option. It involves cycles of 100% oxygen administration at increased atmospheric pressure to enhance oxygen delivery to tissues. The application of HBO_2 may affect all organs and tissues, including the kidneys, which may be sensitive to the changes during HBO_2. As underlying mechanisms for HBO_2, the production of reactive oxygen species, including superoxide, antioxidant reactions, increased plasma levels of growth factors, and nuclear hypoxia-inducible factor-1a (HIF-1a) expression are discussed. Although HBO_2 is frequently used in man, knowledge about the effects of HBO_2 on kidney function is still lacking in humans. The aim of this pilot study was to monitor changes in renal function parameters, including erythropoietin and employing urinary extracellular vesicles (EVs) to document renal alterations.

Materials and Methods

Test persons (n = 23) enrolled presented healthy renal status and received ten HBO_2 sessions. Blood and urine samples were taken at the first, the fifth and the tenth HBO_2 session. EVs were measured by electron microscopy and nanoparticle tracking analysis, surface proteins with Western Blot.

Results

Heart rate showed a significant negative linear trend during HBO_2 in male (prve activity. Serum erythropoietin values, blood pressure, blood and urine values for renal function parameter except for urine osmolality and urine potassium remained unaffected by HBO_2.

Urine osmolality together with the trend of renal Na+/K+/2Cl--cotransporter expression on isolated urinary EVs during HBO_2 significantly increased in both female and male test persons.

Summary/Conclusion

Most likely, the generation of superoxide may account for the trend in the augmented renal NKCC2 expression and urine osmolality. HIF-1 downstream targets including renal sodium transporter affected by HIF-1 alteration remained unchanged suggesting the relative hypoxia after end of HBO_2 may not be sufficient. The decrease in urine potassium excretion remains to be further explored. Overall, renal function upon HBO_2 remained largely unaffected with only minor alterations in urine osmolality.

A 5: Hyperbaric oxygen therapy and longevity: A review of its role in anti-aging, inflammation, and cognitive function

O: n/a
P: Monday, 6/2/2025, 2:00 PM - 3:30 PM
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Introduction/Background
Aging is inevitable that accelerates cellular wear and tear, oxidative damage, and gradual shortening of telomeres which compromise the body's ability to regenerate and repair. Hyperbaric Oxygen Therapy (HBO_2) administers 100% oxygen at elevated pressure and has been suggested to play a role in the body's rejuvenation processes. Emerging research indicated HBO_2 might influence molecular markers of aging by restoring telomere length and improving cellular function. However mechanisms and clinical implications remain under investigation. This narrative review following PRISMA guideline delves into human and animal research, exploring how HBO_2 may slow down the aging clock.

Materials and Methods
A comprehensive search was conducted using the PubMed database, incorporating terms like "hyperbaric oxygen therapy" and "anti-aging" to identify relevant studies up to February 2025. Seven studies meeting the inclusion criteria were selected for analysis.

Results
This review provides potential of HBO_2 efficacy in counteracting aging. Key findings include telomere lengthening in peripheral blood cells, with 66.7% increase in lymphocytes and 119.9% increase in monocytes. Additionally, HBO2 reduced cellular senescence markers, p16INK4a and p21, delaying tissue aging. It also decreased markers of inflammation and oxidative stress, IL-6, NF-κB activation, and malondialdehyde, enhancing antioxidant activity by increasing superoxide dismutase and glutathione peroxidase levels. It improved cognitive function and memory, neuroplasticity with decreased amyloid-beta accumulation reducing risk of neurodegeneration. Cardiovascular improvements were linked to $mHBO_2$'s modulation of the vascular system, enhancing vasorelaxation and protecting the heart during ischemia/reperfusion. Additionally, the VEGF and EPO-mediated angiogenic response appears to facilitate wound healing. On a cellular level, HBO2 activated protective mechanisms, enhanced stem cell proliferation, and promoted DNA repair. Both studies used 100% oxygen, with animals receiving 1.4–3 ATA for 60 minutes over two–six weeks, while humans received 1.4–2.5 ATA for 30–120 minutes, ranging from a single session to three months.

Summary/Conclusion
Current evidence supports HBO_2 may potentially play a role in longevity, cognitive enhancement, improved cardiac function, and inflammation reduction. However, it carries risks such as vision impairment, pulmonary complications, GSH depletion, and oxygen toxicity, requiring further monitoring. Although molecular effects support HBO_2's anti-aging potential, its long-term efficacy remains undetermined and requires further trials for confirmation.

A 6: 100% oxygen mobilizes stem cells and up-regulates MIF and APRIL in humans: a new point on the hormetic dose curve

O: n/a
P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background
The aim of the current study was to test normobaric 100% oxygen (NBO) (PiO2 = 713 mmHg) for stem cell mobilization and cytokine modulation. Although current oxygen therapy (PiO2 = 1,473–2,233 mmHg) is well known to mobilize stem cells and modulate cytokine, little is known about NBO and its place on the low dose stimulation phase of the hormetic dose curve of oxygen. We asked the question, will NBO mobilize stem cells and modulate cytokines. A positive outcome presents the potential to create and refine oxygen treatment protocols, expand access, and optimize patient outcomes.

Materials and Methods
Healthy 30–35-year-old volunteers were exposed to 100% normobaric oxygen for 60 min, M-F, for ten exposures over two weeks. Venous blood samples were collected at four time points: 1) prior to the first exposure (serving as the control for each subject), 2) immediately after the first exposure (to measure the acute effect), 3) immediately before the ninth exposure (to measure the chronic effect), and 4) three days after the final exposure (to assess durability). Blinded scientists used flow cytometry to gate and quantify the Stem Progenitor Cells (SPCs).

Results
CD45dim/CD34+/CD133+ and CD45+/CD34+/CD133+ were significantly mobilized following nine daily one-hour exposures to normobaric 100% oxygen. Conversely CD45−/CD34+/CD133+, CD45-/CD34+/CD133− and CD45−/CD34−/CD133+ phenotypes were downregulated suggesting differentiation into more mature phenotypes. The CD133+ phenotype exhibited a maturing from CD45− to CD45dim stem cells. CD45−/CD34, CD45−/CD31 and CD45−/CD105 were downregulated with no changes in related CD45dim and CD45+ phenotypes. The cytokines "macrophage migration inhibitory factor" (MIF) and "a proliferation inducing ligand" (APRIL) were significantly upregulated.

Summary/Conclusion
This study demonstrates that 100% normobaric oxygen mobilizes stem cells and upregulates the expression of the inflammatory cytokines marking a new point on the low dose stimulation phase of the hormetic dose curve of oxygen.

A 7: Oxygen toxicity predisposed by metabolic acidosis under hyperbaric oxygen therapy: A case report

O: n/a
P: Monday, 6/2/2025, 2:00 PM - 3:30 PM
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Case Description
The patient was a male in his 70s with a history of rectal cancer (treated with resection, chemotherapy, and radiation) who presented for recurrent radiation cystitis. He had previously received two courses of hyperbaric oxygen therapy, which he tolerated well, with resolution of symptoms until it recurred recently.

Hyperbaric oxygen was initiated at 2 ATA for 120 minutes. During the decompression phase of subsequent treatments, he experienced tremors in his right hand, lightheadedness, and facial tingling, which were interpreted as due to central nervous system (CNS) oxygen toxicity.

Intervention
A five-minute air break was incorporated for the next treatment. However, he continued to experience similar symptoms, so two air breaks were incorporated. His symptoms resolved shortly after each air break, which were consistent with CNS oxygen toxicity. To mitigate his risk further, 250 mg of oral levetiracetam was prescribed. However, this did not prevent the onset of oral paresthesias during subsequent treatments.

Further investigation with arterial blood gas showed pH 7.21, bicarbonate 12 mM/L, and pCO_2 31 mmHg. It was concluded that his metabolic acidosis was secondary to his worsening chronic kidney disease. Upon further questioning, he was not taking his prescribed dose of sodium bicarbonate, so sodium citrate was substituted.

Outcome
With the medication management, he experienced no further oxygen toxicity symptoms. After resolving his metabolic acidosis, the levetiracetam and air breaks were discontinued in stepwise fashion, with no recurrence of his previously described symptoms. He tolerated the remainder of his treatments for a total of 57 without further signs of CNS oxygen toxicity.

Discussion
His clinical course suggests that in patients undergoing HBO2 with refractory symptoms of oxygen toxicity persisting despite preventive measures, it may be useful to assess acid-base status. Correction of metabolic acidosis may reduce the risk of further CNS oxygen toxicity. To our knowledge, this case is the first case to link CNS oxygen toxicity with metabolic acidosis. We conclude that metabolic acidosis played a major role in his intolerance of HBO2 and likely increased his propensity to CNS oxygen toxicity symptoms. We hypothesize that metabolic acidosis is a risk factor for CNS oxygen toxicity.

A 8: Successful HBO_2 of a patient s/p orthotopic heart transplant

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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A 51-year-old female on outpatient anticoagulation presented for adjunctive hyperbaric oxygen treatment (HBO2) regarding a left digit #1 foot wound. The patient's past medical history is significant for nonischemic cardiomyopathy s/p orthotropic heart transplantation (OHT) 18 years prior (maintained with immunosuppression), type II DM, ESRD on dialysis, and empyema s/p VATS. The patient had previously undergone left great toe partial ray amputation. The patient was admitted for cellulitis, dry gangrene, and x-ray-proven osteomyelitis.

Intervention

The HBO_2 service was consulted on hospital day #1, and the hyperbaric and vascular teams followed her. The day after admission, arterial duplex demonstrated abnormal left lower arterial examination with > 50% stenosis noted in the SFA, and a LLE extremity ABI of 1.21. Left limb $TcPO_2$ measurements were decreased (25mmHg in the tibia and 20mmg Hg in the forefoot).

During our consultation, the patient's risk factors were assessed. The patient's most recent echocardiogram (one month before admission) with regard to OHT revealed a normal left ventricle chamber size and systolic function (LVEF of 55%), pulmonary artery systolic pressure of 25-30 mmHg, and a moderate pericardial effusion. We initiated daily HBO2 using a USN TT9 via a monoplace chamber the day after admission.

Outcome

Eight days after admission, angiography with vascular surgery was performed with balloon angioplasty/shockwave lithotripsy to the left SFA and popliteal arteries with deployment of ipsilateral stents. Additionally, critical limb ischemia was diagnosed, and the patient underwent residual left first great toe amputation plus removal of the affected MTP head.

Twenty-five days after admission, the patient underwent repeat $TcPO_2$ measurements, demonstrating only mild improvement. 28 days after admission, the patient underwent left transmetatarsal amputation with flap closure. Prior to discharge from the inpatient unit, she underwent a total of 23 HBO2 treatments, with no untoward effects on her cardiac or respiratory status.

Discussion

This case presents the first documented treatment of OHT with HBO_2. A prior case study demonstrated that HBO2 has been used to treat CAGE s/p OHT. Remote OHT is at risk for cardiac allograft vasculopathy (CAV), cardiac arrhythmias, and allograft rejection.

A 9: Systematic review and meta-analysis of hyperbaric oxygen therapy: enhancing recovery and athletic performance

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Efficient recovery from exercise-induced fatigue is critical for athletes trying to improve training and performance outcomes. Hyperbaric Oxygen Therapy (HBO_2) is gaining popularity for its potential to speed up recovery and enhance performance. Regardless, there is uncertainty regarding its effectiveness across different sports and athlete profiles.

Materials and Methods

A systematic review and meta-analysis were conducted following PRISMA guidelines. Databases searched included PubMed, Cochrane Central, Google Scholar, and Embase for studies published from 2015 to 2024. Inclusion criteria focused on studies involving healthy athletes using HBO_2 to assess performance or recovery outcomes. Data on blood lactate levels at baseline, post-workout, and post-recovery were analyzed. Meta-analysis calculated effect sizes using Cohen's d, with subgroup analyses based on age, body fat percentage, and Body Mass Index (BMI). Meta-regression explored the impact of HBO_2 parameters, including pressure, session duration, and frequency.

Results

Eleven studies met the inclusion criteria, with six studies selected for meta-analysis. The pooled effect size for post-recovery blood lactate levels showed a significant reduction following HBO_2 (effect size: -1.71; 95% CI: -3.10 to -0.32). Subgroup analysis indicated that younger athletes and those with lower body fat percentages benefited most, showing enhanced lactate clearance. Higher-pressure protocols (2.5-3.0 ATA) effectively managed inflammation and improved endurance, while lower-pressure protocols (1.3 ATA) were optimal for metabolic recovery and cardiovascular endurance. HBO_2 showed limited application in short-term power output and force production. Meta-regression suggested a trend towards improved outcomes with increased session frequency, although this did not reach statistical significance.

Summary/Conclusion

HBO_2 can improve athletic performance by reducing post-exercise lactate levels to enhance metabolic recovery. Lower-pressure protocols are effective for general recovery, while higher pressures may offer additional benefits for endurance athletes. Future studies should focus on standardized protocols, diverse populations, and long-term outcomes.

Session B – Clinical HBO_2
ABSTRACTS

B 10: Ten sessions of hyperbaric oxygen versus sham treatment in patients with Long COVID (HOT-LoCO): A randomised, placebo-controlled, double-blind, phase II trial

O: Monday, 6/2/2025, 5:00 PM - 5:10 PM
P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

Kjellberg A, Hassler A, Boström E, El Gharbi S, Al-Ezerjawi S, Schening A, Fischer K, Kowalski J, Rodriguez-Wallberg KA, Bruchfeld J, Ståhlberg M, Nygren-Bonnier M, Runold M, Lindholm P
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Introduction/Background

Forty sessions of HBO_2, 2.0 ATA, 90 min, have shown benefits on neurocognitive function and symptoms in long COVID in a placebo-controlled RCT. A longitudinal follow-up of selected subjects suggests a three-month sustained effect, but high-grade evidence for long-term benefits is missing. Ten sessions of HBO_2 are used off-label, but no RCTs are published on this dose. Here we present the results of the HOT-LoCO trial.

Materials and Methods

Previously healthy subjects aged 18–60 years, diagnosed with long COVID, were included at Karolinska University Hospital, Sweden. Subjects were randomly assigned to ten sessions of HBO2 or sham treatments (Placebo) over six weeks. HBO_2, 2.4 ATA/90 minutes, Placebo air, 1.34–1.2 ATA. The objective was to evaluate whether ten sessions of HBO_2 improve short- and long-term health-related quality of life (HRQoL), symptoms, and physical performance in long COVID patients compared with placebo. Primary endpoints were changes from baseline RAND-36 Physical functioning (PF) and Role physical (RP) at 13 weeks. Efficacy was analysed on an intention-to-treat basis. Harms were evaluated according to the actual treatment given. Randomisation (1:1) was done electronically, in blocks stratified by sex and disease severity. Subjects and investigators were blinded to allocation. Trial registration: ClinicalTrials.gov (NCT04842448), EudraCT (2021-000764-30).

Results

Between Sept 15, 2021, and June 20, 2023, 80 subjects (65 women, 15 men) were enrolled and randomised (40 in each group). The trial is completed. The primary endpoint analysis included 79 subjects (40 in HBO_2 and 39 in Control). At 13 weeks, both groups showed improvement, with no significant difference between HBO_2 and placebo in PF (Least square mean difference between groups (LSD), 0.63 [95%CI -7.04 to 8.29], p=0.87) and RP (LSD, 2.35 [95%CI -5.95 to 10.66], p=0.57).

Harms: Forty-three adverse events (AEs), most commonly cough and chest pain/discomfort, occurred in 19 subjects (49%) of the HBO_2 group and 38 AEs in 18 subjects (44%) of the placebo group. One serious AE occurred in HBO_2, and one death occurred in the placebo group.

Summary/Conclusion

Ten HBO_2 sessions did not show more short-term benefits than placebo for long COVID patients. Both groups improved, with a notable sex difference. HBO_2 has a favourable harms profile.

B 11: Hyperbaric oxygen therapy with and without sodium thiosulfate for treatment of wounds caused by calciphylaxis. A retrospective analysis of the past 20 years

O: Monday, 6/2/2025, 5:10 PM - 5:20 PM
P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Calciphylaxis, or uremic arteriolar arteriolopathy, is a rare condition with a grim mortality rate of 80%, with ~50% of these individuals succumbing within the first year. The disease is characterized by calcification and intimal fibrosis, precipitating arteriolar and capillary stenosis and subsequent thrombosis with resultant cutaneous ischemia.

These changes cause livedo reticularis and tender violaceous indurated papules/plaques that progress to necrotic ulceration, typically over adipose-rich areas of the trunk and extremities. Diagnosis is made by clinical and histopathological components.

Materials and Methods

171 Patients with a clinical and/or pathology confirmed diagnosis of calciphylaxis from Emory University Hospital at Midtown databases between 2004 and 2024 were analyzed.
The patient categories are treatment-based as follows (Table 1):

- HBO_2 only (N=66; 46.2%). HBO_2 at 2.0-2.5 ATA for 60-90 minutes., minimum five treatments.
- Sodium Thiosulfate (NaSO) only (N=15; 10.6%). NaSO administered IV or intralesionally.
- Both HBO_2 and NaSO (N=32; 22.3%)
- Neither (N=30; 20.9%)

Treatment response assessed qualitatively by description of healing:

- No Healing(NH) - 75% improvement
- PATIENT EXCLUSIONS: NO WOUNDS, INSUFFICIENT DURATION OF TREATMENT, LOST TO FOLLOW UP

Results

TREATMENT	RESPONSE			
N=143	NH N=42	PH N=59	CH N=42	RESPONDERS N=101
HBO 46.2% N=66	7.5%	51.5%	40.9%	93.9%
aSO 10.6% N=15	53.3%	33.3%	13.3%	46.7%
BOTH 22.3% N=32	9.4%	56.2%	34.3%	90.6%
NEITHER 20.9% N=30	86.7%	6.7%	6.7%	13.3%
HBO + BOTH 68.5% N=98	8.9%	53.1%	38.8%	91.8%
NaSO + BOTH 32.9% N=47	23.4%	48.9%	27.7%	76.6%
NH - <25% HEALING	*PH – 25-75% HEALING*	*CH - >75% HEALING*	*RESPONDERS – PH + CH*	

Summary/Conclusion

Robust response rates were noted in patients receiving HBO_2, with or without NaSO, consistently >90%. Indeed, wound healing rates increased with greater adherence to recommended HBO_2 protocols. Positive rates were also seen with NaSO therapy, with or without HBO_2, but these rates were only 80% of the healing rates of patients receiving HBO_2. It is worth noting that NaSO has been unavailable at times.

B 12: Five-year chronic disease burden and mortality risk in carbon monoxide-poisoned patients, with and without hyperbaric oxygen, compared to patients with wrist fractures

O: Monday, 6/2/2025, 5:20 PM - 5:30 PM
P: n/a

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Introduction/Background
Prior studies identified increased risk for death and chronic disease following carbon monoxide (CO) poisoning; the role of hyperbaric oxygen (HBO_2) is unknown.

Materials and Methods
We searched our system's databases to identify patients (18-75 years) from 2004-2019 presenting with wrist fractures evaluated in Emergency Departments (controls) or CO poisoning. We assessed five- and ten-year mortality and Charlson Comorbidity Index (CCI, a measure of chronic disease burden) at injury and five years later. Patients with wrist fracture were excluded, for hospital admission or imaging beyond the upper extremities.

Results
We included 3,103 patients with CO poisoning (45% female, mean age 39.3±14.2) and 25,111 controls (29% female, age 38.2±15.3). 772 CO-poisoned patients received HBO_2.

By chi-square tests, CO-poisoned patients were more likely to die within 5 and 10 years of poisoning than controls (5-year risk: 4.7% vs 2.2%, odds ratio (OR) 2.17 [95% confidence interval 1.80-2.62], p<0.001) (10-year risk: 8.1% vs 4.8%, OR 1.74 [1.47-2.05], p<0.001). CO-poisoned patients receiving HBO_2 had lower 5-year death risk vs those not receiving HBO_2 (3.8% vs 5.1%), but this did not reach statistical significance (p=0.14), nor did 10-year death risk (6.7% vs 8.5%, p=0.19).

At injury, CO-poisoned patients were statistically more likely to have the following CCI comorbidities compared controls: myocardial infarction, congestive heart failure, dementia, diabetes mellitus, metastatic solid tumor, any malignancy, HIV, and peripheral vascular, cerebrovascular, chronic pulmonary, rheumatologic, peptic ulcer, and liver diseases. Five years later, 35% of patients with CO poisoning had increased their CCI score compared to 30.2% of patients with wrist fractures (OR 1.24 [1.14-1.36], p<0.001).

CO-poisoned patients receiving HBO_2 were less likely to increase their CCI score 5 years after poisoning than patients not receiving HBO_2 (30.1% vs 36.6%, OR 0.75 [0.62-0.91], p=0.004).

Summary/Conclusion
In this retrospective cohort analysis, CO-poisoned patients had increased mortality risk at 5 and 10 years compared to patients with wrist fractures. CO-poisoned patients had greater chronic disease burden at injury and 5 years later compared to controls. However, patients receiving HBO_2 for CO poisoning were less likely to increase their chronic disease burden over time compared to patients who did not receive HBO_2.

B 13: Efficacy of hyperbaric oxygen therapy in improving symptoms and quality of life in patients with Post-Acute COVID-19 Syndrome (PACS)

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

The COVID-19 pandemic has resulted in the need to support large cohorts of patients suffering from Post-Acute COVID-19 Syndrome (PACS) after recovery from acute infection. These PACS patients exhibit a combination of persistent symptoms, including neurocognitive impairment and fatigue. Currently, no known treatment is available for PACS. The current study primarily aims to determine the effects of HBO_2 on patients with Post-Acute COVID-19 Syndrome (PACS).

Materials and Methods

We prospectively enrolled patients presenting symptoms of Post-Acute COVID-19 Syndrome (PACS) following COVID-19 infection in the Tri-Service General Hospital, Taipei, Taiwan. A total of 77 consecutive patients received 10 sessions of HBO_2 to 2.4 atmospheres. Each treatment session lasted 105 minutes, consisting of three 30-minute exposures to 100% oxygen, interspersed with 5-minute air breaks. Outcomes included Borg scale ratings for dyspnea and fatigue, serum levels of inflammatory markers, including IL-1 beta, IL-6, and MMP9, and the 36-item Short Form Health Survey in life quality, performed at days one and ten.

Results

HBO_2 yielded a statistically significant improvement in the Borg scale ratings for dyspnea ($p=0.0177$) and fatigue ($p=0.0021$), a reduction in serum levels of inflammatory markers, including IL-6 ($p=0.0367$), and MMP9 ($p=0.0396$), and enhancement in the 36-item Short Form Health Survey in life quality, including self-aware general health ($p=0.0471$), activity vitality ($p=0.0089$), function and physical functioning ($p=0.0047$).

Summary/Conclusion

HBO_2 was associated with improved symptoms and quality of life in PACS patients, with a reduction in serum levels of inflammatory markers. While more research is needed to confirm these findings, hyperbaric oxygen therapy may offer a promising treatment option for those suffering from Post-Acute COVID-19 Syndrome (PACS).

B 14: Multicenter Hyperbaric Outcomes Registry: 2024 review

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

The Multicenter Registry for Hyperbaric Oxygen Therapy is designed to provide key data on outcomes and complications from hyperbaric oxygen (HBO_2) treatment. These data are important for providers, insurers, and patients. The Registry collects data on all patients seen (both for UHMS-approved and non-approved indications) in participating units. The data from participating centers is aggregated to provide unique information.

Materials and Methods

Defined outcomes data were collected from all patients evaluated at participating centers and entered into a REDCap database. Patients at all centers completed the same questionnaires and had the same outcome measures recorded. Governance of the registry is through a steering committee composed of representatives from each participating center.

Results

Currently, 30 centers are actively entering patient data; additional centers are working through the enrollment process. A total of 11,890 individual patient records are currently in the registry, with 2322 entries in 2024. The top three indications in 2024 were delayed radiation injury (N=654; 28.2%), carbon monoxide (N=310; 13.4%), and Enhancement of healing in selected problem wounds (N=308, 13.3%). The top three non-UHMS indications were “other” (N=44, 32.4%), COVID-19 (N=27, 19.9%), and Crohn’s (N=17, 12.5%). Statistically significant pre- to post-changes in outcomes exist for the most common indications.

Summary/Conclusion

An outcomes registry offers a consistent method for collecting evaluation and treatment results for patients with both UHMS-approved and emerging indications. Participating centers are entering information into this registry, and their de-identified data are being pooled to provide larger datasets on outcomes than any individual center could accumulate over time. These data are essential for refining existing indications, developing new ones, detecting treatment trends, documenting complications, and tracking outcomes over time. New centers are encouraged to join the registry. A key requirement is that data be entered on all patients.

B 15: Should intubated carbon monoxide-poisoned patients be transported and receive hyperbaric oxygen?

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Some hyperbaric medicine physicians decline to transport or treat treating intubated patients acutely poisoned by carbon monoxide (CO) with hyperbaric oxygen (HBO_2), believing their prognosis is poor and that HBO_2 will not offer an advantage over normobaric oxygen. We describe our experience treating intubated CO-poisoned patients and summarize results from the literature.

Materials and Methods

Utah databases and health information systems were searched for intubated CO-poisoned patients from our randomized trial (Weaver et al., NEJM 2002*), our long-term study (Weaver et al., ARCCM 2007α), and our subsequent clinical experience (Weaver et al.) dating back to May 15, 2007β. Previously published mortality data (CCM 2008) from historical patients treated while intubated from 1978-2005 at Virginia Mason Medical Center (VMMC), Seattle, WA was reanalyzed by Dr. Neil Hampson and courteously provided (CCM 2008)Ω. We include experience of the treatment of intubated CO-poisoned patients from the literature dating back to 1968.

Results

In the 2002 randomized trial*, we enrolled 12 intubated patients. From the long-term study, we enrolled seven additional intubated patientsα with 6-week outcomes. Since 2007, we have treated 26 intubated patients.β There were 253 intubated CO-poisoned patients treated at VMMCΩ. From the literature, we found 366 intubated CO-poisoned patients.

Of the 19 enrolled in these prospective trials*αβ, none died. The rate of 6-week cognitive sequelae was 9/19 (47%), and of a magnitude like the non-intubated groups. Of the 26 intubated non-clinical trial patientsβ, one died and one was discharged home in persistent coma. Of the 253 intubated patients,Ω 224 (89%) lived beyond 90 days. Other outcomes are unknown. Across disparate studies from the literature of the 366 patients, 19 (5.2%) died. Cognitive outcomes ranged from normal to slightly impaired.

Summary/Conclusion

These results support that intubated CO-poisoned patients frequently have favorable outcomes, and short-term death is uncommon. Medical decision-making about withholding HBO_2-treatment from intubated patients, believing them to have poor outcomes, is not supported by the evidence. Being intubated because of CO poisoning does not predict outcome.

B 16: Multicenter experience treating Idiopathic Sudden Sensorineural Hearing Loss (ISSHL) with hyperbaric oxygen therapy

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

We present idiopathic sudden sensorineural hearing loss (ISSHL) treated from October 2020 to December 2024, referred by otolaryngologists, treated with steroids, and concomitantly with hyperbaric oxygen (HBO_2) at 2 ATA x 90 minutes daily.

Materials and Methods

All had pre-HBO_2, and most post-HBO_2, audiograms; reassessed after ten HBO_2 treatments, and after 20 treatments, HBO_2 was discontinued if no hearing improvement was observed after ten treatments. If hearing had incomplete recovery after ten treatments, we recommended 20 treatments. We recommended >20 treatments if there was incomplete recovery after 20 treatments. Results reported as mean pure tone average (PTA) in decibels (dB) of 500, 1,000, 2,000, and 4,000 Hz. Normal PTA is 0-25 dB.

Results

We treated 72 patients (32 females) with ISSHL at two HBO_2 centers. Forty-seven patients (65%) began HBO_2 within 2 weeks of onset. Of the 72 patients with ISSHL, 56 patients (78%) had post-treatment audiograms. Ages ranged from nine to 75 years (mean 49.7, SD 14.3).

N=56	Interval days* mean (SD)	# HBO_2 sessions mean (SD)	Mean pre-HBO_2 PTA (SD)	Mean post-HBO_2 PTA (SD)	PTA mean change (SD)
8	5-30, 15 (9)	<10, 8 (1)	58 (30)	37 (26)	21 (23)
19	2-65, 16 (17)	10	63 (29)	53 (34)	9 (24)
12	1-30, 12 (9)	11-19, 17 (2)	68 (28)	50 (26)	18 (24)
17	1-25, 11 (8)	>20, 23 (6)[†]	80 (24)	49 (27)	31 (23)

*Hearing lost to first HBO_2 treatment [†]Range = 20 – 40

Of these 56 patients, the PTA was 68 dB pre- HBO_2 and 49 dB post- HBO_2. Only 6% of patients had no improvement, or worsening. Twenty-four patients (43%) had ≥30% improvement in PTA (average 16 treatments), and 13 (23%) had ≥50% improvement in PTA (average 16 treatments).

Seventeen patients received ≥20 HBO_2 treatments (maximum = 40), with marked improvement (PTA change = 31 dB).

Of six, hearing improved in three when HBO_2 was begun ≥30 days after the onset of hearing loss.

Summary/Conclusion

HBO_2 plus steroids improved hearing in 94% of patients with ISSNHL. With partial improvement in hearing after ten HBO_2 treatments, HBO_2 should be continued beyond ten treatments until a plateau is reached.

B 17: Hyperbaric oxygen therapy for PTSD: Threshold effect for sustained symptom improvement in a biologically-based treatment

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Emerging evidence suggests that hyperbaric oxygen therapy (HBO_2) promotes neuroplasticity and alleviates symptoms in individuals with posttraumatic stress disorder (PTSD). As a biologically-based treatment, HBO_2 may demonstrate a threshold effect, wherein sufficient treatment leads to sustained symptom improvement, while insufficient treatment results in diminishing benefits. This study tested the threshold hypothesis using a 3-month follow-up of a randomized controlled trial (RCT) comparing HBO_2 to sham treatment in veterans with treatment-resistant PTSD.

Materials and Methods

A post hoc analysis was conducted on data from the RCT. The elbow method identifies thresholds in the relationship between end-of-treatment improvement and follow-up outcomes. Spearman's rank correlation was used to assess the relationship between changes in cluster-specific symptoms and total CAPS scores at the end of treatment and at follow-up evaluation.

Results

Participants achieving≥35% improvement by the end of treatment demonstrated continued improvement at follow-up (p=2e^-6). Significant correlations were observed between changes in each symptom cluster and total CAPS scores, with the strongest correlation in intrusive symptoms (Cluster B, r=0.74,p=10^-4 and r=0.80,p=10^-4). Changes in avoidance (Cluster C, r=0.70,p=10^-4) at the end of treatment were the best predictors of follow-up improvements.

Summary/Conclusion

A threshold effect is evident in HBO_2 treatment for PTSD, where≥35% improvement post-treatment predicts continued gains. Symptom reduction beyond the threshold may serve as a target for HBO_2 when prescribed for PTSD. The suggested underlying physiological mechanisms, involving bistable circuit dynamics, justify evaluating the potential threshold effect in other treatment modalities.

B 18: Results of a twelve-month educational campaign to improve the knowledge of referring providers related to the benefits of hyperbaric oxygen therapy on Late Radiation Tissue Injuries (LRTIs)

O: n/a

P: DUPLICATE TO B35

B 19: Eight reasons hyperbaric oxygen remains a better treatment than PENTOCLO for early to moderate stage Mandibular Ostoeradionecrosis.

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Several investigators have suggested that hyperbaric oxygen is no longer the preferred treatment for early to moderate-stage mandibular osteoradionecrosis (ORN). This paper will offer a counterposition based on a review of several key papers.

Materials and Methods

Opposing papers on this topic will be reviewed. The pathophysiology of mandibular ORN will be briefly discussed. We will mention some recent changes in radiation technique and protocol, which may increase the incidence and severity of mandibular ORN.

Results

The following observations provide key findings from the highlighted studies:

1. The Annane trial randomized hyperbaric oxygen to sham exposure BUT did not include surgical debridement in their protocol failing to recognize the principle established by Marx that multi-disciplinary treatment is necessary.
2. Delainian et al, in a Phase II trial, applied a pharmaceutical approach that required up to 36 months of a multi-drug regimen.
3. Six of Delainian's 54 patients died presumably of sepsis.
4. Patients were considered to have a "complete response" even when they had exposed bone after therapy.
5. The pharmaceutical protocol is not durable over time, as evidenced by Dinnoo et al. who applied imaging and clinical evaluations to PENTOCLO-treated patients and showed a disappointing control rate of 25% at 29 months.
6. Mr. Richard Clarke and other detractors have failed to recognize the changing paradigm for head and neck cancers that are now often treated with chemotherapy-enhanced radiation as primary treatment, resulting in higher doses and a risk for more ORN despite of targeted therapies.
7. Those discounting hyperbaric oxygen fail to recognize Marx's accumulated experience, which exceeds 900 patients treated for ORN with results unequaled by any other report.
8. Phone call data demonstrate that major hyperbaric centers have not experienced a decrease in referrals for mandibular ORN.

Summary/Conclusion

Reports advocating treatments not containing hyperbaric oxygen for early to moderate mandibular ORN are subject to several criticisms. A recent study looking at the longevity of response to PENTOCLO is disappointing. Marx's results are not exceeded.

B 20: Changes in the ER stress-chaperone GRP78 is associated with recovery from COVID-19 induced ARDS and can be measured in plasma in patients treated with hyperbaric oxygen

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

We have previously shown that hyperbaric oxygen treatment(HBO_2) in severe COVID-19 induces unique gene changes, downregulating the unfolded protein response (UPR), associated with fast recovery and reduced hospital stay. The UPR, an endoplasmic reticulum(ER) stress response, is orchestrated by one master control protein, the ER chaperone Glucose-Regulated Protein 78(GRP78). GRP78 translocates to the cell surface if ER homeostasis can´t be restored. SARS-CoV-2 can exploit GRP78 as a receptor to maximise viral replication. In this study, we investigated whether GRP78 could be detected in plasma and correlated with the severity of illness.

Materials and Methods

PBMC and plasma were collected from 17 patients with COVID-19-induced ARDS at baseline and day seven. Nine patients received five HBO_2 treatments, 2.4 ATA, 90 minutes with two air breaks. RNA extraction and sequencing have been described previously. GRP78 in plasma was captured with a sandwich ELISA technique, the absorbance was measured at 450 nm, allowing for the quantification of GRP78 according to the manufacturer's instructions (ENZO, Lasen, Switzerland).

Statistics: Normalized counts of GRP78 gene expression and Plasma GRP78 levels were checked for normality with the Kolmogorov-Smirnov test and analysed with ANOVA, corrected for multiplicity with Bonferroni's test. A linear regression analysis was performed with Pearson's r-test to check for correlation between RNA/protein and clinical outcomes. All tests were two-sided, and statistical significance was set at 0.05.

Results

Similar clinical baseline characteristics suggested a successful randomization. HBO_2 was associated with a significant group-by-time interaction in GRP78 RNA (F (1,14)= 10.90, pP78 was significantly lower at day 7 compared with baseline (adj-p GRP78 plasma protein (r= 0.364, p= 0.037) and PaO2/FiO2 (r= -0.462, p= 0.004).

Summary/Conclusion

GRP78 is a central ER stress chaperone upregulated in COVID-19. It can be measured in plasma and is downregulated at the RNA and protein levels during COVID-19 recovery. Changes in GRP78 may be a relevant biomarker for HBO_2 effect and/or disease resolution.

B 21: A comparison of fluorescent microangiography imaging and clinical photographs for the prediction of flap failure in the diabetic patient following initial forefoot amputation.

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Case Description

Fluorescent microangiography can serve as an adjunct to clinical evaluation of the integrity of a threatened flap. This tool can aid the practitioner in assessment of perfusion post-operatively and enhance the ability to track dynamic wound healing in patients undergoing hyperbaric oxygen therapy. We sought to evaluate the ability to predict flap failure for diabetic patients requiring partial amputation of the foot. Three clinicians independently assessed clinical photographs and microangiography images in the immediate post-operative period. Images were then scored on a Likert scale to determine the likelihood of flap failure and the need for further surgical intervention within three months of the initial operation.

Intervention

Thirty-five diabetic patients who underwent surgical resection between 2019 and 2023 were included in this retrospective study. Reviewers separately rated clinical photographs and then microangiography images in the immediate postoperative period on a Likert scoring system of 1 to 7 (1 with low likelihood of flap failure and 7 with high likelihood of failure and need for repeat surgical intervention). Images were presented in a randomized fashion to minimize bias.

Outcome

19/35 (54.2%) patients required return to the operating room for further surgical resection. For those requiring additional surgery, observer scores in the microangiography arm trended higher, favoring improved prediction of flap failure. The average score for the prediction of flap failure was 4.3 when assessing microangiography images versus 4.0 when reviewing clinical photographs. For patients who did not require repeat surgical intervention (N = 16), observed scores were lower in the microangiography arm (average score = 2.98) compared to review of clinical photographs (average score 3.33); more consistently predicting continued flap integrity. In general, less interobserver variability was noted with the scoring of microangiography images.

Discussion

With evaluation of both clinical photographs and microangiography images, observers greatly underappreciated the likelihood of flap failure and the need for additional surgical intervention. Review of microangiography studies in diabetic patients in the immediate postoperative period tended to be more accurate for predicting flap failure and success versus clinical image. This study highlights the challenges of clinical assessment alone with suggestion of improved prediction of flap failure with microangiography.

B 22: Is hyperbaric oxygen treatment safe for urgent, dangerous patients?

O: n/a

P: WITHDREW

B 23: Hyperbaric chamber use in whole lung lavage as an alternative to ECMO

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Pulmonary alveolar proteinosis (PAP) is a condition that results from impaired clearance of lung surfactant protein, leading to its accumulation in the alveoli. Patients with significant symptoms normally undergo whole lung lavage (WLL). WLL is performed under general anesthesia by isolating each lung using a double-lumen endotracheal tube (DLT). Each lung in turn is then filled with normal saline, after which tidal aliquots of fluid are instilled and drained with chest PT to help clear the protein, while patient oxygenation is maintained by ventilating the contralateral lung with 100% O_2. If, in spite of this, hypoxemia occurs, ECMO may be required. We report our experience with WLL performed without ECMO inside a hyperbaric chamber, in which hypoxemia is treated by increasing the ambient pressure.

Materials and Methods

Institutional approval was given for a retrospective review of patients with PAP who had WLL performed at our institution between 1980 and 2024.

Results

A total of 47 patients who underwent 75 WLL procedures were included. Of these, 70 were bilateral lung lavages (both lungs lavaged in the same sitting), five were unilateral, among which 15 procedures required hyperbaria to treat hypoxemia, ambient pressures included 1.3, 1.45, 1.6, 1.8, 1.9, 2, 2.72 ATA. The average procedure time, defined as the time from the initial lung lavage to the time when the double lumen tube was exchanged for a single lumen tube, was 4 hours and 45 minutes. The mean time of intubation was 10.6 hours. Mean days in ICU were 2.17; mean hospital length of stay was 4.78 days. Complications included a pneumothorax (N=4). One case required an emergent cricothyroidotomy due to inability to reintubate after DLT removal (later discovered to have a subglottic fibrotic scar.

Summary/Conclusion

Performing WLL in a hyperbaric chamber that allows treatment of hypoxemia with increased ambient pressure is convenient and requires few personnel. Both lungs can be lavaged in the same day. Based on our retrospective review, patients have a short LOS, short intubation period, short ICU stay and complications such as pneumothoraces or other barotrauma are low. Avoidance of ECMO substantially reduces the cost of the procedure.

B 24: Gender disparities in patients undergoing hyperbaric therapy for pelvic soft tissue radiation injury

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Gender disparities, prevalent throughout medicine, likely occur in hyperbaric medicine. However, no studies have addressed gender disparities in hyperbarics.The purpose of this study was to compare the number of male vs. female identifying patients treated for hyperbaric oxygen therapy (HBO_2) in the setting of pelvic soft tissue radiation injury (STRI). We hypothesized that there would be significantly fewer women than men receiving treatment for pelvic STRI. The secondary purpose of this study was to identify underlying factors contributing to gender disparities, if existing, and how clinicians can address these to improve access to HBO_2.

Materials and Methods

Charts for patients who underwent HBO_2 for pelvic STRI from 2014 to 2024 were reviewed. Age, gender, primary malignancy, year of radiation, time to referral (years), radiation dose (cGy), HBO_2 indication, and lifetime number of HBO_2 were identified. Patients were included in the analysis even if they did not undergo HBO_2. Averages were calculated for each variable. Averages were compared between men vs. women.

Results

From 2014 to 2024, 245 patients underwent HBO_2 for pelvic STRI—fifty-one (21%) female identifying patients and 194 (79%) male identifying patients. On average, female patients were younger at the time of treatment (62 years vs. 72 years). Female patients received a lower total amount of radiation (6330 cGy vs. 7371 cGy). Both groups of patients have a similar lifetime number of HBO_2 treatments (females 36, males 39). Average time from radiation therapy to HBO_2 was slightly faster in females (six years versus eight years).

Summary/Conclusion

Our study found a nearly 4 fold decrease in female patients receiving HBO_2 for pelvic STRI than male patients, which is worse than the different incidence rates of pelvic malignancies between women and men in Minnesota. This highlights the need to further understand possible barriers to care for female patients with pelvic STRI who could benefit from HBO_2. When these barriers are identified and addressed, steps can be taken in the medical system to improve access to care for all patients with indications for HBO_2.

B 25: Hyperbaric oxygen therapy as adjunctive treatment for invasive fungal sinusitis

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Invasive fungal sinusitis (IFS), often caused by Mucormycosis, is a life-threatening condition primarily affecting individuals with poorly controlled diabetes, though any form of immunocompromise increases susceptibility. Standard treatment involves immediate surgical debridement and systemic antifungal therapy. However, hyperbaric oxygen therapy (HBO_2) is increasingly recognized as an adjunctive treatment, possibly improving outcomes for affected patients.

Materials and Methods

A retrospective chart review was conducted for patients with IFS admitted to our institution between June 2014 and June 2024. Patients who left against medical advice or were discharged to hospice in a short time (≤5 days) were excluded from the study. Primary outcomes assessed were survival to discharge, three-month, and 1-year survival. Patients discharged to hospice within 5 days of admission were not considered survivors for analysis purposes. Statistical significance was determined using the Chi-squared test and Student's t-test.

Results

We identified 42 patients who met criteria, 11 received HBO_2 (2.4 ATA, 90 minutes, between four to 50 treatments) and 31 did not. In the non–HBO_2 patients, survival rates were 58.1% (18/31) at discharge, 55.2% (16/29) at three months, and 42.9% (12/28) at one year. Of the 11 HBO_2 patients, survival rates were 63.6% (7/11), 60% (6/10), and 50% (5/10), respectively. In the subset of patients who received ten or more HBO_2 treatments, survival was 87.5% (7/8), 85.7% (6/7), and 71.4% (5/7), respectively. No analyses met criteria for statistical significance. The strongest signal was seen at one-year survival between patients who underwent at least ten treatments vs no treatments (71.4% vs 42.9%, p=0.176)

Summary/Conclusion

While not reaching statistical significance, our results illustrate a trend towards increased survival in patients with IFS who received HBO_2, especially those receiving ten or more treatments. Adequately powered single center studies are difficult given the relative rarity of the disease, and ours is no exception. These findings demonstrate a need for larger-scale investigations into this potentially life-saving therapy.

B 26: Modified approach to glycemic control in diabetic patients undergoing hyperbaric oxygen therapy

O: n/a
P: Monday, 6/2/2025, 2:00 PM - 3:30 PM
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Introduction/Background
Hyperbaric oxygen therapy is believed to have a potential risk of inducing hypoglycemia in patients with diabetes. These patients have required glucose monitoring pre- and post-treatment, and practitioners often elevate blood sugars to hyperglycemic levels before treatment. A new three-category glucose protocol was initiated at SUNY Upstate Hospital in 2019 to reduce these occurrences. The study aimed to determine if the new protocol increased the risk of hypoglycemia and other adverse events for patients with diabetes during hyperbaric oxygen therapy.

Materials and Methods
A retrospective chart review was performed on all patients with diabetes who had treatments under the new protocol. The new protocol categories were: Standard Monitoring Category (min. pre-treatment blood glucose >120 mg/dL), Well Controlled Monitoring Category (min. pre-treatment blood glucose >100 mg/dL), and Stable Monitoring Category (if >90 mg/dL before treatment and >70 mg/dL after treatment during the first three treatments then blood sugar checks were discontinued before treatment). Data collected for each treatment included pre- and post-treatment blood glucose levels and the occurrence of hypoglycemia-related adverse effects.

Results
A total of 55 patients who underwent 1841 treatments were identified. There was no mean difference in the pre- and post-blood glucose between patients in the three different protocol categories. Hypoglycemia occurred after three treatments in the Standard Monitoring Category (3/1382; 0.22%), one treatment in the Well Controlled Monitoring Category (1/148; 0.67%), and zero treatments in the Stable Monitoring Category (0/311; 0%). Hypoglycemia was defined as a serum glucose concentration ≤ 70 mg/dL. No patient had an adverse event related to hypoglycemia throughout the study.

Summary/Conclusion
This retrospective chart review determined that the modified glucose protocol did not cause hypoglycemia-related harm to patients. Patients in the tighter blood sugar control groups did not have more episodes of hypoglycemia or any adverse effects related to hypoglycemia. This data shows that certain patients with well-controlled diabetes may not need to be hyperglycemic before hyperbaric treatment. This data could lead to better glycemic control, decreased healthcare costs, and less invasive blood sugar monitoring for well-controlled diabetics undergoing hyperbaric treatment.

B 27: Clinical outcomes and adverse events of hyperbaric oxygen therapy at 2.0 vs 2.5 ATA for Hemorrhagic Radiation Cystitis

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Radiation cystitis (RC) is a complication of pelvic radiation therapy arising from radiation-induced hypoxic and ischemic injury[1, 2]. It causes many urinary symptoms such as hematuria, dysuria, frequency, urgency, and retention[1]. Hyperbaric Oxygen Therapy (HBO_2) patients are treated in a pressurized chamber (2-3 ATA) to enhance tissue oxygenation, leading to neovascularization and reduced inflammation[3]. While HBO_2 is effective for intractable RC, the pressure consensus is that those above 1.41 ATA are effective, and higher pressures increase the risk of adverse events (AE)[1, 4]. This study compares the efficacy and AE profiles of 2.0 vs. 2.5 ATA HBO_2 treatments.

Materials and Methods

A retrospective chart review of 93 patients treated for RC at two NYU Langone sites over 5 years was conducted. Data was analyzed with Chi-squared and Mann-Whitney in GraphPad Prism version 10.2.3 for Mac.

Results

There was a difference in the number of patients experiencing gross hematuria between those treated at 2.5 ATA versus 2.0 ATA, with fewer patients in the 2.5 ATA group experiencing gross hematuria within one year after HBO_2. There was no difference in the time to recurrence of hematuria (10.2 months at 2.0 ATA vs. 9.6 months at 2.5 ATA). There was no difference in other urinary symptoms, including frequency, urgency, dysuria, retention, and passing clots. The incidence of AEs was higher among patients treated at 2.5 ATA; there was no difference in the type or number of AEs per patient between the cohorts. No difference was found between the cohorts in other treatment parameters, such as number of treatments, months of treatment, and years since cancer diagnosis.

Summary/Conclusion

This is the first reported study comparing HBO_2 at these dosages. HBO_2 at 2.5 ATA appears to be more effective at reducing the recurrence of hematuria within one year following treatment than 2.0 ATA. It does not prolong the time to recurrence. Without a significant increase in AEs, existing treatment protocols could consider adopting 2.5 ATA over 2.0 ATA. Larger clinical studies could be beneficial in determining the ideal treatment dose.

Table 1: *Radiation Cystitis Symptoms within One Year after HBOT Completion, n= 78*

Urinary symptoms (n. % Reduction)	2.0 ATA	2.5 ATA	P-Value
Frequency	13 (27.78)	17 (22.73)	0.348
Urgency	12 (20.00)	10 (44.44)	>0.9999
Gross hematuria	24 (53.66)	9 (78.38)	0.0055
Passing clots	7 (68.18)	5 (66.67)	0.755
Retention	3 (76.92)	0 (100.00)	0.4937
Dysuria	4 (71.43)	6 (76.00)	0.5113

Table 2: *Adverse Events during HBOT, n= 19*

	2.0 ATA	2.5 ATA	P-Value
Patients with adverse events	9	10	-
Adverse Event Count			-
Ear related	5	7	>0.9999
Confinement anxiety	4	6	>0.9999
Visual change	4	3	0.6655
Neurologic related	0	1	>0.9999
Total adverse event occurrence	13	17	-
Average Number of Adverse events Per Patient (SD)	1.44(0.527)	1.70(0.823)	0.6881

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B 28: Hyperbaric Oxygen Therapy for lower limb intractable ulcer

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

We started using Hyperbaric Oxygen Therapy (HBO_2) in 1981 and have been positively applying it in our orthopaedic treatments. This report shows the results of treating lower limb intractable ulcers for the past forty-three years.

Materials and Methods

The following research was conducted from June 1981 to December 2024 at Kawashima Orthopaedic Hospital. We carried out HBO_2 in all 433 cases. Wagner-Grade classification was Grade1 in 58 cases, Grade2 in 40 cases, Grade3 in 32 cases, Grade4 in 41 cases, Grade5 in 11 cases, and other in 251 cases. In addition to HBO_2, almost all of these cases were treated with surgical intervention and/or antibiotics. HBO_2 was carried out under the condition of 2ATA for 60 minutes per day. The number of HBO_2 was four to 390 times (average 50.1 times). Treatment results were evaluated into three groups. "Good" here means cured, while "Fair" means symptoms clearly improved, and "Poor" means symptoms showed little improvement. In addition, 88 cases were evaluated using Transcutaneous oxygen tension ($PtcO_2$).

Results

The results of HBO_2 274 cases of 433 cases (63.3%) were in the “Good” outcome, while 72 cases (16.6%) were in the “Fair” outcome, and 87 cases (20.1%) were in the “Poor” outcome. Amputation was carried out in 71 cases (minor amputation 34 cases, below-knee amputation 26 cases, above-knee amputation 9 cases, unknown 2 cases) of the 87 cases in the “Poor” outcome. The average number of HBO_2 was: “Good” 53.2 times, “Fair” 58.6 times, and “Poor” 89.1 times. The cure rates of Wagner-Grade classification were: Grade1 82.8%, Grade2 55.0%, Grade3 40.6%, Grade4 26.8% and Grade5 0.0%. Furthermore, the average of the $PtcO_2$ was 480.1mmHg in the limb salvage group and 391.8mmHg in the amputation group.

Summary/Conclusion

The cure rate of lower extremity intractable ulcers was 63.3% in our hospital; however, it decreased in severe cases. $PtcO_2$ in the amputation group was lower than in the limb salvage group. Lower limb intractable ulcers are at risk of amputation. However, HBO_2 reduces the risk of amputation and is also effective for wound healing after amputation. HBO_2 is an effective adjunct therapy for lower limb intractable ulcers.

B 29: High altitude simulation testing in a hypobaric chamber: An academic center's approach

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

High altitude simulation tests (HAST) determine the oxygen requirements for patients with compromised cardiorespiratory function to ensure adequate oxygenation during air travel and other altitude exposures. Commercial airlines are pressurized to a maximum of 8000 feet, and smaller private aircraft may be unpressurized. HAST protocols involve administering a hypoxic gas mix corresponding to the calculated O_2% at altitude or simulating the desired altitude in a hypobaric chamber. We describe key considerations and one center's approach to HAST.

Materials and Methods

Evaluation starts with a thorough history and physical, identifying key factors causing hypoxia, current symptoms, and oxygen needs. The planned hypobaric chamber altitude(s) should correspond to the patient's proposed travel itinerary and should usually include 8000 ft. Baseline heart rate, respiratory rate, O_2 saturation (SpO_2), and symptoms are recorded at the surface for rest and light exercise. The chamber is depressurized at 2000 ft/min to the desired altitude. Resting steady state vitals/SpO_2/symptoms are again recorded. Exercise is initiated until a new steady state is reached, where vitals/SpO_2/symptoms are recorded. Supplemental O_2 is titrated as needed based on SpO_2 and symptomatology. The procedure is repeated at additional altitudes as the patient's travel itinerary indicates. A report is generated documenting the response to altitude and oxygen titration. The procedure is billed with CPT code 94453, "High Altitude Simulation Test (HAST)."

Results

Our center has performed more than 50 hypobaric chamber HAST evaluations from 2013 to the present with no adverse events. We have tested altitudes ranging from 2000 ft to 15000 ft. A patient follow-up survey has been generated to assess the validity of our HAST protocol when compared with the patient's real-world altitude experience.

Summary/Conclusion

A standardized approach for HAST is effective for documenting hypoxia at altitude and titrating supplemental O_2 requirements. It has also increased clinician and staff comfort when performing the evaluation.

B 30: Hyperbaric oxygen therapy for chronic carbon monoxide intoxication: A case series

O: n/a

P: WITHDREW

B 31: The efficacy of hyperbaric oxygen therapy in mild traumatic brain injury and post-concussion syndrome: A literature review and meta analysis

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Post-concussion syndrome (PCS) affects 15-35% of mild traumatic brain injury (mTBI) patients, presenting significant therapeutic challenges. This systematic review and meta-analysis synthesizes all available evidence on hyperbaric oxygen therapy (HBO_2) in treating persistent PCS, analyzing findings from 30 studies, including nine randomized controlled trials.

Materials and Methods

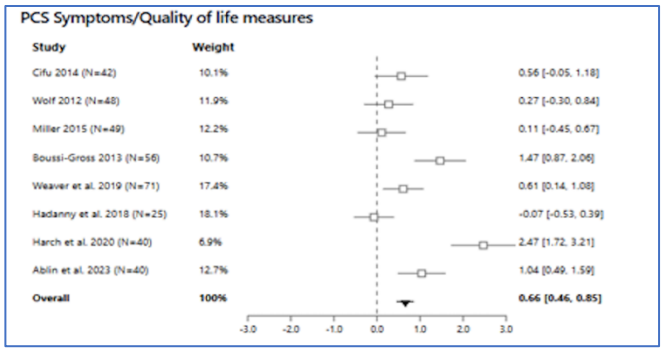
Following PRISMA-P guidelines, we conducted systematic searches across Cochrane Library, PubMed, Google Scholar, and Web of Science (1969-2024). Studies were evaluated using standardized quality assessment tools and risk of bias protocols. Meta-analysis was performed on twelve studies examining cognitive outcomes, symptomatic improvement, and neurological function.

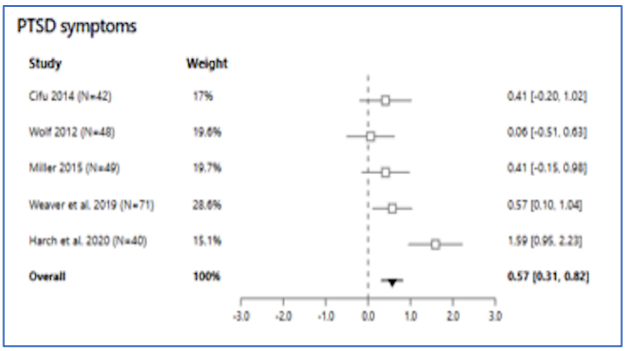
Results

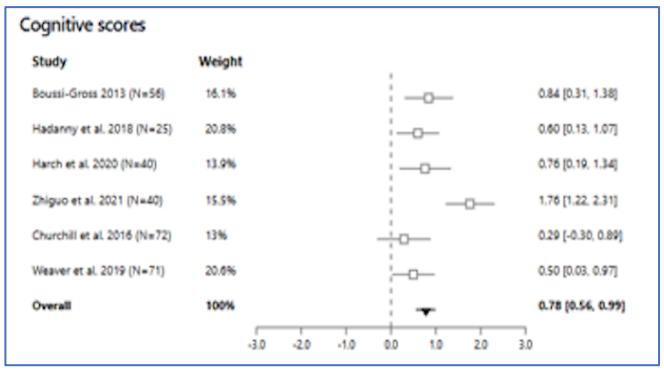
Systematic review of seventeen controlled trials demonstrated significant improvements in memory (p revealed significant improvements in cognitive function (effect size=0.40, 95% CI [0.32-0.48]) and PTSD symptoms (effect size=0.57, 95% CI [0.45-0.69]), while PCS symptom scores showed inconsistent results across studies

Summary/Conclusion

Evidence supports HBO_2's efficacy in treating persistent PCS through multiple pathophysiological mechanisms. Optimal protocols suggest 1.5-2.4 ATA pressure with 40-60 sessions, though treatment response varies by patient phenotype. Future research should focus on developing biomarker-guided selection criteria and optimizing personalized HBO_2 protocols to enhance therapeutic outcomes.







B 32: Evaluating quality of life improvements in radiation cystitis and head and neck cancer patients following hyperbaric oxygen treatment

O: n/a

P: WITHDREW

B 33: Carbon monoxide poisoning: A silent killer with a silent treatment

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Case Description

Hyperbaric oxygen therapy (HBO_2) is a recognized treatment for carbon monoxide (CO) poisoning, however, HBO_2 remains poorly recognized by medical providers and patients. As the deluge of "mild hyperbarics" and soft-sided chambers continues, purporting to be equivalent or similar to medical HBO_2, patients are inevitably harmed. HBO_2 is defined by using pressures of 2.0 ATA or above, with medical-grade oxygen delivered inside a hard-sided chamber meeting regulations by ASME-PVHO and NFPA.

This is a case report of a healthy engineer suffering a severe carbon monoxide poisoning, appropriately recognized and diagnosed by the emergency department, but inappropriately discharged with instructions to find HBO_2 in the community without assistance.

While working in a dynamometer room, the exhaust system failed, and coworkers found the patient two hours later. Surveillance video of the event appears to have shown convulsions before medics arrived and transported the patient to the hospital.

Intervention

At the emergency physician's direction, an online search by the patient's spouse directed care to a medical spa that housed a soft chamber device that supplied oxygen via nasal canula at 1.3 ATA. The facility acknowledged that they could provide the appropriate treatment for carbon monoxide poisoning, and the patient received 30 minutes of treatment for $80 out of pocket.

Outcome

The patient continued to be symptomatic. Thus, the next day he went to his primary care provider, who was alarmed about discharge from the emergency department given persistent neurologic effects. When the internist attempted to confirm that the patient received HBO_2, the spouse answered that HBO_2 had been received. Two weeks later, with no improvement in symptoms, the patient arrived at a quaternary medical center and received 20 USN Treatment Table 9 sessions three weeks after the initial insult. There was no significant clinical improvement from therapy.

Discussion

Despite the availability of a world-class HBO_2 center locally, an internet search directed this patient to a non-medical "mild hyperbaric" chamber. This phenomenon directly threatens patients' health and dilutes the field of medical HBO_2. Despite a complaint filed with the medical board, the original facility continues to operate, and similar chambers are sold online.

B 34: Navigating critical care challenges in hyperbaric medicine: A case report highlighting simultaneous treatment or four, intubated, pediatric patients with acute thermal burns (TBSA 25-45%)

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

Providing hyperbaric oxygen therapy (HBO_2) for acutely burned patients poses unique challenges that can be compounded by comorbid and contextual conditions like inhalation injury. HBO_2 is an important adjunct to managing patients with significant thermal burns, both in the acute phase (mitigating ischemic-reperfusion injury and reducing the zone of stasis) as well as in support of grafting. We present a case series and discuss the complex management for four intubated, critically-ill pediatric patients (ages 8-14) with significant deep-partial to full-thickness burns following a propane tank explosion.

Intervention

HBO_2 occurred in a multiple-place, 3-lock chamber at 2.4 ATA for 90 minutes twice daily (two patients per treatment). Creating a centralized tender staffing plan prevented disruption of the daily routine and emergency treatments. All four patients required intubation due to inhalation injury. Synchronized timing of breaths with SIMV improved tolerance of HBO_2 and reduced the need for sedation. PICU sedation-syringe pumps (CADD and Baxter pumps) required transition to push-doses for safe in-chamber sedation. Daily communication between Burn Surgery and PICU teams was paramount for awareness of current patient status updates and effective coordination of treatment logistics.

Outcome

All four patients received HBO_2 as an adjunct to burn care and grafting. Initial ventilator modes (assist-control) were based on experience with pediatric patients. However, SIMV resulted in improved tolerance of treatments. During the treatment, Omeda spirometry volumes frequently alarmed low. This required an increase in pressure support during the treatment. Dexmedetomidine infusion provided baseline sedation. Ensuring push dose sedatives on hand was key to facilitating ideal sedation as patients required approximately fifteen-minute dosing. Inhalation injury was underappreciated, with stridulous breathing observed on extubation for the first two patients. Subsequent patients thus underwent bronchoscopy prior to extubation. A total of 24 successful HBO_2 treatments with USN TT9 were completed with a good outcome.

Discussion

Concurrent management of four intubated pediatric patients undergoing HBO_2 without disrupting routine or emergent care will likely strain hyperbaric center capabilities. We believe our experience can assist with optimal preparedness for in-chamber and post-extubation challenges in the pediatric burn population.

B 35: Results of an educational campaign to improve the knowledge of referring providers related to the benefits of hyperbaric oxygen therapy on Late Radiation Tissue Injuries (LRTIs)

O: n/a

P: Monday, 6/2/2025, 2:00 PM - 3:30 PM

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Introduction/Background

Radiation therapy is a modality used to treat many forms of cancer, and about 50% of individuals receiving radiotherapy will be long-term survivors. Despite supporting medical evidence, patients experiencing symptoms of LRTI appear to be under-treated with HBO_2 therapy secondary to a lack of understanding of HBO_2 medicine by potential referring providers. This follow-up analysis aims to determine/validate whether a nationwide educational campaign targeting LRTIs could favorably impact patients' access to HBO_2 therapy.

Materials and Methods

A twelve-month LRTI education campaign was initiated on October 1, 2023, led by over 25 directors targeting local and regional oncology and primary care practitioners across North America. Data was collected from 235 RestorixHealth sites utilizing the WoundDocs EMR from October 2023 through September 2024. The total number of HBO_2 therapy treatment sessions organized by ICD 10 codes specifically correlating with patients treated for LRTIs was collected. The comparator group was collected prior to the education campaign from October 2022 through September 2023. Statistical significance was calculated using the Chi-Squared test.

Results

During the twelve months of the LRTI educational campaign, monitored at 235 sites (95% CI:0.823,0.905), there was a statistically significant 12.2% increase in the number of HBO_2 therapy treatments targeting LRTIs when compared to the baseline twelve months before the start of the LRTI campaign through the educational intervention period.

Of HBO_2 Therapy LRTI Treatments Only:

- Pre-LRTI Campaign (October 2022–September 2023) = 21,982
- Active-LRTI Campaign (October 2023–September 2024) = 23,288

The chi-square statistic is 197.2904. The p-value is < 0.00001. Significant at p < .05.
The chi-square statistic with Yates' correction is 197.1376. The p-value is < 0.00001. Significant at p < .05.

- The percent increase between the baseline and intervention periods was 12.2%.
- Baseline period - For all indications treated with adjunct HBO_2 therapy, 23.8% were for LRTIs.
- Intervention period - For all indications treated with adjunct HBO_2 therapy, 26.7% were for LRTIs.

Summary/Conclusion

This real-world retrospective analysis was statistically significant and highlights that patients suffering from LRTIs may never be offered HBO_2 therapy as a treatment option to alleviate their pain and suffering secondary due to a lack of familiarity of referring provider(s) with the benefits of Hyperbaric Medicine. Further studies are warranted to corroborate these findings.

B 36: Synergistic effects of combined platelet-rich plasma and hyperbaric oxygen therapy on functional recovery and pain reduction in chronic knee osteoarthritis: A case study

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

A 49-year-old active male presented with bilateral knee pain (right > left) that had persisted for 14 years despite conservative management. Comprehensive baseline assessments included a 3 Tesla MRI without contrast of both knees, standardized physiotherapist-led knee assessments, and quantitative gait analysis. Initial evaluation revealed pain rated at 4/10 VAS, restricted knee extension and flexion, quadriceps tightness, positive McMurray's and Thessaly tests indicating meniscal pathology, and abnormal rearfoot pressure during gait.

Intervention

The treatment protocol consisted of three ultrasound-guided PRP injections administered one week apart. Each injection was followed by five Hyperbaric Oxygen Therapy (HBO_2) sessions at 2 ATA for 120 minutes with 5-minute air breaks, for a total of 15 HBO_2 sessions. This combined approach was selected to enhance the regenerative properties of both modalities potentially.

Outcome

Immediate post-treatment assessment showed substantial improvements: pain decreased from 4/10 to 1-2/10 VAS, right knee extension improved by 10°, knee flexion increased by 5°, and quadriceps length improved by 10°. Muscle flexibility tests normalized, and McMurray's test converted from positive to negative.

At 2-month follow-up, complete pain resolution (0/10 VAS) was achieved with full active and passive range of motion in all directions, normal muscle length (except for mild left hip flexor tightness), improved gluteus medius strength (4/5 to 5/5), and negative findings on all special tests previously positive for joint and meniscal pathology. MRI findings showed reduced synovial effusion and improved meniscal morphology.

Discussion

This case study provides preliminary evidence of significant functional and structural improvements following combined PRP-HBO_2 intervention for chronic knee pain. The synergistic effects suggest enhanced tissue regeneration and pain modulation pathways not typically seen with either therapy alone. The rapid improvement in objective measures and sustained results at two months indicate potential long-term benefits of this combined approach.

The complementary mechanisms of PRP (growth factors promoting tissue repair) and HBO_2 (enhanced oxygen delivery and anti-inflammatory effects) may explain the comprehensive improvement in structural and functional outcomes. While limited by the single-case design, these promising results warrant further investigation through larger controlled trials to establish efficacy, optimal treatment protocols, and long-term outcomes for patients with knee osteoarthritis and meniscal pathology.

B 37: Improvement of neurological examination after one hyperbaric oxygen treatment 7 days after decompression sickness

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

Several papers dating back 60 years support that late hyperbaric oxygen (HBO_2) improves the outcome in patients with decompression sickness (DCS)(Rivera 1964, Kizer 1982, Myers 1985, Ball 1993, Cianci 2006, Xu 12, Hadanny 2015). This case presents neurological changes immediately before and after one HBO_2 treatment.

CASE: A 64-year-old healthy experienced female was SCUBA diving (air breathing) in the South Pacific. She dove two divers per day for four days uneventfully. She separated from her dive group on the fifth day due to limited visibility and current. Inadvertently she descended to 107 fsw, then ascended more quickly than she desired. She conducted a safety stop between 18-22 fsw for 2 minutes. Her total bottom time was 19 minutes. Ninety minutes later, she dove again, to 50-60 fsw for 50 minutes. Her dive computer did not indicate missed decompression. Five hours later she developed numbness and tingling in both lower extremities, followed by mild arthralgias. She was not concerned. She departed for LAX 1.5 days later. She denied worsening in symptoms during the flight. She drove over the next two days to her home at an altitude of 1300 meters. Her symptoms troubled her and escalated, and she sought Emergency Department care. She was subsequently referred to hyperbaric medicine, 7 days after onset of DCS. On examination, she was mentally intact and without apparent problems with cognition. Her tandem gait and Romberg tests were abnormal. She could not do a Sharpened Romberg with eyes open, yet reported she never had balance issues.

Intervention

HBO_2 at 2 ATA x 90 minutes at pressure without air breathing intervals.

Outcome

Immediately after HBO_2 these prior neurological abnormalities were all normal, including Sharpened Romberg with eyes closed. Her arthralgias and lower extremity numbness were better. HBO_2 will be continued daily until clinical plateau.

Discussion

This case adds to existing literature about the benefit of treating DCS many days after onset, including by a short HBO_2 treatment schedule. This case is unique because it reports a significant improvement in the pre-HBO_2 and immediately post-HBO_2 neurological examination 7 days after the onset of DCS.

B 38: Adjunct HBO_2 for acute macroglossia

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Acute macroglossia may be a complication of traumatic intubation, surgical procedures, and other lingual trauma. Tongue swelling can be severe and prevent post-operative extubation or lead to re-intubation/tracheostomy placement. Hyperbaric oxygen therapy (HBO_2) may reduce macroglossia by reducing edema, alleviating ischemia, and attenuating ischemia-reperfusion injury.

Materials and Methods

After IRB approval was obtained, cases with HBO_2 consultation at a hospital-based academic hyperbaric center between 2012 and 2024 were identified via a hyperbaric consultation log and assessed for outcome measures.

Results

Sixteen hyperbaric consultations were identified; 11 were treated with HBO2, five were not based on risk/benefit (one only mild swelling with concurrent pneumothorax, one uncontrolled seizure, one comfort care, one uncooperative/altered mental status, one died of other complications). Results shown as median (min, max) for treated individuals unless otherwise stated. Median age 52 years (19, 71), seven males (64%) and four females (36%). Initial endotracheal intubation duration: 10.5 hours (1.75, 359). Time of onset to HBO_2 consultation: 17 hours (2, 993). Time of onset to first treatment: 23 hours (2.5, 997). ICU days: eight (1, 109). Hospital days with macroglossia: 15 (2, 73). Total length of stay (LOS): 17 days (2, 109). HBO2 was initiated for two patients (18%) while intubated (endotracheal or nasotracheal), and two patients already with tracheostomy (18%). One patient required tracheostomy during the HBO_2 course (intracranial hemorrhage, ultimately discharged to LTAC). One of the three patients with tracheostomy underwent removal before hospital discharge. No treated patients were re-intubated after initiation of HBO_2.

Most frequent treatment table: 2.45 ATA for 90 minutes (no air breaks). Number of treatments: 3 (1, 8). Adjunct therapies (n, %): steroid (11, 100%), compression wrap (3, 27%), lingual massage (1, 9%), antihistamine (1, 9%). All patients improved, 1 completely resolved in-hospital, 9 resolved after discharge, 1 did not completely resolve (lingual fibroma developed).

Summary/Conclusions

All patients who received HBO_2 had improvement in tongue swelling to varying degrees, no patients progressed to need re-intubation and there were no significant adverse events related to HBO_2. It is reasonable to consider macroglossia as “acute traumatic ischemia” and entertain HBO_2 as an adjunct to other therapies.

B 39: Retrospective cohort study of seizure occurrence after carbon monoxide poisoning

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Studies of large population datasets suggests that carbon monoxide (CO) poisoned patients have higher rates of seizures in subsequent years.

Materials and Methods

We searched our medical system's databases to identify patients (ages 18-75 years) with CO poisoning and compared them to patients with wrist injury who presented to the emergency department from 2004-2019 to determine risk for new seizures in the five years following poisoning or initial injury. Additional inclusion criteria were >1 visit both >15 days prior to and after their injury date. Patients with prior history of seizures were excluded, as were wrist injury patients with additional trauma (e.g., inpatient admission, head and face injury, imaging other than upper extremities).

Results

We identified 2,111 patients with CO poisoning [49% female, mean age 39.6 (SD=14.4)] and 17,549 controls [31% female, mean age 39.4 (SD=15.6)]. There were significantly fewer females in the control group (patio 1.6, 95% CI [1.2, 2.1], pp new seizures developed an average of 674 (SD=594) days after the poisoning. The mean difference between the CO group and wrist injury control group in days from injury to seizure onset (-98.5, 95% CI –[250, 52.7], p=.20) did not reach statistical significance.

The onset of new seizures did not differ significantly between those who received hyperbaric oxygen (3.3%) and those who did not (2.8%, p=.59).

Summary/Conclusion

In this retrospective cohort study across 21 years, patients with CO poisoning were more likely than patients with wrist injuries to develop new seizure occurrence or epilepsy diagnosis following their injury.

B 40: The role of HBO_2 in the management of Iatrogenic Venous Air Embolisms: A two-case series

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

Venous Vascular Air Embolism (VAE) is potentially life-threatening, leading to hypoxic respiratory failure and haemodynamic collapse. Venous VAE may be iatrogenic, via peripheral or central venous catheters or during procedures that expose venous blood to air. There is added risk when venous VAE cross over to the arterial system through a patent foramen ovale or septal defect. Two cases of venous VAE will be discussed; One which received HBO_2 as per UHMS indications, and a second which was managed conservatively in view of co-morbidities.

Intervention

The first case, a 48 year old male, underwent bilateral hip core decompression and bone grafts for Avascular Necrosis. Post-operative bilateral hip CT revealed venous VAE in the left Common Femoral Vein. The patient, who remained asymptomatic and haemodynamically stable throughout, was referred for HBO_2. Bedside Echo performed by Cardiologist confirmed no bubble load in the Right Heart, and no shunt. The patient underwent a single US Navy Treatment Table 5 (USN TT5).

The second case, a 73 year old male with high risk TIA from Basilar Artery Occlusion, had just undergone a CT Angiography of the brain requiring injection of contrast. CT images revealed venous VAE throughout bilateral External Jugular Veins, from an inadvertent air injection via the peripheral venous catheter. The patient, who remained asymptomatic and haemodynamically stable throughout, was referred for HBO_2. However, given the high risk for recurrent Stroke requiring emergent Endovascular Thrombectomy, the patient was managed conservatively. He was kept in Trendelenburg position with Non-Rebreather Mask for 24 hours.

Outcome

Both cases had full resolution of their Venous VAE following their respective interventions, as documented on repeat CT.

Discussion

HBO_2 may not always be preferred in the initial management of venous VAE. Cases of peripheral vein VAE, like the second case, may benefit from conservative management and close observation. In cases of central vein VAE, like the first case, urgent HBO_2 is indicated to prevent life-threatening complications such as Right Ventricular Outflow Tract “Vapour Lock”, and Cerebral Arterial Gas Embolism from crossover to the arterial system. Furthermore, the risk vs benefit of HBO2 must be balanced against co-morbidities and overall clinical condition.

B 41: Hyperbaric oxygen therapy as an adjunctive treatment for penile glans reattachment following traumatic neonatal circumcision

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

An 8-day-old male with hypospadias presented to the Children's Hospital of Philadelphia (CHOP) following an accidental penile glans amputation. The amputation occurred during a religious ceremonial circumcision performed by a non-medical practitioner using a Mogan clamp. The detached glans was placed on ice for 3 hours prior to arrival. Urology performed emergent surgical re-attachment of the glans and foreskin with multi-layer closure within 6 hours post-amputation. The patient was admitted to the NICU post-operatively and nitroglycerin ointment was applied every 6 hours. On postoperative day 1, the reattached glans appeared dusky and Hyperbaric Medicine was consulted.

Intervention

Hyperbaric Oxygen (HBO_2) therapy was initiated in a multiplace chamber 33 hours post-amputation and 27 hours post-reattachment. Oxygen delivery to a neonate proved logistically challenging. Our staff developed a bassinet " oxygen tent " to comfortably and safely deliver oxygen in a multiplace chamber while allowing access for feeding, diapering, and soothing the neonate. The patient underwent 20 hyperbaric oxygen treatments: 7 twice-daily treatments at 2.8 ATA for 90 minutes and six once-daily treatments at 2.0 ATA for 120 minutes, with air breaks as appropriate.

Outcome

In the post-operative period, the reattached glans and foreskin progressed from slight pallor to a dusky appearance. During treatments 1-7, there was continued discoloration and edema. By treatment 14, black eschar covered the majority of the re-anastomosis of the glans. Upon completion of 20 treatments, the patient significantly improved coloration and swelling of the glans. Upon urology evaluation, the surgical site was well healed one month after completing treatment, with no ongoing discoloration or swelling. The patient tolerated the course remarkably well without side effects or adverse events.

Discussion

Penile glans amputation can be a devastating but rare complication of circumcision. Literature regarding standardized procedures for repair and post-operative management is sparse. Based on our research, this is the first case reporting HBO_2 therapy as an adjunctive treatment for traumatic glans amputation from circumcision with surgical reattachment in a neonate. Given the favorable outcome for this neonate, HBO_2 therapy should be considered as an adjunctive treatment post-operatively for penile glans amputations requiring surgical reattachment.

B 42: Hyperbaric oxygen therapy as adjunctive treatment for complex problem wounds associated with non-bacterial chronic osteomyelitis, Crohn's disease, and SAPHO syndrome in a pediatric patient

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

A 9-year-old female with chronic multifocal non-bacterial osteomyelitis with sinus tract formation and Crohn's disease was referred for consideration of hyperbaric oxygen (HBO_2) therapy. She required multiple hospitalizations with admission to the intensive care unit for extensive wound care and surgical debridement. Comprehensive rheumatological evaluation led to the diagnosis of chronic systemic inflammation most consistent with SAPHO syndrome (synovitis, acne, pustulosis, hyperostosis, and osteitis). Accordingly, pediatric surgical consensus was to avoid additional widespread debridement given concern for pathergy.

Intervention

The patient underwent 30 sessions at 2.0 ATA for 120 minutes of 100% oxygen, with five-minute air breaks, six days per week in our Class A (multiplace) chamber. She remained an inpatient throughout her course of hyperbaric therapy. Dressing changes were conducted three times weekly by the wound management team. Wound photographs and measurements were documented to track progress and facilitate multidisciplinary care coordination. The patient also received a monoclonal antibody and weekly methotrexate. Steroid therapy was slowly tapered.

Outcome

Near the completion of HBO_2 therapy, the patient was able to tolerate wound dressing changes without the former necessity for sedation and a complex analgesic regimen. The size of all the patient's wounds, including those previously requiring sharp surgical debridement, significantly decreased. Increased granulation tissue was noted. One complex wound completely closed. Her overall pain was significantly improved, and she transitioned from near-dependence on a wheelchair to intermittent crutch use.

Discussion

Complex problem wounds related to non-bacterial osteomyelitis, Crohn's disease, and SAPHO syndrome are rare but life-altering in the pediatric population. Although a previous publication describes the use of HBO_2 therapy for an adult with SAPHO, this is the first such report in a pediatric patient. A proposed pathophysiologic mechanism is reduction of auto-inflammatory processes mediated by TNF-α, IL-8, and particularly IL-1. Given the current lack of consensus concerning therapy to mitigate SAPHO-associated symptoms, we suggest that appropriately designed randomized studies investigate adjunctive HBO_2.

B 43: Decompression sickness with abdominal symptoms and portal venous gas

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

A 55-year-old male with HTN, hyperlipidemia, and anxiety presented to an outside hospital for headache, upper back pain, double vision, nausea, and abdominal distention/pain following six dives over two days on Nitrox (depths ranging from 96-107 fsw). He became nauseated at 50 fsw on the first dive and rapidly ascended. Nausea resolved, and he continued diving. The above-listed symptoms developed 15 minutes after exiting the water from the sixth dive. The double vision and headache resolved during transport to shore, but the other symptoms persisted. He presented to a hospital where CT abdomen/pelvis (CT A/P) demonstrated portal venous gas (PVG), prompting a recommendation for transfer for Hyperbaric Oxygen Treatment (HBO_2) therapy for suspected Decompression Sickness (DCS).

Intervention

On arrival at our facility, persisting symptoms were abdominal distention/pain and upper back/right shoulder pain. A US Navy Treatment Table 6 without extensions was performed. Post-treatment, abdominal distention/pain was almost completely resolved, and upper back/right shoulder pain was resolved. Overnight symptoms of abdominal distension/pain and upper back/right shoulder pain reoccurred, prompting a tailing HBO_2 treatment at 2.0 ATA for 90 minutes the following day.

Outcome

All symptoms had resolved after the second HBO_2 treatment. An ECHO with bubble study to evaluate for patent foramen ovale (PFO) was recommended and resulted in a positive finding for PFO. Percutaneous PFO closure was recommended and is scheduled.

Discussion

Portal venous gas is rarely noted in DCS evaluations as abdominal CT imaging is not routinely performed, but PVG may be more common in DCS than previously thought. Traditionally, the presence of PVG in DCS has been associated with more severe cases of DCS, raising the possibility of bowel ischemia due to the effects of bubbles that originate in the mesenteric veins. However, not all cases of DCS with PVG will develop significant symptoms. The differential diagnosis of PVG is broad, and all causes should be considered. In the setting of suspected DCS associated with abdominal pain, CT A/P should be considered to evaluate for ischemic bowel or other alternate surgical or emergent causes.

B 44: Case report of salvage HBO_2 for lingual crush injury

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

JD is a 70-year-old female with a history of uncontrolled primary HTN, HLD, and T2DM who initially presented for ICH requiring intubation and EVD. Following intubation, her tongue was noted to be firm, edematous, and lacerated, concerning for a crush injury or "acute traumatic ischemia". For 5 weeks, ENT and critical care teams attempted massage, compression, steroids, bite blocks, sedation, and paralytics with minimal success. Dental trauma eventually resulted in a large through-and-through lingual defect. Hyperbaric medicine was consulted for salvage therapy after failure of multi-modal treatment.

Intervention

HBO_2 was initiated, and the patient received eight treatments: 2.45 ATA for 90 minutes for seven treatments and 2.8 ATA for 85 minutes for one treatment.

Outcome

After three hyperbaric treatments, a noticeable decrease in lingual edema provided anatomical space for the tongue to be repositioned behind the teeth. JD tolerated all eight hyperbaric treatments without complication. 109 days after presentation, JD was discharged. At the first follow-up appointment, complete resolution of the lingual defect was noted.

Discussion

Crush injuries to the tongue are a rare but possible complication of endotracheal (ET) intubation. This can be a challenge for physicians caring for critically ill patients, as tongue edema can compromise the airway and increase the risk of other complications, including infection and necrosis. While HBO_2 has been shown to expedite healing and revascularization in tissues of the head, neck, and oral mucosa, reports of HBO_2 for tongue edema secondary to ET intubation remain limited. In this case report, we demonstrate the utility of HBO_2 as a possible adjuvant therapy for refractory macroglossia secondary to lingual trauma.

B 45: Carbon monoxide poisoning from sulfuric and formic acid

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

Carbon monoxide is the most common poisoning in the USA, almost always caused by inhaling CO produced by the combustion of carbon-containing materials. In addition, inhaling methylene chloride can cause CO poisoning. We report another cause of CO poisoning.

A 48-year-old male with a history of depression attempted suicide by inhalation of 98% concentration of sulfuric acid and 98% formic acid. These were mixed in a 1:1 fashion and placed in a continuous positive airway pressure (CPAP) machine. He inhaled the aerosolized vapor via a CPAP mask, having learned from online sources about methods to commit suicide that the combination of these acids produces CO. After 30 minutes, he denied having symptoms. He drove from a remote location to his apartment. Earlier, he had sent a pre-selected, timed email to the police indicating where they could find his body.

Intervention

The police arrived at his location. He had nausea, vomiting, and a headache. He was transported to an Emergency Department, where his carboxyhemoglobin level was 21%. He was transported to a hyperbaric department and treated with hyperbaric oxygen.

Outcome

The chemical reaction for carbon monoxide production from the combination of formic acid (HCOOH) and sulfuric acid (H_2SO_4) is:

$$HCOOH + H_2SO_4 \longrightarrow HCO_2H \longrightarrow CO + H_2SO_4.H_2O$$

Formic acid readily decomposes by dehydration in the presence of concentrated sulfuric acid to form carbon monoxide and water.

Discussion

There are a few case reports about carbon monoxide poisoning from formic acid that is protonated by sulfuric acid. We report an additional case. Online forums discussing methods of suicide have described this method. Clinicians should be aware of this method of carbon monoxide poisoning.

B 46: Frostbites and hyperbaric oxygen treatment

O: n/a
P: Monday, 6/2/2025, 4:00 PM - 5:30 PM
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Case Description
Frostbite is a severe thermal injury caused by prolonged exposure to temperatures below 0°C, primarily affecting extremities, ears, nose, and cheeks. Tissue damage results from ice crystal formation and microcirculatory alterations. Conventional treatments include gradual rewarming, use of prostaglandins, local care to prevent infections, and in severe cases, amputation due to necrosis.

Hyperbaric oxygen therapy (HBO_2) has been proposed as an adjuvant treatment due to its benefits. It increases dissolved oxygen in plasma, especially in poorly perfused and hypoxic areas, promotes neovascularization and fibroblast generation, accelerating wound healing. Additionally, it has anti-inflammatory, bactericidal, and bacteriostatic effects.

We present two cases of frostbite treated with HBO2:

- Case 1: A 54-year-old mountaineer with Grade 3-4 frostbite on hands and feet.
- Case 2: A 40-year-old mountaineer with Grade 2-3 frostbite on both feet.

Intervention
Case 1: After initial rewarming treatment and prostaglandins, he received 30 HBO_2 sessions, one daily at 2,4 ATA during 90 minutes in a multiplace hyperbaric chamber.Significant amputations were ultimately required.

Case 2: He received a total of 40 HBO_2 sessions, one daily at 2,4 ATA for 90 minutes in a multiplace hyperbaric chamber. Amputations and surgical cleaning of necrotic eschar were performed.

Outcome
Case 1: Significant amputations were ultimately required.

Case 2: Amputations and surgical cleaning of necrotic eschar were performed.

Although advanced frostbite is very serious, HBO_2 can be beneficial with few adverse effects. In these cases, although treatment was initiated in a subacute phase, the results were satisfactory in terms of reducing the severity of necessary amputations.

Discussion
A comprehensive therapeutic strategy including gradual rewarming, HBO_2, prostaglandins, and local care can significantly improve the prognosis of frostbite and the extent of necessary amputations.

B 47: Hippocampi and Midbrain Lesions in Carbon Monoxide Intoxication

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

Emergency medical services rescued a 27-year-old female who attempted suicide using charcoal briquettes. The duration of exposure to carbon monoxide (CO) remains unclear. Upon arrival, her Glasgow Coma Scale was 3. She was intubated and administered 100% oxygen due to her comatose state and unstable vital signs. The initial arterial carboxyhemoglobin level was 17.5%.

Intervention

Computed Tomography (CT) revealed low-density areas in the bilateral hippocampi. Magnetic Resonance Imaging (MRI) demonstrated increased signal intensity in these regions on diffusion-weighted imaging, relatively reduced intensity on the Apparent Diffusion Coefficient map, and elevated intensity on Fluid-Attenuated Inversion Recovery imaging. This severe presentation of CO intoxication warranted hyperbaric oxygen therapy, which was administered at a pressure of 2.8 atm for 60 min on four occasions.

Outcome

Her level of consciousness improved, and she was successfully extubated. MRI taken on the 23rd day showed no cerebral white matter lesions suggestive of delayed neurologic sequelae. However, a delayed midbrain lesion was observed.

Discussion

In cases of severe CO intoxication, hippocampal and midbrain lesions can be observed on MRI.

B 48: From catastrophic devastation to life-sustaining initiatives: the implementation of hyperbaric oxygen therapy following the earthquake in Türkiye - 2023

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

Sümen SG
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Introduction/Background

Following the February 2023 earthquake in the Kahramanmaraş district, thousands of individuals were rescued from the rubble with severe multiple injuries. Due to Crush injuries suffered by many victims, health authorities quickly implemented interdisciplinary medical and surgical management. Although the disaster's epicenter was over 1000 km from Istanbul, several patients were admitted to our hospital. We aim to share the results of hyperbaric oxygen therapy (HBO_2) administered to patients referred to our department post-earthquake.

Materials and Methods

We retrospectively reviewed the medical records of patients who underwent hyperbaric oxygen therapy at Dr. Lütfi Kirdar City Hospital. We analyzed case distributions, including demographic data, total treatment sessions, the time elapsed from the disaster site to our clinic, treatment outcomes, and other criteria.

Results

Our objectives included administering hyperbaric oxygen treatment alongside conventional therapies to reduce mortality and amputation rates associated with crush injuries or other causes. In our department, we treated 14 patients (nine male and five female) with hyperbaric oxygen therapy. The average age of the patients was 29 years (min 7 - max 75). The time spent under the rubble before rescue attempts ranged from 4 to 72 hours. The time from rescue to the first HBO_2 session varied between 84 and 816 hours. The average number of treatment sessions was 20 (min 3 - max 35). Our results indicate that only one patient with multiple fractures died, while most affected extremities were saved following successful treatments.

Summary/Conclusion

HBO_2 has been effectively administered to earthquake survivors for various indications. Given the severity of their injuries, patients may require immediate HBO_2 consultations upon arriving at hospitals. Consequently, hyperbaric facilities and diving medicine physicians may enhance treatment outcomes for injuries sustained at the disaster site and in hospitals far from the epicenter

B 49: Hereditary spherocytosis treated with hyperbaric oxygen

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

Hereditary spherocytosis causes hemolytic anemia due to a genetic mutation resulting in a loss of the biconcave shape of red blood cells (RBCs), increasing fragility and shortening their lifespans. Some consider hyperbaric oxygen (HBO_2) to be contraindicated because HBO_2 could increase oxidative stress, worsen RBCs fragility and increase hemolysis, potentiated by vitamin E deficiency. We found one paper where two patients with hereditary spherocytosis received HBO_2 uneventfully (Wirjosemito and Touhey, J Hyper Med 1988;3(1):45-50).

Intervention

An 85-year-old diabetic female with radiation cystitis from endometrial carcinoma treated with radiation needs HBO_2. She has hereditary spherocytosis with chronic low-grade hemolysis.

Prior to HBO_2 her hemoglobin = 16.8 g/dL, hematocrit = 47.6%, lactic dehydrogenase (LDH) = 240 u/L (normal) and free serum hemoglobin = 65 mg/dL (reference emained unchanged. The free serum hemoglobin was 22 mg/dL. Her daily vitamin E (400 IU) was discontinued after her third HBO_2 treatment because her serum levels were normal.
After her 17th HBO_2 treatment, she remained clinically unchanged. Labs will be repeated after the planned 40 daily HBO_2 treatments.

Outcome

A course of HBO_2 in this patient with hereditary spherocytosis did not worsen her baseline degree of hemolysis.

Discussion

To our knowledge, this is the third case in the literature of a patient with hereditary spherocytosis treated with HBO_2 that did not worsen hemolysis. In patients with hereditary spherocytosis needing HBO_2, consider verifying serum vitamin E levels and providing vitamin E supplementation if deficient.

B 50: Dysarthria clumsy hand syndrome: A case report

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

The left internal carotid artery was inadvertently canulated during routine ultrasound-guided internal jugular access for central venous port placement. This was recognized before dilation, the sheath was removed, and direct pressure was applied for 30 minutes. The port was then placed as intended.

Twenty minutes after arriving in the post-anesthesia care unit, the patient developed dysarthria and right upper extremity (RUE) ataxia, prompting activation of the stroke team. CT imaging of the head and neck was rapidly obtained, and neurology evaluated the patient 20 minutes after symptom onset. Interpretation of the imaging by radiology showed no definite air or other pertinent abnormalities.

Hyperbaric medicine was consulted for possible cerebral arterial gas embolism (CAGE) as the cause of dysarthria and clumsy hand syndrome. Due to the lack of definite air visualized on CT, neurology planned to obtain MRI imaging before initiating hyperbaric treatment. Given the clinical urgency, hyperbaric medicine strongly advocates for immediate hyperbaric oxygen treatment (HBO_2) without further delays. HBO_2 was initiated 72 minutes after symptom onset. Following the first treatment, there was significant improvement in dysarthria and near-complete resolution of RUE ataxia. Subsequent MRA imaging revealed multiple acute ischemic infarcts in the left middle cerebral artery territory.

Intervention

The patient received a Hart-Kindwall treatment and two United States Navy Table 9 tailing treatments.

Outcome

The patient was discharged home after a two-day hospitalization with resolved RUE ataxia and significant improvement in dysarthria.

Discussion

Hyperbaric literature emphasizes that CAGE is a clinical diagnosis that does not require imaging confirmation of air before initiating definitive treatment. Conversely, some neurology and radiology literature recommends additional imaging, including MR perfusion or diffusion-weighted studies, when air is not initially detected. It is well-established that the best outcomes with HBO_2 are achieved when treatment is initiated as soon as possible after symptom onset.
In this case, the hyperbaric physician's advocacy for immediate treatment overcame the inertia of further imaging delays, prioritizing the patient's functional and quality-of-life outcomes. Regardless of imaging findings, prompt initiation of HBO_2 maximizes the recovery potential of clinically diagnosed CAGE patients.

B 51: Hyperbaric oxygen therapy in a patient with coma accompanied by bilateral pneumothorax

O: n/a

P: WITHDREW

B 52: Medical-grade leeches in combination with hyperbaric oxygen therapy as adjunct treatment for venous congestion: A small case series

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

Hirudotherapy, the medical use of leeches, has been used in healthcare since 1500 BC. They help manage venous congestion through their bite and the vasoactive compounds in their saliva. Hyperbaric oxygen (HBO_2) therapy is another adjunct treatment that enhances oxygen delivery to ischemic tissues, promoting wound healing. However, there is a lack of literature exploring the combined use of leeches and HBO_2 therapy. This case series presents four patients with various wound complications, including crush injuries, sutured severed limbs, and compromised skin flaps. Each patient received post- HBO_2 leech therapy in an attempt to optimize the healing of their wound.

Intervention

All patients underwent HBO_2 therapy followed by leech therapy, with additional treatments such as nitropaste, mepilex, and antibiotics based on wound type. Patient one, an 87-year-old female with a failing facial skin flap post-melanoma excision, received four leech therapy sessions. Patient two, a 25-year-old male with a crush injury to his left third digit, underwent three sessions. Patient three, a 39-year-old female with crush injuries and compromised flaps following a motorbike accident, received a single leech session. Patient four, a 41-year-old male with a crush injury and a severed left thumb, underwent five leech therapy sessions post-HBO_2. The number of leeches per session varied from one to three, with each session lasting approximately 30 minutes.

Outcome

Three out of four patients experienced complete wound healing without major complications—patient one healed by day 81, two by day 29, and four by day 54. However, patient three's injury progressed despite intervention, requiring multiple amputations. The average treatment duration for the cohort was 47 ± 22.36 days. All patients had at least one comorbidity, with tobacco use being the most common.

Discussion

In conjunction with HBO_2 therapy, Leech therapy is a valuable adjunctive treatment for venous congestion. This case series demonstrates that Hirudotherapy enhances venous outflow, potentially mitigating risks such as thrombus formation and tissue necrosis. However, the failure of treatment in patient three underscores the importance of patient selection and injury severity assessment. Further studies with larger sample sizes are needed to evaluate long-term efficacy and refine patient criteria for this combined approach.

B 53: Is there equipoise regarding hyperbaric oxygen therapy for the treatment of CRAO in adjacent specialties?

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM
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Introduction/Background

Central Retinal Artery Occlusion (CRAO) is a rare diagnosis with clinically significant morbidity. Many patients will continue to have sustained visual deficits, despite receiving treatment. Emergency Medicine (EM), Neurology, and Ophthalmology typically co-manage these cases early on. Each specialty has various treatment methods; however, none have complete efficacy. For the last 20 years, hyperbaric oxygen therapy (HBO_2) has improved outcomes in this patient population. Anecdotally, each specialty is typically only comfortable recommending what they have been trained in using in their respective specialty. Some specialists may be unaware of or even recommend against HBO_2 in treating CRAO. This survey study assesses the understanding of these adjacent specialties regarding using HBO_2 in treating CRAO.

Materials and Methods

Our survey consisted of 8 questions. It was distributed online, via email, to all physicians affiliated with the departments of EM, Neurology, and Ophthalmology at the University of California, San Diego. Residents, fellows, and attendings all received the survey. Results were collected using Qualtrics.

Results

A total of 37 responses were received. 32 responses from EM, two from Neurology, and three from Ophthalmology. This represents a response rate of 26%, 2 %, and 3% from each respective department. EM responses were 72% attending, 16% fellow, and 12% residents. Neurology responses were 100% attending (one Yes, one Maybe). Ophthalmology was 66% attending (1 No, 1 Maybe) and 33% resident (1 No). EM staff all recommended HBO2 except for 1. Only one person said Yes to “Not recommending HBO_2.”

Summary/Conclusion

We believe that amongst specialists who routinely care for patients with CRAO, there is indeed equipoise among clinicians regarding HBO_2. The current body of literature supports the use of HBO_2 in treating CRAO. This suggests that additional information or educational efforts could be valuable for the training of said specialists.

B 54: Cerebral air embolism on a commercial airline flight

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Case Description

A 68-year-old female was traveling from Cancun to Canada with diarrhea. During the flight, the patient became nauseated and suffered a syncopal event. An RN on the flight started an IV to expedite the delivery of IV fluids. Immediately after IV placement, the patient suffered a syncopal event, followed by respiratory apnea. Defibrillator pads were placed, but no shock was advised. The flight was diverted to our level 1 academic teaching hospital. In the ED, the patient was intubated and taken for emergency CT of the head. GCS in the ED prior to intubation was 6 (positive Babinski and clonus on the left leg), and the patient experienced a seizure. Head CT demonstrated no mass effect or infarct. A few punctate low-density foci in the basal ganglia and occipital lobe "likely represent tiny fat or air emboli." Neurology ordered an MRI that demonstrated abnormal signal within the bilateral thalami, leptomeningeal enhancement, and punctate foci of diffusion abnormalities (right midbrain and cerebellar hemispheres).

Intervention

HBO_2 was consulted to consider hyperbaric oxygen treatment (HBO_2) for cerebral air embolism. Neurology considered the picture of seizures, sudden LOC after IV administration at altitude, and air on the non-contrast head CT as clinically consistent with cerebral air embolism. The patient underwent a US Navy Table 6 on day #1 and a Table 9 on day #2.

Outcome

The patient underwent a total of 2 HBO_2. Echocardiography on day# 2 demonstrated LVEF of 65% and intrapulmonary shunting with an agitated saline study. Patient underwent a repeat MRI on day #3 demonstrating progressive diffusion restriction edema throughout the posterior circulation (bilateral thalami, occipital lobes, brainstem, and cerebellar hemispheres), likely evolving infarcts. A CT demonstrated decreasing scattered punctate foci of air/fat in the left basal ganglia/occipital lobe and possible evolving PCA territory ischemia. Lumbar puncture ruled out meningioencephalitis. The patient was extubated on day #9. Seizures were controlled with antiepileptic medicines.

Discussion

This case represents a novel incident of cerebral air embolism that manifested on a commercial air flight in a person with unrecognized intrapulmonary shunting. Pneumocephalus can be found in barotrauma but also in other conditions.

B 55: Pneumatosis intestinalis treated with hyperbaric oxygen: Case report

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

Sward D

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Case Description

58 yo male, extensive and complicated past oncological history including: DLBCL with therapy consisting of CAR-T, allogenic stem cell transplant, R-CHOP, RICE, R-pola therapy, steroid therapy, radiation therapy all complicated by GVHD/colitis and thrombocytopenia (received Nplate). Returned to the clinic where pneumatosis intestinalis of the ascending and transverse colon was discovered on a CT abdomen/pelvis.

Pneumatosis intestinalis (PI) is the finding of gas within the bowel wall and is a rare disease of often unclear etiology. A wide range of severity appears related to the underlying etiology (increased intraluminal pressure, pulmonary disease, gas-forming bacteria, iatrogenic, etc). In this particular patient, steroid use plus GVHD synergy was thought to be the cause.

Intervention

Our patient received 12 HBO_2 sessions as an outpatient with complete resolution (dose 2.0 - 2.4 ATA x 120 min with all but two HBO_2 at 2.4 ATA).

Outcome

There were no complications. The pneumatosis intestinalis completely resolved on repeat CT imaging.

Discussion

We recommend consideration of hyperbaric oxygen therapy as a safe and effective intervention to treat pneumatosis intestinalis.

Reference:

- *Joseph D. Feuerstein, Nicole White, Tyler M. Berzin. Pneumatosis Intestinalis With a Focus on Hyperbaric Oxygen Therapy, Mayo Clinic Proceedings, Volume 89, Issue 5, 2014, Pages 697-703. These authors recommend a treatment algorithm as outlined below.*

B 56: Masseter Botulinum Toxin injection followed by sudden sensorineural hearing loss: An unusual case report

O: n/a
P: Monday, 6/2/2025, 4:00 PM - 5:30 PM
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Case Description
A 33-year-old female with a recent COVID infection experienced sudden right sensorineural hearing loss several hours after a Botox injection in the right masseter. She reported that she had four Botox injections into her right masseter area at that time, whereas three injections had been the norm previously. There were no associated symptoms of vertigo or pain.

She was immediately started on prednisone 60 mg/day for nine days.

Otology on day ten. She had influenza B the weekend prior. She completed the steroid without improvement. Other than numbness over the conchal bowl, the neurological exam was normal. The tympanic membranes were normal. Audiology showed a complete sensorineural hearing loss in the right ear, 0% discrimination, and only vibrotactile sensation at 100 dB. The left ear had normal hearing.

MRI of the Brain and internal auditory canal was unremarkable.

Intervention
40 Hyperbaric oxygen (HBO_2) treatments started on day 11, given Monday through Friday at 2.4 ATA (90 minutes at pressure, plus 2 10-minute air breaks).

Intratympanic (IT) steroids were started shortly thereafter.

Outcome
By HBO_2 treatment #23, she had a markedly improved audiogram with mild sensorineural hearing loss 250-500 Hz rising to borderline normal hearing 750-1000 Hz returning to normal hearing 2000-8000 Hz with a speech reception threshold (SRT) of 15dB and 100% word recognition. Interestingly, despite audiology findings, she did not note much improvement in her hearing.

After 40 treatments, she was subjectively much improved but not quite back to baseline. Follow-up audiology noted mild sensorineural hearing loss at 250-500 Hz and normal hearing from 750-8000 Hz with SRT of 10dB and 100%-word recognition similar to her unaffected ear.

Discussion
The subjective delay in improvement was likely related to auditory processing rather than a cochlear issue.
Although temporally related to the Botox injections, this may be a COVID or other viral complication.
Botulinum toxin can spread within hours following an injection. COVID-19 can cause sudden hearing loss weeks after acute infection. Both fit this case.

This is the first case report of sudden sensorineural hearing loss related to a botulinum toxin injection.

B 57: Hyperbaric oxygen therapy in sickle cell pain crisis

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Introduction/Background

We report on a pilot study of hyperbaric oxygen as a treatment for acute sickle cell pain crises, with the goal of decreasing hospital length of stay, narcotic requirement, and associated pain. Potential mechanisms by which hyperbaric oxygen could benefit such patients include reversal of sickling, alleviating ischemia, decreasing inflammation, and decreasing leukocyte adhesion.

Materials and Methods

- Eligibility criteria include females and males aged 19 years or older with sickle cell disease in an acute vaso-occlusive pain crisis. Exclusions include pregnancy and a sickle cell crisis complicated by any acute significant concomitant factors/conditions (e.g. acute chest syndrome, acute MI/stroke).
- Patients were recruited for enrolment if they had a prior admission for sickle cell pain crisis to provide a historical control.
- Depending on their response to the therapy, 1-3 hyperbaric oxygen treatments were done twice daily. Each session is 90 minutes plus air breaks and compression/decompression to 2.5 ATA. The minimum time between HBO_2 sessions is 4 hours. Evaluation is through patients' self-assessment via a 1-10 scale for pain level before and after treatments, as well as tracking narcotic dosing and length of stay in the hospital.
- The control is historical, looking back at each subject's prior admissions for sickle cell crisis.

Results

This is a preliminary analysis of the data from the ongoing study. We have treated six patients with HBO_2. The average length of stay for an admission was reduced from 100.4 hours to 54.9 hours with the addition of HBO_2 ($p=0.156$). The total analgesic utilized during the stay was reduced from 2112.4 to 1146.2 morphine milligram equivalents (MME) with the addition of HBO_2 (only 21.0 to 20.9 MME when adjusted for length of stay).

Summary/Conclusion

This is a preliminary analysis of our data, which demonstrates a reduction in the overall length of admission and total opioids required to ameliorate pain in sickle cell pain crisis by adding hyperbaric oxygen treatments to routine care. Should the trend we have seen so far persist, this will support moving forward with a randomized controlled trial.

B 58: Hyperbaric oxygen therapy (HBO_2) for management of Complex Regional Pain Syndrome (CRPS)

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Complex regional pain syndrome (CRPS) is characterized by severe, persistent pain and a variety of inflammatory and trophic symptoms. We reviewed the published literature to evaluate hyperbaric oxygen therapy (HBO_2)'s efficacy in treating CRPS, focusing on both sympathetically maintained pain (SMP) and sympathetically independent pain (SIP) subtypes: SMP patients improve after a sympathetic nerve block, while SIP patients do not or have pain persisting >12 months.

Materials and Methods

A literature search was conducted in PubMed Clinical Queries using the MeSH term "Complex Regional Pain Syndromes" or the keyword "CRPS" and "Hyperbaric Oxygen Therapy" or the keyword "HBO_2." The selected publication types included a randomized controlled trial, a retrospective observational study, a comparative study, a retrospective case series, and several case reports. The search was restricted to English between January 1994 and October 2024.

Results

Thirteen studies involving 276 subjects were reviewed. 37.7% of the patients were SMP, 52.9% were SIP, and 9.4% were undetermined. HBO_2 treatments ranged from 3 (in one patient) to 63 sessions, with an average of 33, typically using 2.4 ATA for 90 minutes. HBO_2 effectively alleviated or resolved symptoms across all CRPS subtypes: in 97% of 104 SMP patients, in 94.6% of 146 SIP, and for all 26 undetermined patients.

Summary/Conclusion

This review suggests HBO_2 may offer significant symptom relief, regardless of CRPS subtype or disease duration. HBO_2's anti-inflammatory and neuroplasticity-promoting properties make it a valuable non-invasive option for CRPS patients, potentially improving outcomes when combined with other modalities. Further research is necessary to refine patient selection and optimize treatment protocols.

B 59: Hyperbaric oxygen therapy as an adjunctive treatment for soft tissue healing: A systematic review of ligament and tendon injury outcomes

O: n/a

P: Monday, 6/2/2025, 4:00 PM - 5:30 PM

Camporesi E

University of South Florida Morsani College of Medicine, 560 Channelside Drive, Tampa, FL 33602
Presenting Author: Enrico Camporesi, MD, FUHM
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Introduction/Background

Soft tissue injuries affecting tendons and ligaments constitute over 50% of musculoskeletal consultations and significantly impact the quality of life. Hyperbaric Oxygen Therapy (HBO_2) is emerging as a potential non-invasive adjunct treatment due to its ability to enhance oxygen delivery to injured tissues and allow for accelerated healing. Despite various clinical and experimental applications, there is limited consistent evidence regarding its efficacy.

Materials and Methods

A systematic search following PRISMA guidelines was conducted across PubMed, Embase, and Cochrane Library up to May 2024. Inclusion criteria included experimental animal studies and clinical trials evaluating HBO_2 for ligament and tendon injuries. The interventions included HBO_2 alone or combined therapies. The efficacy was assessed across biomechanical strength, radiological findings, biochemical markers, and functional performance after treatment. The risk of bias was evaluated using the ROBINS-I tool.

Results

Thirteen studies (693 participants) met the inclusion criteria and were exposed to varied HBO_2 protocols (pressure: 1.3 to 2.8 ATA, duration: 60–120 minutes). Enhanced tensile strength, increased collagen synthesis, and better fiber alignment were consistently observed in HBO_2-treated groups compared to controls. HBO_2 combined with growth factors like Platelet-Derived Growth Factor-BB showed synergistic benefits. While immediate and short-term functional improvements were noted, the long-term effects yielded mixed results, particularly in complex injuries like ACL reconstructions.

Summary/Conclusion

HBO_2 may be a promising adjunctive approach for ligament and tendon injuries, improving tissue repair and biomechanical outcomes. However, the variability in study protocols and limited clinical trials highlight the need for standardized HBO_2 parameters and further research on long-term efficacy.

B 60: Case reports: Hyperbaric oxygen treatment in a girl with Guillain-Barre syndrome receiving mechanical ventilation

O: n/a

P: WITHDREW

B 61: Cerebral arterial gas embolism during watchman device implantation

O: n/a

P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

Moayedi S, Chew KW, Sethuraman K
Center for Hyperbaric Medicine, R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, Baltimore, MD, USA
Presenting Author: Siamak Moayedi MD
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Case Description

A 76-year-old man with a history of paroxysmal atrial fibrillation and gastrointestinal bleeding was undergoing a Watchman device left atrial appendage closure. Immediately after the atrial transseptal puncture and left atrial angiogram, the patient became hypotensive, and premature ventricular contractions and ST depressions were noted on the cardiac monitor. Air bubbles were noted in the side arm of the introducer sheath. The case was aborted and on emergence from anesthesia, the patient was not responsive, with a right gaze preference, right upper extremity myoclonic tremors, and not moving his left upper extremity. His NIH Stroke Scale score was 30. He was intubated for airway protection. A non-contrast computed tomography scan of the brain identified a “tiny focus of gas in the frontal lobe region.” The neuro-critical care team diagnosed cerebral arterial gas embolism (CAGE) and consulted our hyperbaric medicine service.

Intervention

The patient was transferred to our tertiary care center and underwent a U.S. Navy Treatment Table 6 hyperbaric oxygen therapy (HBO_2).

Outcome

Three weeks later, he opened his eyes to voice and answered simple questions with one-word responses. He spontaneously moved his right upper and lower extremities with persistent paralysis and contracture of his left upper extremity. He was transferred to a long-term rehabilitation facility.

Discussion

Watchman devices are implanted in patients with atrial fibrillation who have a contraindication to anticoagulation for the reduction of left atrial embolic events. The procedure involves perforation of the atrial septum and implantation of the device in the left atrium. CAGE during implantation of a Watchman device is a complication that hyperbaric medicine physicians should be aware of. This procedure is becoming more common, with over 26,000 Watchman devices implanted in the U.S. in 2019. Watchman device implantation has a near 1% risk of arterial gas embolism. The possibility of cerebral gas embolism should be considered in patients emerging from anesthesia with neurologic deficits. CAGE is a clinical diagnosis and should not depend on the visualization of air on imaging. When logistically available, HBO_2 therapy should be initiated promptly to ensure the best possible patient outcomes.

B 62: Hyperbaric oxygen therapy for limb preservation in a severe necrotizing soft tissue infection

O: n/a
P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM
McGlynn JJ, Orwig DM
Corewell Health Hyperbaric Medicine, 330 Barclay Ave NE, Grand Rapids, MI 49503
Presenting Author: John McGlynn, MD
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Case Description
The patient is a 62-year-old man with type 2 diabetes, morbid obesity, and bilateral lower extremity lymphedema. He developed a necrotizing soft tissue infection (NSTI) of the right lower leg. He was treated with appropriate antibiotics. The lower leg was circumferentially debrided in the operating room. Initially, his lower leg was not thought to be salvageable due to the amount of necrotic tissue. His surgical team was recommending below-knee amputation.

Intervention
In an attempt to salvage the limb, the patient agreed to a course of HBO_2 to supplement surgical debridements, circumferential negative pressure wound therapy, and antibiotics.

Outcome
Tissue quality improved with HBO_2 and NPWT. Granulation and neoepithelialization resulted. Amputation was avoided, and the patient underwent successful split-thickness skin grafting.

Discussion
NSTIs are a group of infections with high associated morbidity and mortality. Standard management of NSTIs includes surgical debridement and antibiotics. NSTIs carry a high mortality rate, even when treated appropriately. Evidence of variable quality supports the use of hyperbaric oxygen therapy (HBO_2) for NSTI. In a 2021 meta-analysis by Hedetoft et al., data from over 48,000 patients were analyzed. Improvements in mortality and the rate of major amputation were noted in those who received HBO_2. There are multiple possible mechanisms by which HBO2 augments the treatment of NSTI. HBO_2 stimulates endogenous production of anti-inflammatory cytokines and antioxidant defense, which has been shown to decrease mortality in sepsis. HBO_2 can enhance oxygen-dependent antibiotic transport across bacterial cell walls. HBO_2 also mitigates post-inflammatory leukocyte dysfunction in tissue subjected to infection or hypoxia. More high-quality research is needed to define the benefit of this treatment modality clearly.

B 63: A comparative study of management of wound with hyperbaric oxygen therapy along with ionic silver dressings alone in burn and plastic surgery department AIIMS Rishikesh

O: n/a

P: WITHDREW

B 64: Hyperbaric oxygen combined with multidisciplinary cooperation in the treatment of a difficult-to-heal wound of the foot in a diabetic patient

O: n/a

P: WITHDREW

B 65: Five years follow-up of radiation-induced cystitis treated with hyperbaric oxygen therapy

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

Oscarsson N[1], Rosén A[1], Kjellberg A[2], Müller B[3], Giglio D[4], Koskela LR[5], Ettala O[6], Seeman-Lodding H[1]
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Presenting Author: Nicklas Oscarsson
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Background
Chronic radiation-induced cystitis affects 5-10% of patients treated with pelvic radiotherapy, causing hematuria, urgency, frequency, and dysuria, significantly impacting quality of life. Hyperbaric oxygen therapy (HBO_2) provides symptom relief, but evidence on its long-term efficacy remains limited. This report presents the 5-year follow-up of the RICH-ART trial, evaluating the durability of HBO_2's therapeutic effects.

Materials and Methods
RICH-ART (Clinicaltrials.gov NCT01659723) was a multicenter, open-label, crossover trial in which patients were randomized to HBO_2 (30-40 sessions) or standard care (control group), with the control group crossing over to HBO_2 after six months. Symptom relief was assessed using the Expanded Prostate Cancer Index Composite (EPIC) six months post-HBO_2 and annually for five years. Of 79 patients completing the initial study, 70 (mean age 63.8 years [SD 12.7]) were included in this follow-up.

Results
The mean EPIC urinary total score improved from 46.6 (SD 18.4) pre- HBO_2 to 64.6 (SD 24.1) at six months and remained stable at 67.7 (SD 22.7) at five years. Responders (n=48), defined as those with a ≥9-point EPIC score increase post- HBO_2, maintained improvement, with a mean increase of 21.2 (95% CI 12.8-29.6) at five years. Non-responders (n=22) had stable urinary scores over time (43.5 [SD 15.6] pre- HBO_2; 54.1 [SD 26.6] at year five). Five non-responders (22.7%) had a delayed response, showing sustained improvement (>9-point increase) at year one. Nine patients (12.8%) required additional HBO_2 for recurrent symptoms.

Conclusion
These findings support the long-term efficacy of HBO_2 for chronic radiation-induced cystitis, with sustained symptom relief over five years. HBO_2 remains a key therapeutic option for managing late radiation-induced injuries. Further studies should explore optimal treatment protocols, predictive biomarkers, and economic implications.

TUESDAY, JUNE 3

Centennial Ballroom

8am-4pm	**Registration Open**
8:30am-9am	**Announcements**
9am-10:15am	**Eugen Reinartz Memorial Lecture: Commercial Space, Human Spaceflight, the I.S.S. and the U.S. Return to the Moon: Mark N. Sirangelo, PhD**

About the Lecture:
Mark Sirangelo is an early entrepreneurial pioneer of the commercial space industry, a founding member of the Commercial Spaceflight Federation and whose companies have participated in over 300 space missions. He will take us on a fascinating illustrated journey through the past three decades of commercial space, speak to where the industry and state of the art is today and present his personal views of the future of commercial human travel to low earth orbit, the Moon and Mars.

The talk will bring us back to the first commercial efforts to create a commercial human space vehicle, through the inaugural winning X-prize human spaceship and continuing to the development of the Dream Chaser and other commercial space vehicles as replacements for the Shuttle. The discussion will continue on through to discuss the International Space Station, NASA and industry's developing efforts to bring the next generation of humans to live in space, on the Moon and journey to Mars. Also discussed will be the "facts" of the human, medical and safety engineering involved in providing safer transportation and living habitats and as well as thoughts and amusing critique on the "fictions" that may prevail in popular thinking, media and culture regarding space and space travel.

About the Speaker:
Dr. Mark N. Sirangelo is the Aerospace and Engineering Scholar in Residence at the University of Colorado while also being a current member of NASA's Aerospace Safety Advisory Panel (ASAP). He was the founding executive and head of Sierra Nevada Space Systems and its successor SpaceDev.

Over a 25-year aerospace, space and technical career, he has led teams which have successfully managed billions of dollars of programs for over 300 space and aerospace missions to seven planets, the sun, moon, asteroids and around earth.

He is a past Chairman of the Commercial Spaceflight Federation and is a Fellow of the American Institute of Aeronautics and Astronautics. As part of his government service, he was the most recent past Chairman of the U.S. Department of Defense's Defense Innovation Board, served as the Chief Innovation Officer of Colorado and also completed an assignment as Special Assistant to the NASA Administrator helping to design the Artemis program.

Dr. Sirangelo and his organizations have been recognized with numerous corporate awards. These include being inducted into the Space Foundation's Technology Hall of Fame, the World's Top 10 Innovative Space Companies by Fast Company, Inc. Magazine's top 200 companies, Defense Industry's Fast Track 50 amongst many others. He is a long-term licensed pilot, holds Bachelor of Science, Master in Business Administration, and Doctorate level degrees while also have served his country proudly as a U.S. Army officer.

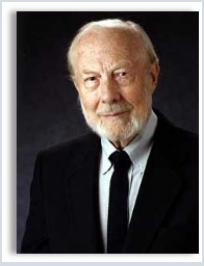
10:15am-10:45am	**Exhibits / Break: Grand Ballroom West**
10:45am-12pm	**UHMS Christian J. Lambertsen Memorial Lecture: Last Breath - Reasoning with life and death at the bottom of the North Sea. - Chris Lemons**

About the Lecture:
Chris will talk about the lead up to that fateful day in 2012 and give you a very personal account of his thoughts and actions when he was left stranded 300 feet down in the icy darkness with no heat, no light and only 5 minutes of gas left to breathe, with his rescuers over 40 minutes away from being able to get to him.

About Speaker:
Chris has been a commercial diver and Supervisor for over 18 years, and currently specializes in deep sea saturation diving, operating almost exclusively in the oil and gas industry.
This highly specialized form of diving involves living in the claustrophobic confines of a decompression chamber for up to 28 days at a time, commuting daily to the seabed in a diving bell, and working at depths of up to 900 feet for 6 hours at a time.

In September of 2012, a freak failure of the dynamic positioning system of the vessel he was working under, resulted in the umbilical which provides him with breathing gas, light and heat being severed completely. He was left on the seabed, in complete darkness 300 feet below the surface, with only the 5 minutes of breathing gas he carried in the emergency tanks on his back, and no way to protect himself from the freezing temperatures.
It took his heroic rescuers over 40 minutes to come back and fetch him, and his miraculous survival story has baffled experts ever since.

His extraordinary story was subsequently immortalized in the hit Netflix/BBC documentary 'Last Breath,' a version of which has been developed into a Hollywood movie starring Woody Harrelson, Simu Liu and Finn Cole and is due for release on the 28th of February 2025.
Chris was born in Edinburgh, raised in Cambridge, and now lives in the South of France with his partner and two daughters.



ABOUT CHRISTIAN J. LAMBERTSEN, MD, DSc (Hon)
Dr. Christian J. Lambertsen received a B.S. Degree from Rutgers University in 1938 and a M.D. Degree from the University of Pennsylvania in 1943. During his medical school period, he invented and first used forms of the initial U.S. self-contained closed-circuit oxygen rebreathing apparatus, for neutral buoyancy underwater swimming and diving. As a student, he aided the early Office of Strategic Services (O.S.S.) in establishing the first cadres of U.S. military operational combat swimmers. Dr. Lambertsen became a U.S. Army medical officer on graduation from medical school in early 1943, and immediately joined the O.S.S. Maritime Unit on active duty through its period of function in World War II. He joined the University of Pennsylvania Medical Faculty in 1946 and became Professor of Pharmacology in 1952. While a faculty member he combined diving research and further underwater rebreathing equipment developments for the Army and Navy. In 1967 he served as Founding President of the Undersea Medical Society (now Undersea and Hyperbaric Medical Society.) Dr. Lambertsen is recognized by the Naval Special Warfare community as "The Father of U.S. Combat Swimming." His hand has touched every aspect of military and commercial diving. Dr. Lambertsen's active contributions to diving began during WWII and became even more progressive in the post-war period through the evolutions of the U.S. Navy Deep Submergence and Naval Special Warfare developmental programs.

12pm-2pm **Lunch (On Own), Special Luncheons and Meetings**

UHMS Track: Regency VI

Session C - Decompression Theory and Mechanisms

2pm-2:30pm **Plenary: Shunted venous bubbles: an update on behavior and pathogenicity: Simon Mitchell, PhD**

About the Lecture:
A pivotal role for shunted venous bubbles in the pathophysiology of cerebral, inner ear, spinal, and cutaneous decompression sickness (DCS) has been indicated by at least 12 studies that associate one or more of these forms of DCS with a right-to-left shunt such as a patent foramen ovale. This is fascinating because these bubbles are tiny and recent studies show they are rapidly involuting under arterial conditions. How, then, might they cause these forms of DCS? This presentation will review the pathogenicity of small, venous bubbles shunted right-to-left early after a dive and will put

the pathogenic mechanisms into context with proposals that other potentially harmful processes like inflammation and microparticle production are important.

About the Speaker:
Simon is an anesthesiologist and diving physician. As a technical diver he was a member of teams that were first to dive and identify three historically significant deep shipwrecks in Australia and New Zealand, including one in 2002 which was the deepest wreck dive undertaken worldwide at the time. He was conferred Fellowship of the Explorers' Club of New York in 2006 and was the DAN Rolex Diver of the Year in 2015. In February 2023 he was a member of the Wet Mules expedition to the Pearse Resurgence cave in New Zealand where a 230 m dive was conducted using hydrogen as a breathing gas on a deep dive for the first time in over 30 years.

2:30pm-2:40pm	**C66:** Decompression to altitude and from high pressure – a common mechanism for microparticle production and putative site for bubble nucleation. Presenting Author: Stephen R. Thom, MD, PhD
2:40pm-2:50pm	**C67:** Neutrophil transcriptomic responses to hyperbaric stress using a human lung-on-a-chip model. Presenting Author: Abigail G. Harrell, MS
2:50pm-3pm	**C68:** Real-Time automated detection of venous gas emboli: Prospective evaluation of a deep learning pipeline after hyperbaric chamber dives. Presenting Author: Arian Azarang, PhD
3pm-3:30pm	**Plenary: *Engineering the academic pipeline for undersea medicine: A global strategy for next-gen STEM workforce development*: Virginie Papadopoulou, PhD**

About the Lecture:
As research in undersea medicine and human performance faces critical attrition, building a resilient and globally connected academic pipeline is more urgent than ever. This talk presents a global strategy to inspire, train, and retain the next generation of scientists in the field. Drawing on lessons from recent Navy-funded STEM initiatives, the launch of the new UHMS STEM Committee, and international academic partnerships, we explore how immersive educational models can help engineer a sustainable Science, Technology, Engineering, and Medicine (STEM) research pipeline that integrates physiology, imaging, and performance science for extreme environments.

About the Speaker:
Dr. Papadopoulou is an Associate Professor in the Department of Radiology and Lampe Joint Department of Biomedical Engineering at the University of North Carolina at Chapel Hill and heads the ENHANCE laboratory (Est. 2024). Her research revolves around ultrasound and microbubbles, their detection and gas physiology modulation in vivo, and their applications in addressing today's needs in biomedical disease and human performance applications.

A physicist by background, "Virginia" received her PhD in Bioengineering in 2016 from Imperial College London in Prof. Mengxing Tang's ultrasound laboratory, concurrently training in the pathophysiology of decompression under a European Union Marie Curie fellowship. She joined UNC Chapel Hill as a postdoc in Prof. Paul Dayton's laboratory in 2016, where she stayed as Research Faculty and eventually Research Director until 2024, before joining Radiology and Biomedical Engineering as an Associate Professor in 2024. Her team's work refining the ultrasonic assessment of decompression bubbles is internationally recognized, with distinctions including the 2017 DAN/Bill Hamilton Memorial Award from the Women Divers Hall of Fame, the 2020 Undersea and Hyperbaric Medicine Society (UHMS) Young Scientist Award, the title of Divers Alert Network Scholar since 2018, as well as the UHMS President's Award for Best Presentation in 2023 and in 2024. Dr. Papadopoulou was also the recipient of the 2022 University of North Carolina Women's Leadership Council "Faculty to Undergraduate Mentoring Award". Most recently, she served on the National Academies 2024 Workshop Committee "Emerging Technology to Address Naval Undersea Medicine Needs".

3:30pm-4pm **Exhibits / Break: Grand Ballroom West**

Session D - Diving Medicine

4pm-4:30pm **Plenary: Session D: What can blood biomarkers tell us about scuba divers and free divers. Padova's experience and beyond: Tommaso Antonio Giacon, MD**

About the Lecture:
Summary, rationale and further perspective of blood analysis on scuba divers and freedivers. Starting from our direct experience in Padova, including most of the relevant research on this specific topic.

About the Speaker:
Anesthesia resident with interest in human physiology and extreme environments. Master's degree in Diving and Hyperbaric Medicine at the University of Padova (ITA). From then active part of the research group directed by Prof Gerardo Bosco. Recently been in New Zealand under the supervision of Prof Simon Mitchell for a clinical and research period. Outdoor lover, ultrarunner, cyclist, sailor and skier.

4:30pm-4:40pm **D74:** Effect of pre-dive ketone food products on hyperoxic hyperpnea and CNSOT. Presenting Author: Kyle Steinbock, BS

4:40pm-4:50pm **D75**: Whole-body nitrogen elimination after diving using an open-circuit indirect measurement method. Presenting Author: Sven De Ridder

4:50pm-5pm **D76:** Central nervous system oxygen toxicity and core temperature responses to HBO_2 during immersion with hypercapnic O_2 at 3 ATA and pure O_2 at 5 ATA in rats. Presenting Author: Courtney Wheelock, PhD

5pm-5:30pm **Plenary: UHM Fellows: Top articles in Undersea Medicine: Jayanth Adusumalli, MBBS, MPH**

About the Lecture
Review top articles in undersea medicine published over the past 1 year
This serves to help update physicians in undersea medicine on various clinically relevant topics and may change the way they practice.

About the Speaker
Duke Undersea and Hyperbaric Medicine Fellow

Session C – Decompression Theory and Mechanisms
ABSTRACTS

C 66: Decompression to altitude and from high pressure: A common mechanism for microparticle production and putative site for bubble nucleation

O: Tuesday, 6/3/2025, 2:30 PM - 2:40 PM
P: n/a
Thom SR, Arya AK, Imtiyaz Z, Bhat AR
University of Maryland School of Medicine
Presenting Author: Stephen R. Thom, MD, PhD
E: sthom@som.umaryland.edu

Introduction/Background
Blood-borne microparticles (MPs) that damage tissues are increased in humans due to altitude decompression and on returning to ambient pressure after high-pressure exposures. We hypothesize that both stresses generate MPs with a gas nucleation site due to neutrophil myeloperoxidase (MPO) activity, hypochlorous acid, and secondary production of volatile chloramines (e.g., NH2Cl, NHCl2 & NCl3). Chloramine expansion during decompression activates piezo channels due to the 2-dimensional membrane distortion, which elicits MPs generation. Chloramines within MPs are a gas nucleation site for bubble formation on decompression.

Materials and Methods
Neutrophils from 7 healthy subjects were subjected for 30 minutes to decompression to an altitude equivalent to 37,870 ft (0.21 ATA) or to 100 psi nitrogen (N2) pressure, followed by decompression. Flow cytometry quantified MPs production and cell activation. Mechanisms were evaluated by comparing results in the presence and absence of 1 µM AZD4831 (MPO inhibitor), 1 mM taurine (NH2Cl scavenger), or 500 nM GsMTx4 (Piezo1 inhibitor). Chloramines in MPs were quantified by fluorescence assay, and gas nucleation site was assessed as MPs volume changes caused by exposure to 100 psi hydrostatic (to decrease MPs size) or N2 pressure (to increase size).

Results
Compared to neutrophils incubated at ambient pressure (control), cells subjected to altitude generated 6.6 +/- 1.5-fold (SD, n=7, pution of pure O2 vs air in altitude studies had no significant effect, thus the stress was not due to hypoxia. Decompression-induced MPs contain ~ 0.28+/-0.08 µmol chloramine/50,000 MPs (vs control 0.08+/-0.1; phigher vs control following altitude and 4.6 +/- 1.4-fold (MPO) and 5.2 +/- 3.4-fold (CD18) for N2 pressure/decompression (all pe changes and neutrophil activation.

Summary/Conclusion
This study provides a biochemical mechanism and the first documentation of a gas nucleation site in human MPs samples due to decompression.

C 67: Neutrophil transcriptomic responses to hyperbaric stress using a human lung-on-a-chip model

O: Tuesday, 6/3/2025, 2:40 PM - 2:50 PM
P: n/a

Harrell AH, Konigsberg IR, Davidson EJ, Yang IV, Thom SR, Shields CW
University of Colorado Boulder. 3415 Colorado Ave, Boulder, CO. 80303
Presenting Author: Abigail G. Harrell (M.S. Chemical Engineering)
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Introduction/Background

Despite major strides in recent years, the etiology of decompression sickness (DCS) is still not fully understood. Prior studies implicate microparticles derived from innate immune cells, suggesting a link between DCS and immune cell activation. Most studies investigating these immune cell responses use human and mouse models, which provide limited replicates and species variability, respectively. However, traditional human in vitro models fail to include critical physiological components that may drive DCS progression. Our prior work proposed a human lung-on-a-chip model to study immune cell responses to dissolved gases and pressurization. We have since expanded on this work by assessing neutrophil genetic responses under these conditions, as immune cells can exhibit similar phenotypic responses through differing genetic mechanisms.

Materials and Methods

Human blood samples extracted from healthy donors were infused into two-channel lung-on-a-chip devices, exposed to alveolar gas mixtures, and pressurized to 1.0 or 3.5 atm for one hour, followed by decompression at a fixed rate. Transcriptomic responses were assessed using RNA-seq and qPCR to determine differentially expressed genes of neutrophils extracted from whole blood.

Results

Our new results indicate a significant immune response occurs at 3.5 atm compared to 1.0 atm controls in the lung-on-a-chip model. For the 3.5 atm condition, 48 differentially expressed genes were observed compared to the 1.0 atm control. We identified three enriched pathways, including increased transmembrane protein receptor tyrosine phosphatase activity. Specifically, we observed increased expression of proinflammatory genes (e.g., NOS2 and C4B_2). This is further exemplified by elevated expression of proinflammatory phenotypic markers (e.g., CD41a and iNOS). Additionally, we observed differentially expressed genes across multiple individuals to assess interindividual variability using qPCR. We observed upregulation of CXCL1, a chemokine involved in neutrophil attraction, across individuals, which could serve as a future target to mitigate DCS.

Summary/Conclusion

This work suggests that innate immune cell responses may be involved in DCS etiology. We identified inflammatory responses by analyzing neutrophil phenotypes and genetic mechanisms. These findings have implications for identifying high-risk individuals and mitigating DCS. In future work, we will observe alveolar macrophage responses to increased pressure and dissolved gases in a co-culture model.

C 68: Real-time automated detection of venous gas emboli: prospective evaluation of a deep learning pipeline after hyperbaric chamber dives

O: Tuesday, 6/3/2025, 2:50 PM - 3:00 PM
P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

Azarang A[1], Currens JB[1,2], Eltz K[1,2], Natoli MJ[3], Lance RM[3], Tillmans F[1,4], Moon RE[3], Papadopoulou V[1,2]
[1]Department of Radiology, The University of North Carolina at Chapel Hill, NC, USA; [2]Lampe Joint Department of Biomedical Engineering, The University of North Carolina at Chapel Hill and North Carolina State University, NC, USA; [3]Center for Hyperbaric Medicine and Environmental Physiology, Department of Anesthesiology, Duke University School of Medicine, Durham, NC, USA; [4]Divers Alert Network, Durham, NC, USA
Presenting Author: Arian Azarang, PhD
E: arian_azarang@med.unc.edu

Introduction/Background

Venous gas emboli (VGE) detected via transthoracic echocardiography are widely used in diving physiology research and for validating new decompression procedures. Our team previously demonstrated that deep learning can automate VGE detection using 196 de-identified echocardiography videos. We then adapted our models for real-time implementation and transitioned to prospective evaluation after hyperbaric chamber and open-water dives. After adjusting our frame detection processing step based on initial findings, we present the first evaluation of our revised real-time processing pipeline.

Materials and Methods

A graphical user interface (GUI) compatible with most clinical scanners was developed for real-time echocardiography capture and automated continuous VGE detection. The complete pipeline was tested in five research participants completing a dry chamber dive to 132 fsw for 20 minutes, followed by decompression. Transthoracic echocardiography was acquired pre-dive at rest (baseline) and every 20 minutes post-dive for at least two hours at Rest and after leg movement (Flex). Real-time automated evaluation was performed, and recordings were saved for expert grading on the Eftedal-Brubakk (EB) scale. AI-generated VGE counts were calculated as the average from all late ventricular diastole frames and compared to human EB grades using receiver operator characteristic (ROC) analysis after binarizing EB grades to low (0–2) and high (3–5).

Results

With one exception (4.54, attributed to lower image quality), pre-dive counts (false-positive bias) ranged from 0.44–1.06 VGE. Automated VGE detection achieved excellent low vs. high classification with an area-under-the-curve (AUC) of 0.87, sensitivity of 0.83, and specificity of 0.88 using a 1.26 bias-adjusted threshold. Separately, low vs. high EB classification on Rest acquisitions outperformed Flex recordings (AUC 0.98 vs. 0.80).

Summary/Conclusion

This study presents the first prospective evaluation of real-time VGE processing and its ability to classify EB grades. Results demonstrate excellent ROC performance and suggest that separate classification thresholds or baseline bias adjustments may be warranted for Rest and Flex acquisitions. Future work will explore whether accounting for temporal VGE variations at the frame level could further improve performance at the video level.

C 69: AI-based VGE grading using over 10,000 Doppler recordings is on par with inter-rater human agreement

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

Azarang A[1], Blogg SL[2,3], Tillmans F[3,6], Lance RM[4], Moon RE[4], Lindholm P[5], Papadopoulou V[1,6]*
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Introduction/Background

Our recent work demonstrated that deep learning can effectively classify venous gas emboli (VGE) grades in Doppler Ultrasound (DU) recordings, achieving success using 274 previously acquired recordings. Building on this foundation, the present study leverages an expanded real-world dataset and synthetic data to explore advanced network strategies. These advancements aim to improve performance further and bridge the gap toward real-world implementation.

Materials and Methods

We combined non-diving human DU recordings with laboratory-measured bubbles to generate synthetic data with ground truth Spencer grades. Additionally, we compiled the largest-to-date repository of post-dive DU recordings, a collection of 10,086 individual audio files. We developed deep learning models based on both raw waveform (1-D) and log-scale Mel-spectrogram (2-D) representations, using a training/validation/test split of 7:1:2. Model performance was thoroughly assessed through average ordinal accuracy (α) for 5-class Spencer grade classification, weighted kappa coefficients (κ) to benchmark against human inter-rater agreement, and sensitivity/specificity for binary classifications: no vs. any VGE (0 vs. 1–4 Spencer grades) and low vs. high VGE (0–2 vs. 3–4 grades).

Results

The highest performance on real-world data was achieved by the 2-D model, with an average ordinal accuracy (α) of 78.5% and a weighted kappa (κ) of 0.65 for precordial recordings, and $\alpha = 79.7\%$ with $\kappa = 0.67$ for subclavian recordings. For the classification of low vs. high VGE in subclavian recordings, the model attained a sensitivity of 96% and a specificity of 68.6%. In precordial recordings, the model distinguished between no VGE and any VGE with a sensitivity of 80.9% and specificity of 72.7%.

Summary/Conclusion

The 2-D model outperformed all other tested approaches, achieving performance comparable to human inter-rater agreement. Our dataset of 10,086 pre-acquired DU recordings is the largest to date, three orders of magnitude larger than those previously used for automated DU grading, enhancing the generalizability of our findings. Future work may further optimize performance by refining models separately for recordings obtained at rest versus those acquired after movement.

C 70: Modeling the mechanics of decompression bubble growth and resolution in the spinal cord under hyperbaric and hypobaric conditions

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Spinal cord decompression sickness (SC-DCS) is one of the most severe forms of decompression illness. The formation and growth of an inert gas bubble in the spinal cord tissue causes it. To understand how the gas bubble damages the surrounding tissue, we have to consider two physical mechanisms: gas diffusion, mechanical deformation, and tearing of the tissue. We have built a multiphysics finite element model of the thoracic spinal cord that simulates these processes and compares it to MRI measurements on ex vivo bovine spinal cords.

Materials and Methods

A segmented mesh model of the spinal cord with separate domains for the gray and white matter was built from high-resolution MRI image stacks. Individual images of small nitrogen bubbles in bovine ex vivo spinal cord tissues were inserted into the model and imported into COMSOL. There, the underlying physics, gas diffusion, and structural mechanics with a hyperelastic constitutive model for the tissue were implemented as a set of coupled differential equations. Material parameters for the tissues were obtained from mechanical measurements on bovine spinal cords. The growth and resolution of the gas bubbles during decompression and compression were simulated to yield the sizes of the gas bubbles and the stress and strain in the surrounding tissue as a function of time under different conditions.

Results

Upon decompression, we observe a rapid expansion of the seed bubble, followed by slower growth through gas diffusion into the bubble. The elasticity of the surrounding tissue contributes significantly to the gas pressure inside the bubble. The mechanical stress in the tissue adjacent to the bubble is largely determined by the absolute drop in pressure and, therefore, is much higher in hyperbaric exposure scenarios than in hypobaric ones. Hyperbaric exposure can easily exceed the yield stress of nerve tissues, whereas hypobaric exposures may not.

Summary/Conclusion

We have used a finite-element model to study the mechanical effects of a growing gas bubble in the spinal cord on the surrounding tissue. We find that the yield stress is often exceeded in hyperbaric cases, leading to tissue tearing, whereas the stresses are much lower in hypobaric exposure.

C 71: Technical validation of a custom MATLAB interface for higher throughput analysis of ultrasound-based cardiac output estimation with relevance to inert gas loading

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

Grant D[1,2], Currens JB[1,2], Leypoldt J[3], Coombs M[3], Tillmans F[1,3], Papadopoulou V[1,2]

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Introduction/Background

Venous gas emboli can be measured with transthoracic echocardiography post-dive as a marker of decompression stress and may be related to cardiac output (CO). CO is estimated by the heart rate, left-ventricular outflow tract diameter, and time velocity integral (VTI). VTI is measured from pulse wave images by tracing a waveform to measure the area underneath, representing the blood velocity for one heart cycle.

1,624 pulse wave Doppler scans of the aortic valve were taken and stored on a clinical ultrasound system as part of an IRB-approved longitudinal human diver study. A custom MATLAB graphical user interface (GUI) was developed to measure VTI offline, and a novice reviewer and an experienced sonographer validated the workflow.

Materials and Methods

A subset of 81 files (11 unique participants) was selected for validation. The novice reviewer measured VTI from the same waveform on the clinical ultrasound system and custom GUI for the entire validation dataset. The sonographer measured VTI on 15 files (ten subjects) using both systems in random order for each file. Agreement between the two reviewers and the two separate systems was estimated using Bland-Altman bias (b) and 95% limits of agreement (l), Pearson correlation (p_1, R_1) or Spearman's correlation coefficient (p_2, R_2), and TOST equivalence testing (p_3, R_3).

Results

For the novice reviewer, there was a high correlation between both systems for VTI measurements ($p_2<0.01$, $R_2=0.9863$; b=-0.230 cm/stroke, l=[-1.35,0.892] cm/stroke) and CO calculations ($p_1<0.01$, $R_1=0.9937$; b=-0.065 L/min, l=[-0.432,0.302] L/min). The same was found for the sonographer using both systems for VTI measurements ($p_1<0.01$, $R_1=0.9450$; b=0.302 cm, l=[-2.60,3.21] cm/stroke) and CO calculations ($p_1<0.01$, $R_1=0.9395$; b=0.038 L/min, l=[-0.784,0.860] L/min).

The novice reviewer (using the custom GUI) and the experienced sonographer (using the clinical system) had good correlation and similar values for both VTI measurements ($p_1<0.01$, $R_1=0.9504$; $p_3<0.01$, $R_3=0.955$; b=0.913 cm/stroke, l=[-1.65,3.47] cm/stroke) and CO calculations ($p_1<0.01$, $R_1=0.912$; $p_3<0.01$, $R_3=0.996$; b=0.275 L/min, l=[-0.633,1.18] L/min).

Summary/Conclusion

This study confirms that the novice reviewer on the custom MATLAB GUI can achieve similar performance for VTI measurements and CO calculations as the experienced sonographer on the clinical system.

C 72: Decompression sickness scenarios suggested by cluster analysis of 765 cases of DCS recorded in commercial diving

O: n/a

P: WITHDREW

C 73: Use of in-water recompression for decompression illness after breath-hold diving: A case series

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

There have been increasing anecdotal reports of in-water recompression (IWR) in breath-hold divers who surface with neurologic symptoms consistent with decompression illness. Given the remote locations where many cases occurred, divers often struggled to access medical care, including hyperbaric chamber treatment, with many self-administering in-water recompression (IWR). IWR guidelines have only been discussed for SCUBA divers in specific scenarios, with consensus protocols going to shallow depths of 9 meters for around 1-3 hours.

Materials and Methods

We conducted detailed interviews with six competitive freedivers on signs, symptoms, management, and resolution of 12 incidences of suspected decompression illness. The diagnosis was presumed based on evidence of pulmonary barotrauma or the presence of spinal or cerebral symptoms. With consent, a review of medical documentation was also performed.

Results

Six male divers described 12 cases with neurologic symptoms that were consistent with decompression illness. Five cases were suggestive of decompression sickness, six were consistent with arterial gas embolism, and one was ambiguous. All reported incidents involved male divers with a mean age of 45 and diving experience of 16.5 years. Suspected causes included dehydration, lung packing, exhaustion, frequent deep dives, and lung barotrauma. Six cases were treated with IWR for 20-90 min at 5-25 meters with partial to complete resolution of symptoms. Three cases reported persistent symptoms after IWR. Four cases received subsequent treatment with hyperbaric oxygen, with one diver reporting significant permanent deficits. Divers made several regimen changes to mitigate risks, including staying well-hydrated, reducing packing, or slowing their ascent. Many have adopted the use of surface oxygen and/or oxygen at around 5 meters depth when diving near their maximum depth.

Summary/Conclusion

We present 12 cases of decompression illness in male breath-hold divers. Most incidents were in remote locations with no access to hyperbaric chambers. Many divers self-administered IWR for their symptoms, either as a bridge to hyperbaric oxygen therapy or as a standalone remedy, with varying improvement in symptoms. There was no consensus on depth or treatment duration among the cases. IWR is being utilized in the breath-hold diving community, and more research is needed to reach a consensus on treatment indications, depth, and duration.

C 133: The effect of hyperbaric oxygen therapy (HBO_2) for treating posttraumatic stress disorder (PTSD)

O: n/a
P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM
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Introduction/Background
Post-Traumatic Stress Disorder (PTSD) is a chronic and disabling condition that affects individuals across diverse populations. Despite available treatments, many individuals with PTSD experience incomplete relief from symptoms. Hyperbaric Oxygen Therapy (HBO_2), a treatment traditionally used for wound healing and decompression sickness, has recently gained attention as a potential adjunctive therapy for neuropsychiatric conditions. This meta-analysis evaluates the effectiveness of HBOT in reducing PTSD symptoms and comorbid anxiety across a range of populations and study designs.

Materials and Methods
A systematic search was conducted through PsycINFO and Google Scholar to identify peer-reviewed studies investigating HBOT's effects on PTSD. Ten studies met inclusion criteria, requiring the use of HBO_2 as a treatment component and reporting quantitative PTSD symptom outcomes. Effect sizes (Cohen's d) were calculated using pretest–posttest means and standard deviations. A fixed-effect model was used to determine net effect sizes for PTSD and anxiety outcomes. HBO_2 involves placing patients in a pressurized chamber breathing 100% oxygen, followed by a return to 21% oxygen at normal atmospheric pressure. This transition triggers a "hyperoxic-hypoxic paradox," stimulating the brain's natural healing and repair mechanisms.

Results
Across the ten studies analyzed, HBOT demonstrated a strong effect size for reducing PTSD symptoms ($d = 0.71$), indicating a substantial improvement in symptom severity following treatment. Additionally, HBO_2 showed a moderate effect size for reducing anxiety symptoms ($d = 0.55$), suggesting broader applicability for co-occurring conditions. Variations in treatment protocols, number of sessions, and oxygen pressure levels were observed, but most studies reported clinically meaningful symptom reduction.

Summary/Conclusion
Findings from this meta-analysis suggest that HBO_2 is an effective treatment for reducing symptoms of PTSD, with moderate secondary benefits for anxiety. These results support further clinical investigation and consideration of HBO_2 as an adjunctive therapy for trauma-related disorders. While more standardized and large-scale clinical trials are needed, current evidence positions HBO_2 as a promising intervention for improving outcomes in individuals with PTSD.

Session D – Diving Medicine
ABSTRACTS

D 74: Effect of pre-dive ketone food products on hyperoxic hyperpnea and CNSOT

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

Steinbock K, Taber K, Drake A, Escobar R, Adusumalli J, Wang J, Ni S, Natoli MJ, D'Agostino DP, Lauer L, Gregory TJ, Kuchibhatla M, Gordee A, Ellis MC, Makowski M, Luedke M, Posada-Quintero HF, Chon KH, Vrijdag X, Freiberger JJ, Gasier H, Derrick BJ

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Introduction/Background

Central Nervous System Oxygen Toxicity (CNSOT) can cause autonomic dysfunction and seizure, which can be fatal underwater. Hyperoxic hyperpnea may be an indicator of impending CNSOT as seen in prior animal studies. We attempt to investigate the role of respiratory parameters as a preceding indicator of CNSOT as a subset analysis of a larger human study.

Materials and Methods

As part of a randomized, controlled, double-blind study investigating the effect of pre-dive ketones on latency to CNSOT, subjects were submerged (head out) in a pool inside a hyperbaric chamber. After compression to 35 fsw (2.06 ATA), they inhaled 100% oxygen while exercising at 100W and performing the MATB-II cognitive test. Heart rate (HR) and respiratory parameters were continuously measured until CNSOT symptoms appeared or 120 minutes elapsed. A blinded analysis of 36 dives was conducted. Paired t-tests or Wilcoxon tests were used to compare HR, respiratory rate (RR), minute ventilation (VE), tidal volume (VT), and tidal volume period (VTP) from ten-minute steady state intervals (SS) to three-minute intervals preceding CNSOT (END).

Results

Twenty subjects (six females, 14 males) with an average age of 25.3 years (SD 5.20), BMI of 24.2 kg/m² (SD 2.49), and VO_2Max of 42.3 mL/kg/min (SD 6.30) were analyzed. Significant differences (p/min) and VEEND (37.1 L/min) were detected (Paired t-test). RR and VT were not significantly different.

Summary/Conclusion

CNSOT led to significant changes in HR, VE, and VTP but did not affect RR and VT. When data collection is complete, unblinding and assessment of the ketone vs. placebo effects will occur. The final analysis will examine the effect of ketone body consumption on these hemodynamic parameters during steady state and preceding CNSOT intervals.

Funding: NAVSEA contract N00024-22-C-4323

D 75: Whole-body nitrogen elimination after diving using an open-circuit indirect measurement method

O: Tuesday, 6/3/2025, 4:40 PM - 4:50 PM

P:

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Introduction/Background

Inert gas exchange and tissue supersaturation are critical factors in decompression sickness, yet precise feedback or actual monitoring of nitrogen (N2) washout remains limited. Routine N2 washout measurements could enhance our understanding of individual nitrogen kinetics, but uncertainty in measurement methods is often overlooked.

Materials and Methods

We developed a portable, cost-effective, indirect open-circuit measurement system comprising a pneumotachometer, CO_2 scrubber, mixing box, O_2 and CO_2 sensors, a custom-made automated intermittent calibration system, and post-processing software. We first performed an error analysis to assess N2 washout measurement uncertainty based on O_2 sensor and pneumotachometer performance. Next, system accuracy was tested with laboratory gases of known concentrations. Finally, repeated N2 washout measurements were conducted while breathing 100% oxygen under normobaric conditions with no prior decompression, and after a 20-minute dry dive at 4 atm in a hyperbaric chamber, with and without exercise. All hyperbaric exposures were preceded by a 30-minute whole-body vibration session, which ended one hour before the start of the compression, to reduce the effect of post-dive bubbles on the nitrogen elimination.

Results

Exhaled N2 concentration varied between 2000 ppm and 400 ppm. The native O_2 sensor fluctuations exceeded 2000 ppm in steady-state conditions. Uncorrected sensor data led to excessive uncertainty in exhaled N2 volume. Implementing our calibration and correction method significantly improved sensor accuracy and precision. Repeated no-dive N2 elimination at rest showed consistent results, whereas post-dive washout varied significantly despite identical exposure conditions. Exercise during diving increased post-dive N2 elimination, likely due to enhanced perfusion and N2 uptake.

Summary/Conclusion

Our system provides individualized N2 washout profiles, allowing inert gas elimination patterns to be differentiated. Detailed information on the methodological accuracy and precision limits is key for meaningful physiological interpretations of any measured N2 elimination pattern. The observed variability in post-dive N2 elimination suggests significant deviations from current theoretical gas exchange models, emphasizing the importance of individual and day-to-day changes in gas exchange efficiency on the actual inert gas load during decompression.

D 76: Central nervous system oxygen toxicity and core temperature responses to HBO_2 during immersion with hypercapnic O_2 at 3 ATA and pure O_2 at 5 ATA in rats

O: Tuesday, 6/3/2025, 4:50 PM - 5:00 PM
P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM
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Introduction/Background
In limited human trials, water immersion and CO_2 retention have been shown to augment symptoms of central nervous system oxygen toxicity (CNS-OT) latency to seizure (LSz). This work aimed to determine CNS-OT LSz in a freely behaving rat model during immersed (WET) and non-immersed (DRY) dives using hyperbaric oxygen (HBO_2) to 5 ATA (100% O_2) and hypercapnic HBO_2 to 3 ATA (2.5% CO_2 bal. $_{O2)}$.

Materials and Methods
Male Sprague-Dawley rats (n=26) were familiarized to daily sessions (2 wk) of head-out water immersion (34°C), which was then used to expose rats to HBO_2 on 2-4 separate dives, each separated by a minimum of 1 week. Conditions were randomized between WET and DRY and between 3 ATA and 5 ATA. A small cohort (n=6) underwent surgery to implant DSI radio telemetry devices, continuously recording brain EEG activity and core temperature (Tc) during the dives. LSz was timed from 3 ATA until the onset of tonic-clonic convulsions or until EEG Sz activity was noted. Tc change (Δ) was calculated from the start of dive (3 ATA) to LSz. Data were analyzed with mixed-effects one-way ANOVA.

Results
LSz in 3 ATA hypercapnic HBO_2 were DRY: 17.1 ± 9.0 min and WET: 10.0 ± 3.9 min and in 5 ATA HBO_2 were DRY: 10.7 ± 3.3 and WET: 13.1 ± 6.3 min. LSz differed between DRY and WET in 3 ATA only (p=0.01). ΔTc was not different (p=0.054) between conditions. Combined average ΔTc was -0.67 ± 0.68°C prior to Sz, but greater ΔTc was not associated (R2=0.16, p=0.051) with decreased LSz.

Summary/Conclusion
Immersion decreases CNS-OT LSz during exposure to hypercapnic HBO_2 at 3 ATA but not during exposure to 100% O_2 HBO_2 at 5 ATA. Core temperature change during immersion and dry dives was not correlated with LSz but decreased prior to CNS-OT onset in each condition.

D 77: Chronic Bicarbonate Elevation as a risk factor for CNS O_2 toxicity

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

Goddard OG, Natoli MJ, Derrick BJ, Ellis MC, Gasier HG, MacLeod DB, Drake A, Taber K, Yoder T, Wright MC, Covington DB, Moon RE

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Introduction/Background

Malfunction of CO_2 scrubbing on submarines and elevated ambient CO_2 levels leads to increased serum bicarbonate, which may reduce the drive to breathe (hypercapnic ventilatory response, HCVR). Lower HCVR in divers is associated with CO_2 retention during underwater exertion, which can cause cerebral vasodilation and increased CNS O_2 toxicity. This study examined the effects of higher serum bicarbonate on control of breathing and arterial PCO2 during submerged rest and exercise at the surface and 98 fsw. We hypothesized that higher serum bicarbonate would reduce HCVR and increase PCO_2 during underwater exertion.

Materials and Methods

After institutional approval and free and informed consent, 10 fit, non-smoking males and non-pregnant females (eight males, two females) participated. Chronic bicarbonate elevation was simulated by administration of 300 mEq of sodium bicarbonate daily for three days. HCVR was measured prior to each phase of the study: control and bicarbonate pre-treatment (randomized order). Participants were instrumented with a radial arterial line and EKG, then studied at rest and during moderate exercise (VO_2 2.1-2.4 $L.min^{-1}$) fully submersed in thermoneutral water in a hyperbaric chamber at the surface and 98 fsw. Parameters were measured at rest and during exercise on an electrically braked cycle ergometer. Statistical analysis used a paired t-test.

Results

HCVR was 2.8±0.9 (control) and 1.2±0.9 (bicarbonate)

Table 1: Mean ± SD. *P<0.05 vs. control.

Depth	Pre-Treatment	Exertion	V_E ($L.min^{-1}$ BTPS)	PCO_2 (mmHg)
Surface	Control	Rest	16.1±4.2	27.2±5.2
Surface	Control	Exercise	48.0±10.8	34.4±6.3
98 fsw	Control	Rest	14.8±6.2	27.8±3.5
98 fsw	Control	Exercise	43.3±7.8	39.7±5.3
Surface	Bicarbonate	Rest	15.9±6.5	29.8±5.0
Surface	Bicarbonate	Exercise	49.7±11.4	37.0±3.8
98 fsw	Bicarbonate	Rest	12.7±5.0	30.4±3.9
98 fsw	Bicarbonate	Exercise	43.3±7.2	42.6±3.3

Bicarbonate preloading increased arterial PCO_2 (p=0.03) at depth during moderate submersed exercise at 98 fsw. A corresponding decrease in ventilatory response to CO_2 was evidenced by a lower HCVR (p=0.0559) in pretreated individuals suggesting elevated serum bicarbonate levels blunt CO_2 chemosensitivity.

Summary/Conclusion

These results support the conclusion that higher serum bicarbonate levels lead to reduced HCVR and elevated PCO_2 during moderate exercise at depth, likely increasing the risk of CNS O_2 toxicity.

Acknowledgement: This study was supported by ONR grant N00014-23-1-2830.

D 78: Effect of pre-dive ketone food products on latency to CNS oxygen toxicity

O: Tuesday, 6/3/2025, 4:30 PM - 4:40 PM

P: n/a

Steinbock K, Taber K, Drake A, Escobar R, Adusumalli J, Wang J, Ni S, Natoli MJ, D'Agostino DP, Lauer L, Gregory TJ, Kuchibhatla M, Gordee A, Ellis MC, Makowski M, Luedke M, Posada-Quintero HF, Chon KH, Vrijdag X, Freiberger JJ, Gasier H, Derrick BJ

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Introduction/Background

Central nervous system oxygen toxicity (CNSOT) is a concern for combat divers using high pO2 gas mixtures to enhance stealth, range, and reduce decompression sickness risk. CNSOT can cause sensory changes, autonomic dysfunction, and seizures, which can be fatal underwater. Ketogenic diets increase serum ketone bodies (KBs), which have antioxidant properties that may protect against reactive oxygen species (ROS)-mediated conditions like CNSOT. Ketone supplementation has demonstrated effectiveness in delaying CNSOT onset in animal models.

Materials and Methods

This prospective, randomized, controlled, double-blind study investigated the effects of elevated serum KBs on CNSOT latency in healthy subjects. Each participant completed two trials—one with a weight-based ketone regimen and one with a placebo. Post-ingestion, exhaled acetone and serum beta-hydroxybutyrate/ acetoacetate levels were measured. Subjects were submerged (head out) in a pool inside a hyperbaric chamber. After compression to 35 fsw (2.06 ATA), they inhaled 100% oxygen while exercising at 100W and performing the MATB-II cognitive test. Physiological metrics were recorded using LabChart Pro. Serum venous blood gas and ketone samples were serially collected until CNSOT symptoms appeared or 120 minutes had elapsed. A blinded analysis of the first 36 experiments was conducted.

Results

Twenty subjects (6 females, 14 males) with a mean ± SD age of 25.3 ± 5.2 years, a BMI of 24.2 ± 2.49 kg/m², and a VO_2max of 42.3 ± 6.30 mL/kg/min were enrolled. During ketone or placebo ingestion, 36% of trials proceeded with no side effects, 50% had mild symptoms, and 14% had moderate symptoms. The most common ingestion-phase symptom was nausea (39%). During hyperbaric oxygen exposure, 86% of dives resulted in termination for suspected CNSOT symptoms. Five experiments reached the 120-minute limit without CNSOT. The mean ± SD latency to symptom onset was 56.4 ± 35.3 minutes.

Summary/Conclusion

KB and placebo ingestion were relatively well-tolerated, and average latency to CNSOT has exceeded the US Navy limit of 25 minutes for this exposure. Unblinding and assessment of the ketone vs placebo effects will occur when data collection is complete in the coming months. Final analysis will examine the impact of KB supplementation on adverse event risk, physiological responses, and CNSOT latency.

Funding: NAVSEA contract N00024-22-C-4323

D 79: Using HRV to monitor circadian rhythm changes and fatigue in naval submarine crews

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Submariners engaged in underwater operations work in continuous shifts under confined conditions, potentially leading to circadian rhythm disruptions and physiological disturbances. However, such effects have not been studied in the crews of the Navy's submarines in TAIWAN. This study aims to evaluate the physiological impact of shift work and the confined occupational environment on submariners.

Materials and Methods

A study involving R.O.C. Navy submariners included two groups: 17 male submariners who underwent 48-hour monitoring and 20 who were monitored for nine days. Continuous heart rate variability (HRV) monitoring was conducted using a portable ECG (QOCA ECG103, Quanta Computer, TAIWAN). Cosinor Rhythmometry visualizes circadian rhythm fluctuations. Saliva samples were collected before and after melatonin (sMel), cortisol (sCor), and alpha-amylase (sAA) levels. Sleepiness and fatigue were assessed using the Pittsburgh Sleep Quality Index, Karolinska Sleepiness Scale, and Fatigue Assessment Scale.

Results

On average, the 48-hour group participants were 32.83 years old (±9.77) with a BMI of 24.37 (±3.78). In the 9-day group, participants averaged 28 years (±5.86) with a BMI of 24.7 (±2.54). Both groups exhibited autonomic disturbances characterized by sympathetic dominance and reduced heart rate variability (HRV) flexibility. This was evidenced by decreases in the Standard Deviation of Normal-to-Normal Intervals (SDNN), Root Mean Square of Successive Differences (RMSSD), and High Frequency (HF) components, alongside an increase in the Low Frequency/High Frequency Ratio (LF/HF). Interestingly, younger and operational-role personnel adapted better to these conditions during the nine-day operation. A consistent five-hour phase shift, akin to jet lag, was observed by the fifth day of the nine-day operation. Notably, HRV rebounded during maneuvering, suggesting polyvagal arousal as a stress response. Additionally, significant changes were observed in certain biochemical markers: sMel and sCor levels increased after nine days, while sAA showed significant alterations after the 48-hour operation. Despite these physiological changes, fatigue and sleep scores did not exhibit significant intra-individual variations.

Summary/Conclusion

Both 48-hour and nine-day submarine shift work worsen circadian rhythm disruptions and stress, though fatigue and insomnia are not significantly reflected in self-assessment questionnaires. Addressing circadian misalignment and stress management is essential in extended underwater operations.

D 80: Effects of resistive respiratory muscle training with and without carbon monoxide on ventilatory chemosensitivity and exercise endurance in divers

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

Drake A, Yoder TL, Makowski MS, Bartlett NC, Vallee I, Maggiore G, Taber K, Patel A, Natoli MJ, Lauer LM, Gregory TJ, Derrick BJ, Ellis MC, Piper S, Cooter-Wright M, Moon RE
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Introduction / Background

Exercise endurance in diving can be limited by respiratory muscle fatigue due to increased breathing work associated with elevated gas density and decreased lung tissue compliance. Subsequent hypoventilation can induce hypercapnia, raising the risk of O_2 toxicity. Hypercapnic ventilatory response (HCVR, increased ventilation in response to elevated PCO_2) is a major determinant of PCO_2 while diving: low baseline HCVR correlates with higher PCO_2 during submerged exercise. Respiratory muscle training (RMT) can modify HCVR and enhance exercise endurance. Training while breathing low-dose CO has been found to promote mitochondrial biogenesis in muscle. This study aimed to test the effects of RMT with and without CO on ventilatory chemosensitivity and submerged exercise endurance at 55 fsw.

Materials and Methods

After institutional approval and obtaining free and informed consent, a total of 30 fit participants between 18 and 45 years, non-pregnant, non-smoking, and without cardiorespiratory disease, underwent initial assessment of HCVR, after which they performed an endurance test at 70-85% VO_2max in thermoneutral water at 55 fsw. Tests were repeated following RMT: 30-minute sessions, five days per week for four weeks, breathing against an intermittent threshold load that was increased weekly as tolerated. RMT breathing gas was double-blinded, with Group 1 (N=15) on air and Group 2 (N=15) on air with 200 ppm CO. Statistical analysis involved a paired t-test and a Wilcoxon Rank Sum test.

Results

Following RMT, HCVR increased from 1.63±1.05 to 2.23±1.62 $L.min^{-1}.mmHg^{-1}$ (P=0.03). The increase only occurred in participants with baseline HCVR at or below the baseline mean. Arterial PCO_2 during exercise was unaffected by RMT or training gas: (Pre-Post) 38.5±5.2-39.9±6.5 mmHg (air), 40.1±8.7-38.4±5.2 mmHg (CO). Average endurance time increased from 41.7±19.3 to 58.4±28.2 minutes (P<0.0001). Endurance time increased to a lesser extent in the CO group (10.9±11.3 min) compared to the air group (22.4±15.5 minutes), but this difference was not statistically significant.

Summary / Conclusions

The data suggest RMT increases submerged exercise endurance at 55 fsw and HCVR in individuals with a low baseline. The addition of CO had no significant impact on endurance time, suggesting limited potential for enhancing RMT benefits in divers.

Acknowledgement: This study was supported by ONR grant N00014-21-1-2366.

D 81: Changes to integrated diaphragmatic function following respiratory muscle training with air vs sub-toxic CO

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Divers experience increased ventilatory load, which can lead to respiratory muscle fatigue and hypercapnia. Respiratory muscle training (RMT) has been shown to augment endurance in divers. A prior study in our lab showed sub-toxic carbon monoxide (CO) exposure has beneficial effects on skeletal muscle, and there have been recent bans on CO use to enhance competitive cycling performance. It is unknown if CO exposure would also augment the respiratory muscles. This study aimed to test the effects of RMT (with and without CO) on integrated diaphragmatic function (IDF) to see if there is a beneficial effect of including CO in RMT.

Materials and Methods

Fit male and female subjects (VO_2 peak > 35 $mL*kg^{-1}*min^{-1}$ and 30 35 $mL*kg^{-1}*min^{-1}$ respectively) were recruited. Baseline testing included integrated diaphragmatic function measures such as maximum inspiratory/expiratory pressures (MIP and MEP), ultrasound-measured diaphragm thickness during a total lung capacity breath hold and exhalation, transdiaphragmatic pressure (P_{di}) via double balloon nasogastric tube, and maximum voluntary ventilation (MVV). Subjects then completed twenty 30-minute RMT sessions over one month with either air or 200ppm CO (double-blinded). Baseline testing was repeated following RMT.

Results

Thirty subjects completed the study. Preliminary results show RMT overall increasing respiratory muscle static pressures (MIP and MEP), MVV, and diaphragmatic thickness. No significant difference was seen in these measures for subjects who were exposed to CO during their RMT compared to air. While not significant, the mean benefit of RMT across all variables tended to be lower for those exposed to CO during RMT compared to the subjects exposed to only air.

Summary/Conclusion

As predicted, RMT benefits divers and improves many factors of IDF. However, using sub-toxic CO in RMT did not seem to improve performance compared to using air, and its use may even decrease the magnitude of RMT benefits. This is contradictory to the recent trends of CO being portrayed as performance-enhancing, at least in regard to respiratory muscle performance.

Funded by Office of Naval Research grant #N00014-21-1-2366

D 82: Modeling ineffective breathing via the mismatch of airflow to the respiratory pump

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

During a dive, the water column modulates breathing, increasing respiratory drive and eliciting new breathing strategies. These extreme breathing strategies are poorly understood in terms of how multiple muscles coordinate to produce complex, non-sinusoidal patterns. A better understanding of muscle coordination could enhance training beyond breath timing techniques like box breathing.

Materials and Methods

Participants (n=20) were subjected to a diving analog respiratory load, which included pressure threshold, flow resistance, chest wall, and abdominal restriction to simulate the challenges encountered in undersea environments of 30 feet and 60 feet. Respiratory signals include airflow, esophageal, ribcage, and abdominal movements via the respiratory motion belt. To model ineffective breathing, we define the volume inhaled (air moved) over the pressure-time product (respiratory drive). Predictor metrics representing the coordination of respiratory muscles include lag between muscle movement and airflow and shape similarity in the velocity between sensors. Ineffective breathing is the volume inhaled divided by the pressure-time product (respiratory drive). To model, two novel features were created to extract lag times between the respiratory belt and flow signals to capture mismatches in muscle coordination via signal lag and velocity profile similarity.

Results

The abdominal movement's lag compared to the onset of airflow and the profile similarity between flow and ribcage intensity had the highest correlation to ineffective breathing. The highest model had an r=0.65 using only two features across all conditions. At depth, abdominal movement lag decreased by 35.7\% (mean=1.79, SE=0.01 to mean=1.15, SE=0.02. Concurrently, flow-ribcage movement similarity increased 190\% (mean=0.22,SE=0.008 to mean=0.64,SE=0.01).

Summary/Conclusion

Based on these findings regarding the coordination of respiratory pressure and its link to ineffective work, we can better understand how the various components of the respiratory pump integrate and function together. We hypothesize that as divers descend in the water column, their anatomical physiology mimics that of a person with obstructive respiratory disorders, where the ribcage movement often leads the flow signal due to the increase in airway resistance, delaying the flow. This suggests that there may be optimal respiratory paradigms to choose to improve the effectiveness of the work.

D 83: Discrepancies in diving fatality investigations: current issues and proposed changes

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Various organizations are evaluating their protocols for handling fatal dive accidents. However, the lack of data sharing between multiple entities, namely medical examiners and researchers, remains a challenge in understanding these fatalities. This study aimed to evaluate the data obtained by different parties during investigations and assess how that data can be shared to facilitate more accurate analyses.

Materials and methods

Sixty-nine fatality cases, reported to Divers Alert Network (DAN) between 2010 and 2018, were evaluated for the presence of 116 variables related to diving accidents, e.g., diver age and equipment. The completeness of each variable was assessed along with the primary source of information. Five Medical Examiners (MEs) ranked each variable that would not come from their reporting on a scale of importance from 0 (low) to 3 (high). The same was done for ten cases reported to DAN Europe to compare programs. These anonymized data were used with IRB approval (Protocol #011 and Protocol #038).

Results

The table below lists the variables with priority scores from the MEs of twelve or above, for which the DAN cases had completeness of 30 percent or higher. The Accident Scenario was ranked highest priority and was 43 percent complete for the DAN cases and 90 percent complete for the DAN Europe cases. This table highlights what DAN and DAN Europe can offer MEs to encourage data-sharing following fatal accidents.

Variable	ME Priority Score	% Complete in DAN Cases	% Complete in DAN Europe Cases
Accident Scenario (summary)	15	43	90
Risks from Equipment (summary)	13	45	70
Date of Death	12	91	90
Diver Class	12	90	60
Risks from Diving/Dive Profile (summary)	12	46	90
When Loss of Consciousness Occurred	12	35	60
Recovery	12	32	70
Entrapment?	12	32	20
Diver Experience	12	30	90
Buddy Separation?	12	30	50

Data sources were variable between regions, owing to different procedures based on regional authorities. For example, sixty-two variables were provided to DAN by law enforcement reports rather than MEs. For DAN Europe, in contrast, Accident Scenario was 96 percent complete, as sixty-six of the variables were provided by the medical examiners.

Summary/Conclusions

There are numerous challenges in obtaining accurate information surrounding diving fatalities. The insight from the MEs illustrates what their priorities are for receiving data from the diving community, which can be used to encourage better communication. The comparison between the two programs offers insight into the varied processes of investigation. Knowing what information is limited allows for better data exchange to close the gap in reporting.

D 84: Screening the dysbaric osteonecrosis with MRI: a unique survey and a case report in Japan

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

The Japan Maritime Self-Defense Force Undersea Medical Center (JMSDF-UMC) plays a major role in the education, training, and research of saturation diving (SD) in JMSDF. We JMSDF-UMC has a deep diving simulator which reaches 440-meter seawater (msw) at maximum and a SD program that uses a linear decompression protocol as a template. Deep-sea diving is one of the risk factors for dysbaric osteonecrosis (DON).

Materials and Methods

Between December 2019 and January 2022, we surveyed 62 male SD divers (age: 40.61±6.93) for screening DON with magnetic resonance imaging (MRI). Three (4.8%) had abnormal findings as DON. Two divers had knee pain and a past history of decompression sickness (DCS), and the other did not show any symptoms. We recognized that MRI was a useful modality to detect the early stage of DON. At the same time, we conducted physical and biochemical examinations for those participants and found that the history of DCS was one of the risk factors of DON.

Results

We are continuing with this survey for screening DON with MRI even now. Just recently, we found that a 40s male SD diver who did not have a past history of DCS and other suspicious risk factors of DON had abnormal findings as DON. Before participating in this survey, he had only two SD chances at the depths of 60 msw and 330 msw. Although he did not show any symptoms, MRI examination showed that there are map-like lesions on his right supracondylar femur area and left proximal tibia metaphysis area.

Summary/Conclusion

DON usually begins without symptoms, but symptoms usually present with the progression of joint damage. It's important to prevent the onset of DON. We would like to introduce our unique study on DON and report this atypical case of DON with some suggestions on the role of MRI in screening and prevention of DON.

D 85: Increased fractional exhaled nitric oxide among competitive freedivers with freediving induced pulmonary syndrome

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Freediving Induced Pulmonary Syndrome (FIPS), colloquially called lung squeeze, encompasses various pulmonary symptoms frequently observed in breath-hold divers. The exact etiology of the condition is unknown, but it is characterized by pulmonary edema and/or hemoptysis after a breath-hold dive. Though the mechanism behind this edema is not clear, movement of fluid into lung tissues is governed by both pressure and lung permeability, the latter of which may be heightened by airway inflammation. Fractional exhaled nitric oxide (FeNO) has been used to track airway inflammation and treatment response in inflammatory pulmonary pathologies such as asthma. We hypothesize that abnormal FeNO levels will be associated with an elevated risk of FIPS among competitive free divers.

Materials and Methods

Participants included competitive freedivers recruited using convenience sampling from four international competitions. Divers performed pre- and post-dive FeNO measurements using a NIOX VERO device and completed a post-dive questionnaire assessing FIPS symptoms and dive profiles. The incidence of FIPS symptoms was calculated, and risk ratios were used to assess the relationship between post-dive FeNO measurements of 30+ ppb or more and the presence or absence of FIPS symptoms (hemoptysis, sputum, chest tightness, cough, etc.). A paired t-test was used to assess changes in FeNO pre- and post.

Results

106 divers completed 294 dives and participated in 327 FeNO measurements, 121 pre, 206 post. Among 96 paired sets of measurements, FeNO decreased significantly pre- to post (23.1 ± 14.0 to 20.2 ± 13.1, < 0.0001). The incidence of FIPS was 23.1% (68/294), and the risk ratio for FIPS among divers with post-dive FeNO of 30 or more was 1.6, (p = 0.03).

Summary/Conclusion

Increased FeNO was found to be significantly associated with increased risk of FIPS symptoms among competitive freedivers. These findings suggest that underlying pulmonary inflammation may contribute to FIPS susceptibility.

D 86: World War 2 Undersea/Aero Medical History: Escaping from a submerged WW2 heavy bomber after ditching at sea using aviator's portable oxygen equipment

O: N/A

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

20 Nov 1944. "Incidents of submersion and actual or suspected drowning of personnel after ditching of bombardment type aircraft have been noted… in many instances the ditched airplane continued to float for many minutes, even though the fuselage was partially or fully submerged… escape of all plane personnel could perhaps be effected, providing physical injury is not too serious and providing personnel could remain underwater sufficiently long to reach escape hatches and windows" (USAAF Aero Med Lab report TSEAL-3-660-68-A, 20 Nov 1944, Capt. W. G. Kulesz).

Materials and Methods

Aviation physiologists at the USAAF Aero Medical Laboratory (Wright Field, Dayton, Ohio), adapted aviator's walk-around O_2 equipment for testing individual underwater escape from 10-50 feet of seawater (fsw) in a pool at the Experimental Diving Unit, US Navy Yard, Washington, D.C. Multiple airmen also tested mass escapes from a mockup of a B-24 Liberator heavy bomber submerged in six fsw (top of waist gunner window submerged one fsw) in an Ohio lake.

Results

Using an A-13 demand regulator with a D-2 O_2 cylinder (suspended beneath airman's armpit) and wearing an A-14 demand type O_2 mask the volunteer had sufficient oxygen to survive and escape from the following depths: ~3.5 min at 50-fsw, ~5 min at 20-25-fsw, and ~6min at 10-fsw; D-2 cylinder-pressure dropped from 400 to 40psi during the escape. Optimal respiration was obtained when the cylinder regulator and face mask were maintained at the same water level. Six airmen successfully escaped from the B-24 fuselage in ~2 minutes.

Summary/Conclusion

The standard portable O_2 walk-around assembly, consisting of the A-13 regulator and the D-2 cylinder, operates satisfactorily underwater as a demand-type apparatus when used with the A-14 demand-type face mask. Underwater escape can be successfully effected if it is completed before the oxygen supply is exhausted. This is just one example of the many collaborative research projects done by the USAAF Aero Med Lab and US Navy Experimental Diving Unit during WW2 under the auspices of the Committee on Aviation Medicine and its six subcommittees (Wash. D.C.).

D 87: Changes in forced vital capacity with immersed exercise on 100% oxygen under hyperbaric conditions

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

100% oxygen is a breathing gas commonly used in various diving operations. The effects of breathing 100 % oxygen on the forced vital capacity (FVC) while immersed under hyperbaric conditions are unknown. This study aimed to determine if there are any acute changes in lung parameters, mainly the forced vital capacity, by analyzing previously gathered data.

Materials and Methods

FVC was measured at baseline prior to the study. The intervention consisted of immersing the study subjects in a pool of water inside a hyperbaric chamber pressurized to 2.06 ATA. Subjects breathed 100 % oxygen while exercising at approximately 100 W using a pedaling apparatus. The study was terminated when the subjects either had symptoms of oxygen toxicity or the study reached the time limit of 120 minutes. Post-intervention FVC was completed at the end of the study intervention. Data was compiled and analyzed using GraphPad Prism statistical software.

Results

Data from 29 studies involving 19 individual subjects were compiled. Some subjects did the intervention more than once. The pre- and post-study PFTs were analyzed. The FVC, measured as the percentage of predicted, was analyzed using a paired t-test. The mean of the differences between the two was –1.520 (p value=0.127). The subjects were on oxygen for 59.9 min on average.

Summary/Conclusion

Our study suggests no significant acute changes in FVC when breathing 100% oxygen while performing immersed exercise under hyperbaric conditions.

Funding Source: NAVSEA Grant # N00024-22-C-4323

D 88: Urinary metabolic profile of compressed air scuba diving

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Navy divers operate in extreme environments, facing unique physiological challenges that stress the body significantly. Heliox and compressed air are used under different diving conditions based on depth and associated risks, each affecting physiological functions during non-saturation diving. We have successfully demonstrated the metabolomic profile associated with Heliox diving. However, the metabolomic profile for compressed air diving remains unclear. This study aims to address this gap by analyzing simulated compressed air diving in healthy participants using urine metabolomics to elucidate the metabolic changes and potential biomarkers associated with compressed air diving.

Materials and Methods

Fifteen healthy male R.O.C. Navy divers who underwent simulated diving training in a wet chamber at Zuoying Armed Forces General Hospital (Kaohsiung, Taiwan). The simulation replicated underwater conditions at a depth of 190 feet with compressed air. Urine samples were collected 30 minutes before and after diving, followed by metabolic analysis using LC-MS (Waters Xevo™ TQ-S System). The obtained data were further processed through KEGG pathway enrichment and disease-associated metabolic mapping to identify significant biochemical alterations.

Results

The study participants had an average age of 32.5 years (±5.25), a mean height of 174.5 cm (±6.2), a mean body weight of 74.27 kg (±7.95), and a body mass index (BMI) of 24.37 kg/m² (±2.36). We identified significant differences in metabolite profiles before and after diving using Partial Least Squares Discriminant Analysis (PLS-DA) and Orthogonal PLS-DA (OPLS-DA). A total of 96 metabolites were detected, with 40 up-regulated and 56 down-regulated post-diving. These metabolites are linked to Tryptophan metabolism, the Citrate cycle (TCA cycle), Pantothenate and CoA biosynthesis, beta-Alanine metabolism, and Glyoxylate and dicarboxylate metabolism, as per KEGG, and play key roles in oxidative stress, neurological function, and energy production. Notably, Mannitol, L-Tryptophan, and Tryptamine emerged as potentially critical metabolites in this context.

Summary/Conclusion

This study explores changes in urine metabolomic patterns following a simulated 190 feet compressed air dive by R.O.C. military divers. Our findings reveal distinct metabolomic patterns between Heliox and compressed air.

D 89: Diving deeper into communication: a framework of handoffs following critical diving incidents

O: N/A

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Following a diving incident, a unique system is activated to connect an injured diver with the definitive care needed to resolve any resultant diving-related illnesses/injuries (DRII). This system spans from the injured divers themselves, their support networks, the first responders providing immediate care or rescue, the general care practitioners receiving them, and the definitive care practitioners with the specialized capabilities needed to manage DRIIs. The interactions between these agents often reflect information transfers or handoffs, which ensure the communication of factors relevant to patient outcomes such as medical history, preceding events, signs/symptoms, and other considerations. Given the continued trend of suspending hyperbaric services for the treatment of emergent conditions, a strengthening of the outlined system is required to continue providing accurate and timely care for those experiencing DRIIs.

Materials and Methods

This investigation developed a theoretical framework based on the hand-offs between agents following DRIIs requiring medical care. This framework utilizes approaches from social network analysis, including identifying agent nodes and the corresponding relationships between them, based on anecdotal and case report evidence from the literature surrounding DRII. Based on this framework, relevant literature surrounding handoffs is incorporated to identify potential recommendations for leveraging the identified relationships and strengthening the system to improve patient outcomes.

Results

Eight agent nodes were identified in developing the outlined theoretical framework, and there were nineteen different relationships between them. These relationships were a combination of one-way and two-way interactions reflecting handoffs of information relevant to patient outcomes. Key recommendations to consider, that target all agent nodes and relationships in the system, include the development of standardized communication tools and methods in addition to the promotion of said tools and methods by regulatory, educational, training, and accrediting bodies. Six additional recommendations will be provided which are aimed at improving specific relationships between agent nodes.

Summary/Conclusion

While this investigation provides a theoretical framework of agent interactions following DRIIs requiring medical care, further work is required to examine the relative strengths of the proposed connections and evaluate the utility of the recommendations outlined.

D 90: Association between delaying air travel after decompression illness (DCI) and reoccurrence of DCI symptoms: Preliminary findings from prospective survey

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Decompression illness (DCI) is a significant health concern among divers, caused by changes in environmental pressure during and after underwater exposure. It has been suggested that recurrence of DCI symptoms is more common in individuals who fly post-treatment compared to those who do not. However, there is no standardized, evidence-based guidance on when it is safe to fly after treatment. Physicians provide varying recommendations, ranging from immediate travel to prolonged delays. This study aims to assess the impact of flight timing after DCI treatment on DCI symptom recurrence or worsening.

Materials and Methods

This is an ongoing prospective survey conducted by Divers Alert Network (DAN). Divers who received DCI treatment were invited to complete an online questionnaire detailing their DCI treatment, along with post-treatment travel experiences and outcomes. Descriptive statistics were used, and the Cochran-Armitage trend test and Chi-Square test of independence were performed at a significance level of 0.05 using SAS V9.4.

Results

Among 458 respondents, 240 (52.4%) traveled home by air after treatment. Among those 240 individuals, the mean (SD) age was 53.17 (12.99) years. The most common treatment was a combination of surface oxygen administration and hyperbaric oxygenation (115, 47.92%). The median (range) time from treatment to flying was 72 (0–1848) hours. Among those who flew, 151 (62.66%) had multiple flight legs, after which 34 (14.17%) experienced recurrence or worsening symptoms. The most frequently reported symptoms were numbness/paresthesia (13, 20.31%), joint pain (9, 14.06%), and dizziness/vertigo (8, 12.50%). The Cochran-Armitage trend test ($Z = -0.2512$, $p = 0.8017$) found no significant trend between symptom recurrence and flight timing. The Chi-Square test of independence ($\chi^2(1) = 0.0544$, $p = 0.8157$) found no association between symptom recurrence and multiple flight legs.

Summary/Conclusion

These preliminary findings suggest that symptom recurrence post-DCI treatment was not significantly associated with flight timing or multiple flight legs, although few traveled less than 2-3 days later. Considering the variability in pre-flight delay time in the current data, and the fact that the study is ongoing and further data are being collected, additional analysis will be conducted to develop optimal post-DCI travel safety recommendations.

D 91: Multi-component breathing patterns influences work of breathing estimation and cognitive performance under load

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Accurate estimation of work of breathing (WoB) is essential for optimizing respiratory support and performance in extreme environments such as undersea and hyperbaric conditions. Traditional models assume a sinusoidal breathing pattern, but individual differences in breathing mechanics may alter WoB calculations. This study investigates how non-sinusoidal breathing patterns and respiratory compensation strategies influence WoB estimation and cognitive performance under respiratory load.

Materials and Methods

Participants (n = 25) were subjected to a diving analog respiratory load, including pressure threshold, flow resistance, chest wall, and abdominal restriction. Airflow and esophageal, mouth, and gastric pressures were recorded. WoB was calculated using esophageal and mouth pressure, and participants were classified as Overestimators (WoB_mouth > WoB_esophageal) or Underestimators (WoB_mouth < WoB_esophageal). The top three participants from each group (those with the highest and lowest WoB discrepancies) were analyzed. Breathing dynamics, including inspiratory time, tidal volume, airflow-pressure correlation, and Mean Sinusoidal Squared Error (MSSE), were compared. Cognitive function was evaluated using a psychomotor vigilance task, with statistical comparisons via rank-sum tests.

Results

Overestimators had significantly longer inspiratory times, higher tidal volumes, and greater changes in gastric pressure (p airflow, mouth pressure, and esophageal pressure (p multiple sine waves, not a single sinusoidal. Notably, Overestimators performed better on the cognitive task, with lower median reaction times than Underestimators (p = 0.0118).

Summary/Conclusion

These findings suggest that multi-component breaths and abdominal engagement alter WoB estimation and may enhance cognitive performance under respiratory load. Standard WoB models relying on mouth pressure may be inaccurate for individuals with complex breathing strategies. Distinct muscle recruitment strategies may contribute to non-sinusoidal breathing, affecting pressure distribution and work allocation across the respiratory system. Understanding these changes is critical for optimizing respiratory support in diving environments, and high-workload conditions. Future research should explore whether breathing pattern modifications can improve cognitive resilience and mission performance.

D 92: A systematic review and meta-analysis of the effect of delayed recompression treatment on DCI outcome

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Guidelines and textbooks recommend therapeutic recompression treatment (RCT) for divers suffering decompression illness (DCI). RCT should be given in a timely manner, but the consequence of delayed treatment is debated. This work aimed to investigate the effect of delayed RCT on DCI outcome.

Materials and Methods

We have initiated a Prospero-registered, systematic review and meta-analysis of the literature compliant with the Cochrane handbook for systematic reviews, including ROBINS-I methodology for risk of bias assessment of non-randomized studies. Eligible studies have compared the clinical outcomes of divers suffering DCI receiving early or late RCT. Studies have been grouped according to statistical methodology: Logistic or linear regression or Odds Ratios (OR) for residual symptoms after first or last treatment. Studies reporting OR have been grouped into those comparing treatment before and after 90 minutes (Early), three hours (intermediate delay), and six hours (long delay).

Results

The work is ongoing. We have identified thirty-two eligible studies, but only twenty-one present statistical measures of OR or regression coefficients. No randomized controlled trials were found. Two studies grading DCI on a 0-10 severity scale reported 0.01 (P=0.06) and 0.1(POR (1.01, P=0.03). One of the four studies comparing outcomes after intermediate delay reported an increased OR (2.10, P=0.04). Three of the four studies investigating outcome after long delay reported increased OR (1.00, 2.15, and 2.22), Parlier than 30 minutes after presentation. Most studies had a serious risk of bias.

Summary/Conclusion

This preliminary review of the eligible studies did not disclose a clearly defined relationship between RCT delay and DCI outcome. Final results are pending.

D 93: Decompression illness in breath-hold divers - diagnosis and management insights from an online survey

O: n/a

P: Tuesday, 6/3/2025, 4:00 PM - 5:30 PM

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Introduction/Background

Breath-hold divers can surface with neurological symptoms consistent with nitrogen buildup in tissues or gas entry into the arterial circulation, collectively termed decompression illness (DCI). While DCI has historically been attributed to diving with compressed air, breath-hold divers have reported similar syndromes. The causes, diagnosis, and management of DCI in breath-hold divers is poorly understood.

Materials and Methods

We developed an online survey that queried breath-hold divers on the symptoms they experienced during decompression illness events and the medical management of each event.

Results

A total of 36 (31M, 5F) breath-hold divers filled out the survey. Most were recreational or competitive freedivers or spearfishers with an average age of 45 years and 18 years of breath-hold diving experience. Of those, 33 (92%) held an accredited training agency certification. A total of 18 (50%) reported experiencing DCI, with 23 DCI incidents reported by 14 individuals from 1999 to 2024. 74% of DCI incidents occurred during training, with an average depth of 81 meters and an average speed of 1.01 m/s. 78% of DCI incidents occurred while diving to depths shallower than a previous personal best. The most common symptoms were weakness, numbness, slurred speech, and fatigue. The most common treatment modalities were surface oxygen, in-water recompression, and hyperbaric oxygen therapy. 89% of divers had partial or complete resolution of their symptoms. The top cited contributors to the DCI incidents were depth, short surface interval between dives, and pulmonary barotrauma.

Summary/Conclusion

Breath-hold divers can experience DCI even when diving within their limits. The most cited contributors to DCI were depth, short surface interval between dives, and pulmonary barotrauma. Most divers' symptoms resolved after treatment with surface oxygen, in-water recompression, and/or hyperbaric oxygen therapy.

D 94: Evaluation of current dive computers

O: N/A

P: WITHDREW

D 95: Freediving telemedicine- A new primer

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

Freediving is a rapidly growing grassroots sport that has captured the dedication of a small but vibrant community. Since 2017, I have provided telemedicine services to elite freedivers and newcomers, earning their trust through a personalized approach to managing diving-related health concerns. This primer introduces a novel telemedicine protocol designed for remote assessment in remote locations and management of freediving incidents. It focuses on cardiopulmonary monitoring and symptom evaluation, taking into account the perspective of an athlete myself.

Materials and Methods

Clinical experience from 2017 to 20-25 has been collected.

A clinical algorithm has been developed for each type of incident: Hypoxia, Lung barotrauma, DCI, Sinus/ear barotrauma, and miscellaneous.

The telemedicine protocol integrates remote assessments with objective measurements using simple, portable diagnostic tests and maneuvers familiar to Freedivers.

Components:

- Remote Patient Assessment: Utilizing phone and video calls to gather initial history, Anamnesis, assess incident circumstances, and conduct visual examinations, and asking of specific questions familiar to athletes and freediving coaches: Depth/Discipline/Depth of incident/ Personal best of Depth or length.
- Physiological Testing: Implementation of pulse oximetry at rest and during guided activities designed to simulate freediving conditions (Designed by the Author).
- Symptom Review and Analysis: Remote review of symptom progression, emphasizing correlating clinical findings with individual freediving metrics.
- Data Integration: Combining remote test results with patient-reported outcomes to evaluate the evolution of symptoms and guide clinical decision-making to Return to Dive.

Results

Preliminary application of this protocol within the freediving community has demonstrated its feasibility and effectiveness. Freedivers, trained in self-assessment and remote monitoring, report improved understanding of their physiological responses during deep breath-hold diving. Pulse oximetry and symptom analysis data have enabled timely interventions and enhanced personalized care. Integrating individual performance metrics has further refined the evaluation of hypoxic events and related complications.

Summary/Conclusion

This new primer for freediving telemedicine represents a significant advancement in the remote management of diving-related health issues. Combining telecommunication technologies with simple diagnostic tests and individualized performance data offers a scalable model for enhancing safety and clinical outcomes in freediving Medicine. Ongoing implementation and further research is needed.

D 96: Serial chest CT imaging in a freediver with a case of pulmonary barotrauma of descent (lung squeeze) showing the time course of resolution

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Case Description

Freedivers sometimes suffer respiratory symptoms, including freediving-induced pulmonary syndrome (FIPS). Etiology includes immersion pulmonary edema and barotrauma of descent in the tracheobronchial or pulmonary parenchyma, also colloquially called squeeze. The pathophysiology and healing are still largely unknown, with different forms including tracheobronchial or pulmonary parenchymal injury. This case report describes a freediver who developed hemoptysis following a 49-meter personal best constant weight bi-fin dive, presenting with two episodes of hemoptysis within 24 hours post-dive. His style of diving entails finning down to the desired depth, turning with a single pull on the rope, and then finning up to the surface without using the arms. The diver exhibited no other symptoms and remained hemodynamically stable.

Intervention

CT imaging performed two days post-dive showed ground-glass opacities in the right upper and middle lobes. Treatment involved hospitalization, high-dose corticosteroids, and antibiotics.

Outcome

Follow-up CT scans at seven- and 21-days post-dive revealed almost complete resolution followed by complete resolution of pulmonary abnormalities by the final scan.

Discussion

This case is unique for its documentation of changes in lung findings over three sequential CT scans, providing a timeline of anatomical recovery. This would not be recommended from a radiation safety perspective, but yielded interesting data into the time course of this trauma. The findings raise questions about the underdiagnosis of squeeze injuries, as this diver displayed minimal symptoms despite radiographic evidence of ground-glass opacities. In conclusion, this case highlights the need for standardized imaging and management protocols and further research into the natural history and clinical significance of freediving-induced pulmonary syndrome (FIPS).

D 97: Cave diving in Mexico: A case report

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Case Description

Patient X is a 35-year-old female who was transferred from the ER for treatment of decompression sickness for symptoms that had been present for five days following a weeklong cave diving trip in Tulum, Mexico. She stated she went to a recreational dive center in the morning prior to arriving at the ER and was treated at either 1.4 or 1.8 ATA, which improved her headache. While in the ER, she refused labwork or transport to our chamber. On evaluation, she reported inadequate decompression stop on the final dive of her trip and subsequently flew home the following morning, less than 24 hours after her last dive. She also admitted to chronic ear equilibration issues while diving and recurrent otitis externa, for which she is prescribed multiple antibiotics and steroids to take after symptom onset. She could not elicit what agency she is certified through or her level of certification. The exam showed evidence of otitis externa, the patient was disheveled and anxious, and wore sandals with dirt-covered feet.

Intervention

Treat patient for Type I Decompression Sickness with US Navy Treatment Table 5 at 2.8 ATA with ascent to 2 ATA stop for total treatment time of 135 minutes.

Outcome

On descent, the patient was unable to equilibrate ears; max depth reached 14 fsw. After ascent to 9fsw, Afrin, and maneuvers, patient continued in discomfort. Ears were examined with no evidence of barotrauma, but painful traction of the auricle. After the discussion, the decision was made by the physician and the patient to abort the dive.

Discussion

This case demonstrates the importance and nuance of treating DCS in unreliable patients. Multiple elements of Patient X's history bring concern of psychiatric involvement, potential sequelae of CAGE, truthfulness of the patient, and the physician's ability to diagnose DCS properly. This case also addresses the patient's ability to tolerate prescribed treatment, clinical troubleshooting to improve the patient's symptoms to undergo treatment, and discussing the risk/benefit of being treated and respecting patient autonomy. With other seemingly benign coexisting conditions, this showcases the importance of counseling patients to seek treatment from specialists to resolve those issues prior to future diving.

D 98: Closed circuit rebreathers airway protection tools and their use among technical divers

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

The estimated death rate among rebreather divers is high at 1.8 to 3.8 deaths per 100,000 rebreather dives, and the activity popularity is growing. A previous epidemiological study from the French Navy has shown that among 54 divers who lost consciousness during a dive, none died, and only two had a moderate water inspiration while using a Mouthpiece Retaining Strap (MRS) in a dive team configuration. However, recreational and technical divers express less willingness to use a MRS. Drowning is a major cause of death among them. Therefore, our main objective during this study was to better understand the use of MRS among divers and to evaluate the possible correlation between proper training with the MRS and its voluntary use.

Materials and Methods

An international online survey was disseminated on social media targeting certified rebreather divers. It collected demographic data, diving experience, the potential use of a MRS and how the divers were trained on it. We collected 566 complete responses and used descriptive statistics with a chi-square test to evaluate whether divers with formal MRS training reported different views of MRS use.

Results

Among the 566 respondents, 23.5% were rebreather instructors, and 37.1% were trained on the MRS. Of those trained, 4.5% received training during a military class, 3.5% during a commercial or scientific diving class, and 90.9% during a recreational or technical diving class. Among the divers trained to use the MRS, 62.89% believe the MRS is an important safety tool, while only 42.49% of the divers who were not trained on it recognize its importance.

Summary/Conclusion

These preliminary results highlight the importance of training on the MRS to see it as a relevant safety tool for rebreather divers

D 99: Thoracic disc disease places patient at risk for spinal DCS

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Case Description

A 35-year-old male with no pertinent past medical history presented to the emergency department with myalgias, fatigue, A 35-year-old male with no pertinent past medical history presented to the emergency department with myalgias, fatigue, disequilibrium, and urinary retention after eight recreational spearfishing dives, with depths ranging from 150-170 fsw, with a maximum depth of 206 fsw. Vigorous activity, including fending off a shark, and his extreme dive profiles caused his dive computer to lock out. Symptoms began after boarding his boat and persisted despite an in-water recompression attempt at 24 fsw on air. He presented to the local ED with full-body weakness and 1-liter urinary retention. He was transferred to the Hyperbaric Medicine Department six hours later. On examination, he could not lift his right lower extremity (RLE), had 3/5 strength in his left lower extremity (LLE), and had truncal ataxia and hyporeflexia.

Intervention

He began treatment with a US Navy Treatment Table 6 (TT6) and afterwards regained partial strength in the RLE, but urinary retention persisted, requiring a Foley catheter. Imaging, including MRI of the brain, cervical, thoracic, and lumbar spine, showed only a disc herniation at T4-T5 with mild cord edema. After a second TT6, the patient showed further improvement, including increased strength and the ability to perform a RLE heel-to-shin test. To avoid pulmonary oxygen toxicity, he was transitioned to daily USN Treatment Table 9. The patient could stand and walk four feet with assistance after his third treatment and could void spontaneously, allowing for Foley removal and discharge after his fourth treatment. By his seventh and last treatment, he could walk more than 100 feet unassisted, and his truncal disequilibrium had improved but was not yet at baseline.

Outcome

At follow-up, seven weeks later, he had mild gait unsteadiness and reported post-void fullness and constipation.

Discussion

In this case, the MRI thoracic findings may contribute to understanding the pathophysiology of this patient's spinal decompression sickness (DCS). The area of thoracic cord compression likely has decreased perfusion and altered gas exchange, possibly making him more vulnerable to developing spinal DCS in this area. Further research into this disease mechanism is important as it could offer insight into divers at increased risk of spinal DCS.

D 100: Marine injury and envenomation: Insights into medical management practices in Türkiye

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

Climate change has significantly affected the marine environment. The introduction of various invasive species presents a threat to public health. The incidence of injuries has increased annually due to outbreaks of specific harmful marine species, such as lionfish, jellyfish, sea urchins, and pufferfish. Scuba divers, fishermen, and swimmers are particularly susceptible to the risks associated with these stings and bites. This study aims to present the findings of our management strategies for individuals necessitating medical consultation over the past decade.

Materials and Methods

A retrospective review was undertaken regarding patients' medical records who experienced injuries inflicted by marine animals from 2018 to 2024. The predominant number of patients successfully established contact through the Turkish Research Foundation. The foundation's official website, www.yayakarsa.org, and scientific conferences significantly facilitated patient communication. The analysis encompassed the case distribution, including demographic information, marine animal types, patient complaints and findings, treatment outcomes, and other pertinent criteria.

Results

Our study's results indicate that 40 participants (5-65 years of age) sustained injuries from various marine organisms. Among the individuals who sought medical consultation, 16 were male and 22 were female, reaching out through email or telephone. Notably, ten of the affected individuals were children. Most injuries, amounting to 50%, were attributed to jellyfish stings, while 20% of the patients experienced injuries caused by hydroids and anemones. One case involved a traumatic amputation of a finger. The skin lesions were predominantly located on the upper extremities, with five patients presenting localized lesions on the head and neck. Patients predominantly expressed concerns regarding dermatological issues, including skin rashes, pruritus, a burning sensation, and edema.

Summary/Conclusion

Currently, the primary categorization of marine injuries in Türkiye is minor. Jellyfish are the most common organisms found in our seas, harbors, and beaches. Certain injuries may necessitate significant medical attention. Therefore, it is essential to adhere to the most recent species guidelines and consult diving physicians to ensure timely and appropriate treatment for these conditions.

D 101: Returning to dive after spontaneous pneumothorax and bilateral pleurectomy: A case report

O: n/a
P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM
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Case Description
A 32-year-old Caucasian male diving instructor with over 500 dives experienced a right-sided spontaneous pneumothorax underwater. Despite having abnormal chest tightness at the beginning of the dive, he continued to complete that dive at a maximum depth of 16.5 meters. Following the incident, he underwent right complete pleurectomy and wedge resection as definitive treatment. Imaging after surgery shows small subpleural blebs at the left apical lung, the largest measuring is 0.7 x 1.6 cm. Given his strong passion to resume diving, he underwent prophylactic left-sided pleurectomy with talc poudrage and wedge resection one year later. Postoperative imaging and pulmonary function tests were normal, with no residual lung abnormalities.

Intervention
Following spontaneous pneumothorax, guidelines for fitness to dive vary across different diving medical organisations. Bilateral Surgical Pleurectomy is the key recommendation before considering a return to diving, but guidelines remain inconsistent. A multidisciplinary evaluation, including a pulmonologist, cardiothoracic surgeon, and diving medicine specialist, is involved.

Outcome
After a thorough evaluation, the patient is considered fit to dive adhering to diving safety protocols and periodic follow-up. Despite being physically fit, he experienced an anxiety attack during his first two post-surgery dives. However, with firm reassurance from the doctor and support of a trusted dive buddy, he successfully overcame his psychological barriers and resumed diving without further incidents. He has done 12 dives over four months, reaching a maximum depth of 25 meters without physical or mental issues.

Discussion
Current guidelines emphasize the necessity of bilateral pleurectomy before returning to dive after spontaneous pneumothorax. However, long-term studies on recurrence risk, pulmonary complications, and optimal follow-up imaging post-surgery are lacking. Additionally, psychological readiness is also an important factor that is often underrecognized. This case highlights the importance of individualized assessment and multidisciplinary input in determining fitness to dive post-spontaneous pneumothorax and pleurectomy. Further research is needed to establish comprehensive fit-to-dive recommendations for divers with similar medical conditions.

D 102: Medical consultancy in the archeological diving project of Antalya-Kumluca Bronze Age Shipwreck (2022-2024)

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

A Bronze Age Shipwreck was found in Kumluca-Antalya in 2018. The wreck dates back to the 16th to 15th century BC and is understood to be the oldest merchant shipwreck discovered in the world. The large-scale excavation works of the wreck were carried out between 2022 and 2024. Diving was performed on ships named Arkeo, Virazon II, and UPL. A multi-place pressure chamber was placed on the boats to treat decompression sickness. Three underwater and hyperbaric medicine specialists provided a medical consultancy. Four resident doctors were also assigned to the ship in 2024. We aimed to present the results of medical consultancy at the dive site during excavations.

Materials and Methods

Sixteen men and 13 women divers carried out 1660 (1297 /363) dives. The average depth of the total dives was 39.81.6±19 meters, with a maximum of 72.3 meters. A custom-made decompression table was used for the dives. Medical consultancy in the field had the following objectives: To carry out preventive medicine against diseases and accidents, and treat any events related to diving or other causes. A handheld Doppler was used to listen for any possible bubbles.

Results

Our results show no significant health problems during the study period, and no decompression sickness was observed. Bubbles were detected only in one male diver after his eighth dive. Repeated pulmonary function measurements were performed at the study's beginning, middle, and end. It was found that there were only significant changes in slow vital capacity (SVC) values in function parameters ($P=0.016$). There was no significant change in other pulmonary function test parameters ($p>0.05$). Apart from these evaluations, a few divers were diagnosed with sinus barotrauma, otitis externa, equalization problems of the tympanic membrane, and mild traumatic injuries.

Summary/Conclusion

Archaeological excavations are anticipated to increase as scientists express a heightened curiosity regarding the revelation of historical contexts. Consequently, a pressure chamber and diving medicine physicians and consultants at the diving site are paramount in ensuring safety during these relatively deep dives.

D 103: Effective delayed tailing treatments with non-Navy treatment table in a case of neurologic DCS

O: n/a
P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM
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Case Description
A 29-year-old female completed dives between 31-65 feet of seawater (fsw) on nitrox 32% over 93 minutes (Table 1). During ascent from the final dive, she felt unwell and returned to 20 fsw on 100% O_2 for 19 minutes. Shortly after surfacing, she developed weakness, numbness, ataxia, and vertigo. She was evaluated at a local hyperbaric facility and treated with a USNTT6 without extensions 9 hours after surfacing. However, her vertigo, ataxia, and weakness persisted, leaving her debilitated and unable to work. She presented for evaluation at a tertiary hyperbaric facility 10 days after the initial injury. She was found to have profound bilateral upper extremity weakness, right lower extremity weakness, vertigo, and unsteady gait, felt to be residual DCS.

Intervention
Starting the day of re-evaluation, she received three once-daily HBO_2 treatments via Brummelkampf Table (three-minute compression, 2.8 ATA for 85 minutes, two five-minute air breaks, 24-minute tender decompression stop at 20 fsw with patient remaining on O_2).

Outcome
After treatment #1, she was able to walk independently but continued to have persistent right-sided weakness and ataxia. Following two subsequent treatments, strength returned to baseline, and ataxia resolved.

Discussion
This case demonstrates that HBO_2 may still be effective in DCS cases with delays in the overall treatment course. Despite ten days between initial and subsequent treatments, this patient achieved symptom resolution with serial Brummelkampf tables. Given the current lack of 24/7 chamber availability for divers, this case also suggests it may be reasonable to encourage an initial/immediate treatment at local facilities, followed by transfer to a tertiary hyperbaric facility, even if timing is not optimal. Finally, the Brummelkampf Table is a reasonable option for serial treatments in appropriate DCS cases.

Table 1

Dive	Max Depth (fsw)	EAD	Bottom Time	Surface Interval
1	35.7 (35)	26	17 minutes 20 seconds	9 min
2	31	22	19 minutes 21 seconds	13 min
3	63.6	51	17 minutes 19 seconds	7 minutes
4	63.3	51	22 minutes 46 seconds	

D 104: Diving our way to empathy: Evaluating standardized empathy training in the Handicapped Scuba Association's Adaptive Dive Buddy Training Course

O: n/a
P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM
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Introduction/Background
SCUBA has historically been considered an extreme sport with significant barriers to entry. The Handicapped Scuba Association (HSA) has challenged this narrative since 1981 by bringing the sport to those of all abilities. One must complete the adaptive buddy course to assist and train adaptive divers. This training includes general medical considerations, intensive technical training, and rigorous empathy exercises. HSA empathy training is critical to certification and involves immersive simulation including wheelchair-bound and "blind" exercises as well as paraplegic and quadriplegic underwater simulations.

Empathy and the ability to teach and improve this skill are also becoming core tenets in medical education, and insights into practices that objectively increase empathy could help further develop and inform these curricula in medical education.

To that end, our research questions are as follows:

Is there an objective increase in empathy as measured by the Perth Empathy Scale in certified scuba divers who obtain standardized, intensive empathy training in July 2023 through Adaptable Scuba?

Is there a statistically significant difference in baseline empathy between certified scuba divers who are enrolled in the HSA Adaptive Dive Buddy training course and the general population, as reported by the Perth Empathy Scale?

Materials and Methods
We explored our primary research question with a standardized, validated empathy measure. We partnered with a local branch of the HSA, a non-profit in Dallas called Adaptable Scuba. Adaptable Scuba trains several groups of adaptive buddies yearly according to HSA's international standards. We used the validated Perth Empathy Scale (PES) to measure empathy scores throughout training objectively.

Summary/Conclusion
We believe subjective empathy increased, especially with this specific and vulnerable population. Upon further discussion, we surmise there may be a need for more cohorts, use of a different scale, or creation of a scale especially for caregivers and colleagues of those with disabilities.

D 105: Physiological advantage of increased arm span to height ratio among competitive freedivers

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

Introduction: Competitive freedivers push the limits of physiological adaptation to extremes of pressure and depth. Concurrently, cardiopulmonary complications, including pulmonary barotrauma, immersion pulmonary edema, and alveolar hemorrhage (collectively referred to as "FIPS" – freediving-induced pulmonary syndrome), have been increasingly documented among freedivers. An elevated arm span to height ratio (ASHR) is a recognized phenotypic feature of connective tissue disorders such as Marfan's Syndrome. It is overrepresented in sports that demand increased reach and flexibility, such as basketball and swimming. Using ASHR phenotype as a proxy for genetic variability in connective tissue elasticity, we hypothesized that increased ASHR may confer an adaptive advantage by increasing chest wall compliance and/or pulmonary compression tolerance – thereby facilitating deeper dives – and/or reducing the likelihood of FIPS.

Materials and Methods

Methods: ASHR was measured as wingspan/height in cm, with wingspan measured from the terminal end of each third digit and height measured while standing. Participants were 63 divers (43 males, 20 females) at the 2024 CMAS World Championships, average age 41 ±10.0 yrs (mean ± SD). Competition dive depth (m) and FIPS symptoms were evaluated using a post-dive questionnaire. Associations between ASHR and dive depth were analyzed using simple linear regression, and logistic regression was used to assess the relationship between ASHR and FIPS after controlling for demographic factors.

Results

Results: Mean ASHR among the study population was 1.02 ± 0.024, and average dive depth was 74.4 ±20.5 meters. Forty-three percent of divers (27/63) reported FIPS symptoms. In a simple linear regression, ASHR was significantly correlated with increased depth (R^2=0.09 $p = 0.009$). In a logistic regression assessing predictors of FIPS symptoms, female sex and depth were significant predictors, while age and ASHR were not (female sex: OR = 0.071, $p = 0.0025$, depth: OR = 1.04, $p = 0.030$, age: OR 1.01, $p = 0.70$, ASHR: OR = 0.026, $p = 0.80$).

Summary/Conclusion

These findings suggest that an increased ASHR may confer an adaptive advantage in competitive freediving, possibly due to enhanced connective tissue elasticity and chest wall compliance.

D 106: Remote return-to-freedive assessment. A clinical set of maneuvers

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

Freediving demands rigorous evaluation of physiological readiness before returning to the depths. In response, the Author has developed a novel set of maneuvers aimed at testing return-to-dive readiness for freedivers. Designed for application by physicians with specialized freediving knowledge and implemented in a controlled setting with a companion present, this protocol evaluates oxygenation and symptom responses under various conditions. The maneuvers include assessments at rest versus post-activity, a brief residual volume (RV) apnea, RV stretches, and static apneas at full lung capacity and functional residual capacity (FRC). This is a remote stress test for Freediving.

Materials and Methods

The protocol consists of four primary maneuvers performed under direct physician supervision with a buddy present for safety. First, baseline pulse oximetry is recorded at rest and again after moderate physical activity, allowing for comparison of oxygen saturation levels under differing exertional states. Second, participants undergo a five-second apnea at RV, during which pulse oximetry readings are continuously monitored to capture rapid changes in oxygenation. Third, a series of RV/FRC/TLC stretches are performed with concurrent pulse oximetry and symptom monitoring to evaluate respiratory efficiency and detect early signs of hypoxic stress. Fourth, static apneas are conducted at full lung capacity (TLC) and FRC, providing additional data on oxygen saturation and symptom evolution at different lung volumes. Data from each maneuver is recorded and analyzed to establish a profile of each diver's physiological response, with particular attention to individual performance metrics and symptom progression.

Results

RV apnea consistently identifies concerns even in mild cases of lung barotrauma. To avoid confounding findings, it is crucial not to trigger the dive reflex. These findings suggest that the protocol can effectively identify individuals who are ready to resume diving and those who may require additional recovery time.

Summary/Conclusion

This new, physician-directed manauvers for freediving telemedicine offers a comprehensive, safe method for evaluating return-to-dive readiness through a series of standardized maneuvers. By integrating pulse oximetry and symptom monitoring across varied respiratory challenges, the protocol provides valuable insights into individual diving physiology and enhances overall freediving safety. Further studies will refine these maneuvers for broader clinical application.

D 107: Review of the use of US Navy Table 6A and Comex in Puerto Rico from 1997 to 2024

O: n/a
P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM
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Introduction/Background
Divers with severe decompression sickness have always presented a challenge to treating physicians. Recompression therapy is the definitive treatment for DCI and AGE. The choice of the most appropriate and effective protocol for this extremely sick diver is a difficult one. A limited number of options are available for this task. A deep table using mix-gases is a reasonable alternative consideration for these presentations to prevent serious neurological deficits, avoid incapacity, and preserve life. To guarantee the safety of patients and staff, a medical facility performing deep tables must meet certain specific conditions. Among these are an appropriate chamber size, adequate equipment, trained staff with experience in deep tables, redundant staff, and adequate gas supply.

Puerto Rico is an American territory situated in the Caribbean Sea. The Hyperbaric Medicine Center (HMC) has provided diving accident treatment on the island since 1997. Most of the cases of DCI decompression in Puerto Rico are linked to artisanal fishermen who harvest marine species such as conch shells, lobsters, and spearfish. Many of these individuals presented with severe illness, some of whom developed an initial catastrophic event that frequently progressed to a life-threatening condition. As a result of the high nitrogen loading, severe DCI and AGE, and multiple neurological deficits, this patient required critical medical management including endotracheal intubation, mechanical ventilation, and the use of decompression tables, such as the US Navy 6A or Comex table, with mixed gases. This presentation is intended to present a retrospective review of the use of deep tables in Puerto Rico over the past 27 years.

Materials and Methods
Data analysis of the use of deep tables Comex and 6A for 27 years in Puerto Rico Hyperbaric Medicine Center. Bousseuges score >7

Results
- 10 Comex tables
- 6 US Navy 6A
- Bousseuges score >7
- DCS Type 2 and 3

Summary/Conclusion
- 0 accident in staff
- Diving population with high nitrogen loading and complex DCI
- Comex is a practical choice for deep tables
- Other factors out of Bousseuges score discussed

D 108: Evaluation of the therapeutic Veterans Immersion Program (VIP) at the Georgia Aquarium from satisfaction survey analysis and narrative literature review.

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

Recreational SCUBA diving is a promising, yet understudied, form of rehabilitation for veterans with physical and/or mental disabilities. The Georgia Aquarium's unique Veterans Immersion Program (VIP) has facilitated therapeutic immersion for thousands of veterans in field expeditions and weekly dive/swim programs in the Ocean Voyager exhibit since its inception in 2008. This study assesses the program's impact, efficacy, and future direction through analysis of the VIP satisfaction survey results and narrative literature review of the therapeutic effects of diving for veterans. The literature review identified gaps in knowledge of the therapeutic effects of dive immersion on veterans; a distinctive opportunity, we propose additions to the survey that could supplement the knowledge base and inform future program enhancement.

Materials and Methods

PubMed and Google Scholar were searched with keywords "veteran", "scuba", and "therapy" within a publication date range of 2015-2025 to conduct the literature review. In the six months from July through December of 2024, within thirty minutes of VIP programming, 126 veterans completed a survey that collected demographic information, assessed satisfaction with the program and trust of Aquarium staff on a Likert scale, measured "state of being" outcomes, and prompted free response recommendations for VIP program improvement. Data collection will continue through 2025.

Results

Frequency distribution analysis of VIP survey results indicates positive results for the satisfaction, state of being, and trust level established by the veteran participants at the Georgia Aquarium. Many comments indicated "life-changing" experiences that positively influenced the participants. Qualitative analysis of free response recommendations for improvement suggested incorporating greater familial involvement in the experience.

Summary/Conclusions

Analysis of VIP survey results concludes that it is a positive experience for veteran participants and fruitful with program enhancement recommendations. A literature review revealed that the long-term effects of therapeutic dive immersion experiences for veterans are largely understudied, as past studies of therapeutic programming have small sample sizes and limited outcome follow-up. We propose that assessing "state of being" outcomes longitudinally and introducing measures of camaraderie, stress, and mindfulness before and after programming could aid in future data collection and inform program enhancement.

D 109: Freediving Medical Incident Registry-A Proposal

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

A Gap has been identified. A complete database, including recreational and competitive freediving, must be collected to cross-match variables and generate statistics and causation. The author's clinical experience has dictated the variables presented in this proposal.

Materials and Methods

Clinical experience, 2017-2025, in in-person and remote Freediving medicine incident assessment and guidance by the Author has been used to generate a sport-directed approach. The author has identified that a common reason for consultation is the continuation of freediving activity at depths compatible with competitive freediving.

Results

Variables (An online tool has been developed), include

- Age
- Discipline
- Depth
- Dive time
- Hypoxia present: Surface or depth
- Rescue difficulty
- Past medical Hx
- Past Surgical Hx
- Equalization technique and Experience **
- PB Personal Best
- % of PB at which incident happened
- Among others

Summary/Conclusion

This is a viable option to collect data. A tool that is not available to UHMS or DAN, which is sport-specific and Sport-directed.

D 110: Training effects in proficiency of pre-dive safety checks

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Presenting Author: Adrian Carpenter, MD
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Introduction/Background

Diving is a complex yet easily accessible activity, and training in the recreational setting confers lifelong qualification. Divers are generally responsible for their safety, and a core aspect of this safety is the performance of a pre-dive readiness assessment, usually performed on/by a dive buddy. The pre-dive readiness assessment is part of the core teaching of all SCUBA training programs. Its purpose is to confirm key aspects of a diver's equipment and set the stage for a safe dive. The dive buddy performing the readiness assessment can potentially miss minor or critical errors in equipment readiness, and any missed errors can negatively impact the safety of the planned dive. Research into aviation and surgical procedure safety shows that minor and critical errors are commonly encountered in technical activities and that "near-misses" vastly outnumber bad outcomes.

Materials and Methods

Over a four-year period, by observing a skill-based scenario, we have investigated the proficiency of pre-dive safety assessments in a group of clinicians attending the Physician Training in Diving Medicine Course to demonstrate whether factors related to type of training and volume and recency of dive experience impact pre-dive readiness assessments.

Results

Using an analysis of covariates, we can show that within this group of highly trained clinicians, the most significant predictor of performance in a simulated pre-dive readiness check is the level of SCUBA training they have, with a significant improvement in performance amongst Dive Masters.

Summary/Conclusion

This is important because the check itself is a simple task to perform, ostensibly one that could be performed well at any level; most divers are trained at the "Open Water" or "Advanced Open Water" level, indicating that there may be significant room for improvement in the training of the pre-dive safety check, or in the maintenance of this skill amongst divers at this level.

WEDNESDAY, JUNE 4

UHMS Track: Regency VI

8:30am-10am **Plenary: International panel: Vestibular DCI; DEEP; Saturation diving table reviews: Philip Bryson, MBBS; Andrew Abercromby, PhD; Rosanna Stokes, MBBS; Jean-Pierre Imbert, PhD**

About the Lecture

- **Vestibular testing and rehabilitation in divers with inner ear decompression sickness:** Presentation of an observational case series of divers with inner ear decompression sickness including vestibular testing outcomes vs. normative results. Discussion regarding vestibular rehabilitation methods and practical aspects of management.
- **DEEP**
- **Saturation diving table reviews**

About the Speakers

Phil Bryson, MBBS

Dr Bryson started off his diving medicine interest at Discovery Bay Hyperbaric Unit in Jamaica whilst he was working in Kingston in the very early days of his medical career. He then moved to Plymouth (UK) where he worked as a volunteer at the Diving Diseases Research Centre for 6 years whilst he completed his training to be a GP.

He then managed to turn his hobby into a career and carried on working at DDRC for the next 25 years being the Medical Director there for his last 11 years, prior to leaving to take up a job at International SOS in December 2010. In 2023 TAC Healthcare took over the Aberdeen International SOS business and he is now their Medical Director of Diving Services.

He has published extensively in specialist medical journals, been the medical advisor to Sport Diving organizations in the UK, sits on the DMAC, EDTC, UK Diving Medical Committee and EUBS committees and is the current Vice President of the UHMS. He has also sat on several IMCA working groups.

Andrew Abercromby, PhD

Dr. Andrew Abercromby is deputy lead for advanced human life support and performance at NASA. In this agency-wide role, Andrew supports the identification and development of technology needs to enable NASA's future human exploration missions. Andrew received an MEng in mechanical engineering from the University of Edinburgh, during which he worked on X-38 guidance systems in the Flight Mechanics Laboratory at the NASA Johnson Space Center (JSC). He earned a PhD in motor control from the University of Houston while conducting his doctoral research in NASA's Neurosciences Laboratory. Andrew has over 20 years of experience at NASA, He is the founder and former lead of the Human Physiology, Performance, Protection and Operations (H-3PO) Laboratory at JSC, whose mission is to provide world-class health and performance in extreme environments on earth and in space and has included studies in deserts, active volcanoes, Arctic impact craters, reduced-gravity parabolic aircraft, and hypobaric chambers. Andrew's contributions have been recognized with multiple awards, including the Rotary National Award for Space Achievement (RNASA) Stellar Award and the NASA Outstanding Leadership Medal.

Rosanna Stokes, MBBS

Rosanna is a hyperbaric and diving physician working at DDRC Healthcare in Plymouth, UK. She currently is undertaking a PhD researching the mechanisms of injury and recovering in scuba divers with inner ear decompression sickness (IEDCS).

Jean-Pierre Imbert, PhD

Dr. Jean-Pierre Imbert spent 19 years at Comex, a historical leading diving company, as Diving Manager. He was involved in the Comex research hydrogen dives and computed the French MT92 tables. He participated in the Norwegian deep projects of the 80s and developed the Comex procedures for saturation to 300 in Brazil. He became an IANTD instructor in France and trained trimix and rebreather divers for 10 years. He has returned to the offshore industry as a consultant, editing diving manuals and decompression procedures for major North Sea companies. He has steadily kept publishing on decompression modelling and, recently, on divers' monitoring.

Session E - HBO_2 Operations, Chambers and Equipment

10:30am-11am **Plenary: Session E: Extremely Intensive Care – Successful delivery of Hyperbaric ECMO - Ian Millar, MD and Bridget Devaney, MBChB**

About the Lecture

An introduction to the history and mechanics of extra-corporeal membrane oxygenation (ECMO) will be provided including past examples of hyperbaric use. This will be followed by a detailed narrative case report of the provision of HBO_2 to a critically ill trauma patient with life-threatening synergistic vaso-invasive fungal infection in the setting of ECMO dependence following thoracic trauma requiring a pneumonectomy. The safety considerations, modifications, testing and clinical experience of providing ECMO in hyperbaric conditions on 13 occasions will be detailed

About the Speakers

Ian Millar, MD

Dr Ian Millar is a senior specialist in Diving & Hyperbaric Medicine at The Alfred Hospital in Melbourne, Australia, a quaternary super-specialty hospital and Level 1 Trauma Centre. Dr Millar and The Alfred have leading edge hyperbaric capabilities supported by advanced critical care equipment and staffing of a combined multiplace / monoplace facility.

Bridget Devaney, MBChB

Bridget is an Emergency Physician at The Alfred Hospital, in Melbourne, Australia. She is also the Medical Director of the Hyperbaric Service, and an Adjunct Research Fellow with the School of Public Health and Preventive Medicine at Monash University. Bridget has a clinical and research interest in the interface between critical care and hyperbaric medicine. She is particularly interested in necrotising soft tissue infections, cerebral arterial gas emboli, and the care of the critically unwell patient in the hyperbaric environment. Working with her team to safely, and successfully, deliver hyperbaric oxygen treatment to a patient on extracorporeal membrane oxygenation (ECMO) is a career highlight.

11am-11:10am **E111:** Retrospective cohort study of Microvascular Fluorescence Angiography (MFA) use in hyperbaric oxygen therapy patients following lower extremity amputation complicated by flap ischemia. Presenting Author: Benjamin R. Banks, MD, MS

11:10am-11:20am **E112:** Additional Information Obtained from the CMS Controlled Study Employing Billing Records to Report Effects and Costs of Hyperbaric Oxygen for Radiation Cystitis. Presenting Author: John J. Feldmeier, DO

11:20am-11:30am **E113:** Sharpened Romberg Test variability in a randomized, double-blind trial of Hyperbaric Oxygen for Persistent Symptoms after Brain Injury. Presenting Author: Rosemary Ziemnik, MS

Session F - Clinical Evaluations

11:30pm-11:40am **F130:** Myopic changes persist 6 weeks after hyperbaric oxygen treatment course in monoplace chamber. Presenting Author: Joan W Chou, MD

11:4apm-11:50am **F131:** Ultrasound muscle scans collected during decompression may predict post-dive venous gas emboli loads. Presenting Author: Joshua Currens

11:50am-12pm	**F132**: Divers tend to produce individually consistent venous gas emboli grades after conducting the same dive multiple times. Presenting Author: Joshua Currens
12pm-2pm	**Lunch (On Own), Special Luncheons and Meetings**
2pm-2:30pm	**Plenary: Microparticle research: An international collaboration with South Korean physicians on carbon monoxide poisoning - Steve Thom, MD**

About the Lecture

Clinical research in hyperbaric medicine is challenging and international cooperation can hasten the pace of discovery. A case in point is work on the pathophysiology and treatment of carbon monoxide (CO) poisoning. A recent study (Science Advances **11**, eado975. 2025) involving 150 CO-poisoned patients demonstrated that CO-induced neurological injury has an inflammatory etiology. Due to microparticle (MP)-mediated communications between the brain and systemic circulation, CO-induced cognitive deficits may be reversable. South Korean physicians played a major role in this work by obtaining blood samples and sharing clinical outcome results on their patients. This presentation will summarize the study results and describe how international collaborations can be readily established.

About the Speaker

Stephen R. Thom, MD, PhD, Professor of Emergency Medicine and our department's Director of Research studies the role of vasculogenic stem cells in diabetic wound healing, nitric oxide in cytoskeletal regulation of neutrophil β2 adhesion molecules, and pro-inflammatory microparticles in the pathophysiology of decompression sickness. His work is funded by the National Institutes of Health, the Office of Naval Research, and the US Air Force.

2:30pm-3pm	**Eustachian Tube Dysfunction & Middle Ear Barotrauma Diagnosis, Grading, Treatment, & Prevention** **Owen J O'Neill, MD, MPH, FUHM, FACHM, FAPWCA, FAPWHc**

About the Lecture

About the Speakers

Dr. Owen O'Neill is President and Medical Director of U.S. Hyperbaric Tunnel Medicine and Research Team and the medical director of the Department of Undersea & Hyperbaric Medicine at Phelps Hospital Northwell Health. He has been an active member of the UHMS for many years and currently serves as the co-chairman of the education committee and is a member of the Publications Committee and diving committees. He is the recipient of the UHMS commercial diving award and Excellence if hyperbaric medicine award. He has served various positions on the board of the UHMS and is the current President.

3pm-3:30pm	**Regulatory Oversight – Hyperbaric Medicine's Pandora Box** **John Feldmeier, DO and Tom Workman, CHT;**

About the Lecture

About the Speakers

Dr. Feldmeier received his D.O. degree from The Philadelphia College of Osteopathic Medicine in 1979 with USAF sponsorship and completed residency training in Radiation Oncology at the University of Texas Health Science Center at San Antonio, Texas in 1985. He received a fellowship certificate from the USAF Hyperbaric Medicine Fellowship Training Program at Brooks Air Force Base in San Antonio, Texas and was a staff physician there from 1980 to 1982. Dr. Feldmeier was simultaneously the Chief of Radiation Oncology and Chairman of the Hyperbaric Medicine Department at Wright-Patterson Air Force Base Medical Center in Dayton, Ohio before separating from the USAF in 1985. Dr. Feldmeier has served as the Chief of Radiation Oncology at the University of Texas Health Science Center in San Antonio, Grace Hospital in Detroit, MI and the Chairman of Radiation Oncology at the University of Toledo Medical Center from which he retired in 2013 with the award of Professor Emeritus. Dr. Feldmeier has authored numerous publications in both radiation oncology and hyperbaric medicine. He has been the editor of the Undersea & Hyperbaric Medical Society (UHMS) Hyperbaric Oxygen Therapy Committee Report. He served as review editor of Undersea and Hyperbaric Medicine. He is a Fellow of Undersea and Hyperbaric Medicine and Past- President of the UHMS. He currently co-chairs the UHMS Research Committee. He is a Fellow of the American College of Radiation Oncology. He is a medical consultant to International ATMO. He is the only physician in the U.S. board certified in both Radiation Oncology and Undersea and Hyperbaric Medicine.

Tom Workman recently retired as the Director of Quality Assurance & Regulatory Affairs for the Undersea & Hyperbaric Medical Society. He was responsible for the development and management of the Society's Clinical Hyperbaric Facility Accreditation Program.

He retired from the United States Air Force as a colonel after more than 23 years of service devoted to aerospace and hyperbaric physiology. From 1980 to 1992, Col Workman was assigned to the USAF Hyperbaric Center, Brooks AFB TX. Active in many professional organizations for over 45 years, he has served on the National Fire Protection Association's Technical Committee for Hyperbaric and Hypobaric Facilities since 1984 and the American Society of Mechanical Engineers Pressure Vessel for Human Occupancy Technical Committee for 30 years, among many other committee leadership positions. Included in his many awards are the Undersea & Hyperbaric Medical Society's (UHMS) Craig Hoffman Memorial Award presented in 2001 for his contributions to diving safety and the first UHMS Gulf Coast Chapter Wilbur T. Workman Award named in honor. He is also the recipient of the Aerospace Physiologist Society's Paul Bert Award for Physiological Research, the Wiley Post for Operational Physiology and the Fred Hitchcock Award.

3:30pm-4pm **Exhibits / Break: Grand Ballroom West**

4pm-5:30pm **Ram Bowl: Centennial Ballroom**

About the Ram Bowl

The 15th Annual RAM Bowl features participants from the Air Force, Navy, Army, Mayo Clinic, UTMB and international representatives competing for the Louis H. Bauer Trophy. Aerospace Medicine Residents are required to demonstrate multiple competencies to satisfy the requirements of ACGME and ABPM and serve as specialists in the field. Multiple tools are available for developing appropriate didactic knowledge in aerospace medicine, public health, epidemiology, biostatistics and health care management. Residents participate in a college bowl format that test aerospace medicine competencies including the flight environment (atmosphere, radiation, vibration, acceleration, and microgravity), clinical aerospace medicine, aircraft and space vehicle systems/operations, accident investigation, historical events, aerospace physiology, human factors, ergonomics, medical standards, Federal Aviation Administration regulations, passenger transport, restraint and escape, cockpit resource management and aeromedical transportation. Questions are divided into toss-up and bonus questions. Multiple rounds of competition will lead to the selection of an individual victor and awarding of the Louis H. Bauer Trophy to the top team, sponsored by the American Society of Aerospace Medicine Specialists.

Objectives:

The contest will enable participants to prepare for ABPM examinations in Aerospace Medicine.
Attendees will receive an intense review of Aerospace and Preventive Medicine.

7:00pm-10pm **UHMS Honors Night: Grand Hall East A/B/C/D (ticket required)**

Session E – HBO_2 Operations, Chambers and Equipment ABSTRACTS

E 111: Retrospective cohort study of Microvascular Fluorescence Angiography (MFA) use in hyperbaric oxygen therapy patients following lower extremity amputation complicated by flap ischemia

O: Wednesday, 6/4/2025, 11:00 AM - 11:10 AM
P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

Banks B[1]; Ononenyi A[1]; Wankowski D[2]; Riutta S[2]; Lamptey M[2]; Gesell L[1]
[1]St. Luke's Medical Center, Aurora Health Care – Advocate Health, Milwaukee, WI; [2]Graduate Medical Education Research Support – Midwest Region, Aurora UW Medical Group, Academic Affairs, Aurora Sinai Medical Center, Aurora Health Care – Advocate Health, Milwaukee, WI
Presenting Author: Benjamin R. Banks, MD., MS.
E: benjamin.banks@aah.org

Introduction/Background

Microvascular Fluorescence Angiography (MFA) allows for assessment of focal tissue perfusion following an amputation. Sequential MFA studies provide visualization of initial microvasculature and evolving angiogenesis at an amputation site, allowing clinicians to assess the impact of Hyperbaric Oxygen Therapy (HBO_2) throughout a patient's recovery. In turn, MFA may then influence the prolongation or completion of HBO_2. This study assessed whether MFA impacted the duration of HBO_2 following lower extremity distal amputation in patients who developed a postoperative ischemic compromised flap ("comp flap").

Materials and Methods

In this retrospective chart review, lower extremity amputation patients with clinical findings for comp flap and who also received HBO_2 were identified. The patients were divided into cohort group (underwent MFA imaging) and control group (no MFA imaging). HBO_2 duration and clinical outcomes were compared between groups.

Results

267 patients who underwent toe amputation (101 cohorts/166 controls) were identified. Patients received between one and 60 HBO_2 treatments. Overall, the MFA group received more HBO_2 treatments than the control group: 46% of MFA patients received 11-20 treatments compared to 34% of controls; 30% of MFA patients received 21-30 treatments compared to 23% of controls; and 12% of MFA patients received 31 or more treatments compared to 9% of controls. Notably, one-third (34%) of control patients received ten or fewer HBO_2 treatments, compared to 13% for the MFA group.

Summary/Conclusion

MFA's application in HBO_2 patient selection and influence on treatment duration has been promoted. However, there is little information on the direct impact. Interestingly, non-MFA patients were more likely to receive ≤10 treatments when compared to the MFA group. MFA patients were more likely to receive 11-20 treatments than non-MFA groups. Additionally, MFA appears to influence HBO_2 by increasing the number of treatments in comp flap patients for all hyperbaric treatment course subgroups who received >10 HBO_2. Once a patient surpasses 20 HBO_2 treatments, the impact of MFA on treatment duration is less robust. Further analyses are needed to understand competing factors as we explore MFA's role in hyperbaric medicine.

E 112: Additional information obtained from the cms controlled study employing billing records to report effects and costs of hyperbaric oxygen for Radiation Cystitis

O: Wednesday, 6/4/2025, 11:10 AM - 11:20 AM
P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM
Feldmeier JJ[1], Kirby JP[2], Gelly HB[3], Robins M[4], Peters JS[4]
[1]University of Toledo Medical Center, [2]Washinghton University School of Medicine, [3]Regenerative and Hyperbaric Medicine, Marietta, Georgia, [4]Senior Medical Director, Intermountain Health, [5]Undersea and Hyperbaric Medicine
University of Toledo Medical Center, Toledo, OH
Presenting Author: John J. Feldmeier, DO
E: jfeldmeier@aol.com

Introduction/Background
Our group has previously reported enhanced clinical outcomes and cost savings in treating radiation cystitis with hyperbaric oxygen compared to standard care. Clinical interventions were unmasked without HIPAA violation by comparing CMS fee-for-service billings from October 2014 to December 2019. This comparison-demonstrated a clear clinical and cost advantage for the hyperbaric group. Additional valuable information was discovered in this study and will be presented here.

Materials and Methods
This review is intended to present and discuss additional findings of this study, including incidence, natural history, and treatment results, some of which were unexpected. It is accomplished by analyzing secondary results found in our previous publication.

Results
1. Our analysis showed that of the 3309 records analyzed, 31% received hyperbaric oxygen, and the remaining 69% in the control group received standard care.
2. Patients in the treatment group slightly exceeded the control group's Charlson Comorbidity Index.
3. The analysis included identifying geographic areas in which cystitis was more common and its treatment with hyperbaric oxygen was more likely.
4. A substantial portion of each group was treated for non-hemorrhagic radiation injury.
5. In the first follow-up, there was a decreased mortality for hyperbaric patients.

Summary/Conclusion
Real-world data obtained from large databases and analyzed can reveal useful and unexpected information beyond the main outcome parameters of a formal study. The report of these should be considered when notable. Such secondary analyses may be significant on their own account or may open avenues for future research.

E 113: Sharpened Romberg test variability in a randomized, double-blind trial of hyperbaric oxygen for persistent symptoms after brain injury

O: Wednesday, 6/4/2025, 11:20 AM - 11:30 AM
P: n/a

Ziemnik R[1], Weaver LK[1,2], Deru K[1]
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[2]University of Utah School of Medicine, Salt Lake City, UTPresenting Author: Rosemary Ziemnik, MS
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Introduction/Background
In a randomized trial of hyperbaric oxygen (HBO_2) after brain injury (HYBOBI-2) (Scientific Reports 2025), we present Sharpened Romberg Test (SRT), Romberg, and Tandem Gait (TG) results.

Materials and Methods
Adult participants with persistent symptoms from non-stroke brain injury were randomized to receive 40 one-hour blinded (Hyperbaric oxygen-HBO_2 or sham sessions) in a monoplace chamber over 12 weeks. The SRT, Romberg, and TG were administered by trained clinicians at baseline, 13 weeks (after 40 chamber sessions), and 6 months. A normal SRT and Romberg were holding position for 30 seconds.

Results
Forty-seven participants were randomized (45% female, mean age 47). Participants' qualifying injuries were traumatic brain injury (22 HBO_2, 18 sham), carbon monoxide poisoning (4 HBO_2, two sham), and hypoxic injury (1 sham). There were no significant baseline differences between intervention groups on these neurological subtests. At baseline, there was no statistically significant difference in left vs right foot back. There were no consistent changes in these examinations in either intervention group.

		Baseline to 13 weeks				Baseline to 6 months			
	Baseline Abnormal	No change	Abnormal to normal	Normal to abnormal	*p*	No change	Abnormal to normal	Normal to abnormal	*p*
SRT N (%)									
HBO_2	13 (50)	15 (68)	3 (14)	4 (18)	0.7	13 (54)	3 (12.5)	8 (33)	1.0
Sham	8 (38)	13 (72)	1 (6)	4 (22)		8 (50)	2 (12.5)	6 (38)	
Romberg N (%)									
HBO_2[a]	4 (15)	18 (82)	3 (14)	1 (4.5)	1.0	19 (86)	3 (14)	0 (0)	0.3
Sham	2 (9)	15 (83)	2 (11)	1 (5.6)		13 (81)	1 (6)	2 (13)	
Tandem gait N (%)									
HBO_2[b]	5 (20)	17 (81)	1 (5)	3 (14)	0.5	18 (78)	3 (13)	2 (9)	0.6
Sham	7 (33)	12 (67)	3 (17)	3 (17)		12 (75)	1 (6)	3 (19)	

Not recorded at [a]6 months (*n*=2) and [b]baseline (*n*=1)

Summary/Conclusion
The SRT was the neurological subtest more likely to be abnormal at baseline compared to the Romberg and TG. Subsequent testing in these brain-injured participants showed greater variability on the SRT. Explanations include variable patient dysfunction, motivation, and variability across clinicians.

E 114: Decompression sickness and oxygen toxicity among hyperbaric chamber inside attendants: An update on 40 years of sea-level treatment experience

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

Witucki P, Kortz M, Duchnick J, Grover I, Neuman T
University of California, San Diego Hyperbaric Division
Presenting Author: Peter Witucki, MD
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Introduction/Background

There is an inherent risk of decompression sickness (DCS) and central nervous system (CNS) oxygen toxicity to inside attendants (IAs) of multiplace hyperbaric chambers. Forty years ago, the University of California, San Diego Hyperbaric Medicine Center (UCSD) developed three decompression protocols, depending on IA total bottom time (TBT), to mitigate these rare but potentially serious complications. Here, we review the literature and update the incidence data originally published in 2013 to characterize better the risk of DCS and oxygen toxicity for IAs.

Materials and Methods

- Protocol 1: For a total bottom time (TBT) of less than 80 minutes at 2.4 atmospheres absolute (ATA) or shallower, no oxygen breathing is required, and the U.S. Navy (1955) no-decompression tables were utilized (324 exposures).
- Protocol 2: For a TBT between 80 and 119 minutes, IAs breathed oxygen for 15 minutes before initiating ascent (34,601 exposures).
- Protocol 3: For a TBT between 120-139 minutes IAs breathed oxygen for 30 minutes prior to ascent (1,009 exposures).

Results

These protocols have been utilized for nearly 40 years, with no observed cases of DCS or central nervous system oxygen toxicity in IAs. Based on more than 35,000 exposures, these updated results have an upper risk limit of DCS and oxygen toxicity of 0.01219 (95% CI) using UCSD IA decompression Protocol 1, 0.00016 for Protocol 2, and 0.00395 for Protocol 3.

Summary/Conclusion

We believe no other decompression schedule has ever been tested with such a high confidence level. As originally concluded, this methodology may be useful at other sea-level multiplace hyperbaric chambers.

E 115: Clinical application of a barotrauma early detection and response system during hyperbaric oxygen therapy

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

Wang SJ, Kang PR, Yoon SH
Hallym University Dongtan Sacred Heart Hospital, 40, Seokwoo-dong, Hwaseong city, Gyeonggido, Republic of Korea
Presenting Author: SJ Wang, MD.PhD
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Introduction/Background

Barotrauma is the most common side effect of hyperbaric oxygen therapy, and no method has been developed to prevent it completely. Barotrauma symptoms can result in extended treatment time, interruption of treatment, and may be untreatable. Efforts for pressure equilibrium are challenging to apply to patients with reduced consciousness or cognitive and behavioral abnormalities. Therefore, the development and clinical application of a system that can prevent and cope with barotrauma is essential, and the researchers developed a headset-type system(Anti-Barotrauma System: ABTS) and applied it to clinical trials

Materials and Methods

The study was conducted at three medical institutions in a prospective parallel design. Participants were randomized into two groups. Video Otoscope was applied before and after treatment, and images were saved to measure the degree of injury by otoscopic observation using Modified Edmond's Score. All participants were assessed for ear pain using a pain scale. The number of treatment discontinuations due to barotrauma and participants' satisfaction were measured.

Results

There was a difference in the presence of ear pain with 7 participants in the test group and 12 participants in the control group. ($p<0.05$) The mean scale of ear pain was also different, with 4.8 in the test group and 5.5 in the control group.($p<0.05$) Edmond's Score before and after treatment was 1.44 and 1.5, and 1,5 and 1,61 in the test group, respectively. Treatment stops during pressurization were higher in the test group at 5.02 and the control group at 1.83.($p<0.05$) The total time used for decompression during pressurization was also longer in the test group at 212.7 seconds and 122.5 seconds ($p<0.05$).

Summary/Conclusion

The use of ABTS may help in the early detection and prevention of barotrauma. It can also reduce ear pain and tympanic membrane injury. However, it may increase the number of pauses during pressurization and the time spent decompressing, increasing the total treatment time. The need to request a headset-like device may contribute to decreased satisfaction. Future modifications to the algorithm and headset design can improve this.

E 116: Summary of Dexcom G7 CGM testing in hyperbaric air and hyperbaric oxygen environments

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM
Huang E[1], Savaser D[1], Hocking J[1], Huang A[2]
[1]Legacy Emanuel Medical Center, [2]Jesuit High School, Portland, OR
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Introduction/Background

The use of continuous glucose monitors (CGMs) in a hyperbaric environment has become more prevalent as they are used in more patients with diabetes, but the safety of these devices has not been universally accepted. A series of studies have investigated the safety and performance of the Dexcom G6 and G7 CGM (Dexcom LLC, San Diego, CA) in both hyperbaric air (HBA) and hyperbaric oxygen (HBO_2) environments.

Materials and Methods

We obtained commercially available G6 and G7 CGMs and tested them in HBA and HBO_2 environments. Initial studies pressurized G6 and G7 CGMs to 3 atmospheres absolute (ATA) HBA to determine if they functioned properly. Subsequent studies compared G6 CGM results to blood glucose (BG) drawn from patients without diabetes. Multiple G7 CGMs were recently tested at 3 ATA in a 100% oxygen environment to see if they functioned as designed. Finally, bare G7 printed circuit boards (PCBs) were short-circuited while in a 100% oxygen environment at 3 ATA to determine if there was any risk of combustion.

Results

Pressurization of G6 and G7 CGMs to 3 ATA in air or oxygen did not cause physical damage to the CGMs, and all CGMs functioned within normal parameters. CGM readings approximated BG readings for patients without diabetes receiving HBO_2. Short-circuiting G7 PCBs and button-cell batteries in a 3 ATA HBO2 environment did not cause arcing, heating, or fire.

Summary/Conclusion

We conclude that intact G6 and G7 CGMs should be safe to use while undergoing HBO_2 in either an air or 100% oxygen environment up to a pressure of 3 ATA. However, results from the Dexcom CGM testing cannot necessarily be extrapolated to other manufacturers' CGMs, as manufacturing techniques play a role in safety.

E 117: Influence of microvascular fluorescence angiography on the hyperbaric oxygen therapy treatment course

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

Do the findings of Microvascular Fluorescence Angiography (MFA) change the physician's judgment on wound/flap status and planned course of hyperbaric oxygen therapy (HBO_2)?

Currently, the use of MFA is not a standardized practice in the Hyperbaric Medicine & Wound Care (HWC) field. Some physicians rely primarily on their clinical exam, while others may use MFA to complement their exam. Within the HWC field, it is unclear if MFA is of decision-making value, considering the high purchase cost. This project aimed to measure the influence of MFA in the physician's assessment of wounds/flaps to understand better the value of MFA and the impact on the duration of the HBO_2 treatment course.

Materials and Methods

Physicians at Aurora St. Luke's Medical Center's HWC department were given surveys pre- & post-MFA with questions regarding the patient's wound status, whether HBOT duration will be changed, and the provider's level of confidence (Likert scale) in their decision to modify or not modify HBO_2 treatment duration. Physicians' answers from pre- & post-MFA surveys were compared to determine if the findings from MFA led to changes in wound impression, planned HBO_2 duration, and confidence.

Results

Thirty-five pre-/post-physician surveys were collected. Compared to clinical assessment, 37% of physicians changed their impression of the wound/flap's clinical status, 43% changed the planned HBO_2 duration, and 80% reported their level of confidence in the planned HBO_2 duration increased after using MFA.

Summary/Conclusion

MFA provides objective information on hyperbaric patients' wound/flap tissue viability that may not be clinically apparent. Our results demonstrate that using MFA allowed physicians to fully assess and appreciate wound/flap clinical status and adjust planned HBO_2 duration to more accurately reflect the objective state of the patient's wound/flap. Further, using MFA led to 80% of physicians reporting increased confidence in their decisions for the planned treatment course, even if no changes were made to the wound/flap impression or HBO_2 plan. These findings substantiate using MFA to augment the clinical exam when treating hyperbaric patients.

E 118: Hyperbaric treatment of HeartMate 3 left ventricular assist device dependent patient

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

Lauer L[1,2]; Gregory T[1]; De Blasio J[1]; Schinazi E[1]; Kraft K[1]; Clough J[1]; Masker J[1]; Turcotte F[1]; Sparks J[1]; Wilkinson A[1]; Natoli M[1]; McDorman M[1]; Ransom Z[1]; De Hoog T[1]; Doar O[1]; Brown R[1]; Blue L[4]; Allen J[1]; Covington D[1,3]; Derrick B[1]; Ellis MC[1]; Stolp B[1]; Moon R[1,3.]

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Introduction/Background

Hyperbaric treatment has often been withheld from patients dependent on life support devices such as a left ventricular assist device (LVAD) due to a lack of testing by the manufacturer in a hyperbaric environment. The few publications on the use of LVADs in the hyperbaric chamber included modifications to the chamber or the device to minimize pressure on the device or to meet the National Fire Protection Association code. A patient requiring urgent hyperbaric treatment prompted a review of the literature and treatment methods.

Materials and Methods

Function of a training HeartMate 3 LVAD at hyperbaric pressure was conducted with the LVAD connected to a mock circulatory system and with the device powered from the chamber's 120VAC power supply. Separately, the LVAD mobile power unit and controller (with an 11-volt internal lithium-ion battery in place) were purged with nitrogen and pressure tested at 2, 2.8, and 4 ATA with varying compression, bottom, and decompression times to assess for fire risk and functionality of the device. The LVAD Team trained the hyperbaric staff on alarms, controller functions, and changing power sources. Emergency procedures for clinical management were developed and rehearsed.

Results

Initial unmanned testing was conducted without fire or evidence of damage to the device during visual inspection. The LVAD device and components functioned properly during repeated manned pressure tests. Staff familiarization with the device, LVAD-specific medical considerations, emergency procedures, and treatment checklists was deemed adequate preparation for treating a patient. Subsequently, the patient received 60 treatments without hemodynamic compromise or significant variation in controller parameters. There was no evidence of damage or device malfunction after the treatment course.

Summary/Conclusion

We believe this adds to existing information that we may be able to expand the use of hyperbaric oxygen therapy for patients dependent on an LVAD, in the appropriate clinical setting.

E 119: Hyperbaric facilities list: A deluge of "mild" on hyperbaric oxygen therapy

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

Hocking J[1], David MT[2], Gustavson RB[3], Kessinger TA[4], Allen CM[4], Johnston AL[5], Freymiller B[1], McCluskey D[6], Medak AJ[7], Tanaka HL[7]

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Introduction/Background

by the public. Historically, the hyperbaric medicine field has grappled with entities treating conditions without evidence-based indications. However, a new threat has emerged. There is now a deluge of "mild hyperbarics" and soft-sided chambers purporting to be equivalent to medical-grade HBO_2. Recently, companies and media have touted celebrities and professional athletes having multiple hyperbaric chambers at home for mental wellness and physical recovery (neither is a UHMS-approved indication), but unfortunately, referring to soft-sided chambers at lower pressures. The definition of hyperbaric oxygen therapy remains treatments at pressures of 2.0 ATA or above, with medical-grade prescribed oxygen, using a hard-sided regulations-approved (ASME-PVHO and NFPA) chamber.

Materials and Methods

This is an online survey of hyperbaric centers found locally in the Pacific Chapter of UHMS (California, Hawaii, Oregon, Arizona, Nevada, Colorado, Wyoming) as gathered and evaluated by ten independent researchers.

Results

Two hundred and thirty-two purported hyperbaric facilities were found listed and advertised online. Of these facilities, only 113 were found to be centers we would ascribe to perform clinical hyperbaric oxygen therapy. Of these 113, only 17 were found to be UHMS-accredited hyperbaric facilities. Only four centers were found to provide 24/7 emergency and critical care services.

The majority of facilities found online advertised unrelated services such as cryotherapy, red light therapy, functional medicine, and IV therapy, among others, even if they had a hard-sided chamber.

Summary/Conclusion

Prior publications have shown that there is a lack of 24/7 chambers throughout the United States. This survey further emphasizes this point but also highlights the dilution of the field with non-clinical "mild hyperbaric" facilities that purport to care for medical patients in an equivalent manner. Further, there is no evidence of regulation of these nonclinical facilities, which poses serious patient safety issues. Our recommendation is advocacy for UHMS accreditation of all medical hyperbaric facilities

E 120: Critical care nursing in hyperbaric medicine: management of simultaneous pediatric burn cases

O: n/a
P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM
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Case Description
An urban hyperbaric department was consulted regarding five pediatric patients (ages six to 14) who sustained acute thermal burns (TBSA 25–45%) following a propane tank explosion. All patients were in critical condition, required mechanical ventilation, and were significantly sedated. This case underscored the substantial resource demands and unique nursing challenges inherent in managing complex cases of severe burns in a hyperbaric environment.

Intervention
The hyperbaric team modified established protocols to address the unique requirements of the pediatric population. Hyperbaric nurses collaborated with burn nurses, PICU/burn staff, and respiratory therapists to ensure optimal staffing, equipment preparedness, and medication availability. On the clinical side, this involved ensuring appropriate staffing ratios in the chamber, transitioning from continuous sedation infusions, and maintaining ventilator settings on a hyperbaric ventilator (Zoll). Equipment-related challenges included utilizing hyperbaric-safe burn dressings, lacking hyperbaric-safe syringes and CADD pumps, and maintaining delicate pediatric lines.

Outcome
Four of the five patients were treated in our multiplace chamber; one was excluded from therapy due to a less severe injury. Two patients were treated simultaneously with two inside attendants (typically a nurse and a resident physician). Patients were kept on PICU SIMV ventilator settings with periodic ABGs off arterial lines to confirm appropriate ventilation. Due to the unavailability of HBO-specific syringes and CADD pumps, sedation was administered using intermittent push-dose boluses. Rigorous sign-outs with burn nursing ensured that only hyperbaric-appropriate dressings entered the chamber. Patients tolerated the treatments without significant incident.

Discussion
This case underscores the role of critical care nurses in managing high-risk pediatric burn patients in a hyperbaric setting. Their expertise in decision-making, ventilator management, and sedation titration was essential in adapting protocols to meet pediatric needs. Nursing requires technical proficiency in operating life-support systems and situational awareness, ensuring patient monitoring and rapid response to clinical changes. It is imperative to enhance these practices by developing pediatric-specific order sets, instituting a dedicated pediatric safety checklist, evaluating equipment such as syringe pumps for a hyperbaric environment, and implementing targeted training initiatives. These measures will build on proven practices while addressing the complexities of hyperbaric critical care.

E 121: Serious incident reports caused by hyperbaric oxygen treatment with a monoplace chamber in Japan

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Case Description

There was a fatal incident during hyperbaric oxygen treatment with a monoplace chamber in the United States in 2025. There have been four serious incidents of a monoplace chamber in Japan. The purpose of the presentation is to share incident information in Japan again, raise awareness of incident prevention, and take countermeasures.

Intervention

The four serious HBO_2 incidents of a monoplace chamber from 1969 to 2024 were recorded and analyzed regarding incident type, patients' fatalities, causes, and firefighting activities.

Outcome

Four incidents involving a monoplace chamber in Japan occurred in 1967, 1989, 1992, and 1996.

1) Incident types: three cases were fires, and one was a fire and explosion.
2) Patients' fatalities: All patients died.
3) Cause: All were pocket warmers. Three cases brought in lit pocket warmers, and one case brought in disposable pocket warmers.
4) Firefighting activities:

4-1) Incident in 1967: No specific data was available.
4-2) Incident in 1989: The safety valve of the chamber blew out during the fire, so the door was opened and extinguished with a fire extinguisher.
4-3) Incident in 1992: The inside of the chamber was on fire when the door was opened, and a fire extinguisher was used.
4-4) Incident in 1996: Due to a large explosion, no fire extinguishing activity was conducted inside the chamber.

Discussion

Currently, 578 hospitals perform HBO_2, and 534 monoplace and 44 multiplace chambers in Japan. Japan Undersea and Hyperbaric Medical Society (JUHMS) has established strict safety standards and regulations. JUHMS has introduced a specialist doctor and specialist technician system to ensure the quality of medical professionals in the HBO_2 field. Fortunately, Japan has had no serious incidents for around 30 years.

Pocket warmers caused all four incidents involving monoplace chambers in Japan. For this reason, the importance of checking belongings before treatment should be seriously re-recognized.

E 122: Noninvasive fetal monitoring recommendations in Class A chamber

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

Emergent treatment of pregnant patients requiring hyperbaric medicine is rare; however, for those at fetal viability between 22 and 42 weeks of gestation, no current fetal monitoring devices have been tested for use in a hyperbaric chamber. At 20 weeks, the fundus is typically at the maternal umbilicus, and gestational age can be estimated by measuring from the top of the pubic bone to the top of the fundus, plus or minus three centimeters. Continuous fetal monitoring is preferred for timely decisions, such as conservative intrauterine resuscitation or emergency cesarean delivery. Point of Care ultrasound or intermittent monitoring techniques are less effective in these conditions, especially with available specialty consultants and nursing.

Materials and Methods

We used the wireless GE Novii Patch system for maternal and fetal ECG, which allows heart rate transmission in non-pressurized Class A chamber conditions. Previous wireless ultrasound systems proved effective for heart rate tracing in pressurized situations. We also tested the equipment in both Class C and Class A chambers, including handheld dopplers, without pressurizing pregnant patients.

Results

The wireless transmission of heart rate data through the Class A chamber was feasible. However, the gold standard would involve a dedicated wired line through the chamber, which was prohibitive to test, given the high cost of equipment perforator installation.

Summary/Conclusion

Emergent treatment of pregnant patients should be performed, even at viability. Early delivery may be considered at term, and intermittent monitoring protocol implementation is recommended for emergent hyperbaric treatments, given the setup speed and wide gestational age use.

Other wireless systems, like the Phillips Avalon CL Cableless system (suitable from 24 weeks gestation), Novii Plus (from 34 weeks), or Nuvo Invu (from 32 weeks), could alleviate some concerns with ease of setup, reliability and usefulness. Until such technology or funding is available for testing, a wired line is preferable over wireless systems, and reliable wireless continuous is preferable over intermittent Doppler or ultrasound due to ability for faster intervention and decision making.

E 123: Go No-Go Survey 3.0: Finding common ground and developing a reference guide

O: n/a

P: Wednesday, 6/4/2025, 10:30 AM - 12:00 PM

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Introduction/Background

In the hyperbaric industry, there are many different approaches to delivering hyperbaric oxygen therapy and allowing items inside Class A or Class B chambers, respectively. The purpose of this survey was to collect data on practice patterns and trends regarding items allowed inside hyperbaric chambers. This effort aims to offer this data as a reference for hyperbaric facilities to consider.

Materials and Methods

A survey was sent to Class A and Class B facilities asking about their facility type, services, items allowed inside the chamber, equipment used, air breaks, and approval process. The surveys were sent to 5,402 recipients, including all Undersea and Hyperbaric Medical Society members.

Results

- Class A Multiplace Facilities: 34 facilities responded with varying results.
- Class B Monoplace Facilities: 115 facilities responded with varying results.

Summary/Conclusion

While most facilities shared comparable results, some were split more evenly. More notably, not one question about item approval was 100 percent either way. There are different interpretations of items considered safe or hazardous inside hyperbaric chambers, with some making conditional needs to allow an item

E 124: Short-circuited button-cell batteries in a 100% oxygen 3 ATA environment

O: n/a

P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

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Introduction/Background

The use of battery-operated devices in a hyperbaric chamber is regulated by the National Fire Protection Association (NFPA). Section 14.2.9.3.16.4 of the NFPA99 Health Care Facilities Code states that batteries should be “fully enclosed and secured within the equipment enclosure.” We wanted to determine whether button-cell batteries posed a fire risk if used in a 100% oxygen-filled chamber. We theorized that a short-circuited battery would maximize the possibility of fire, and the two primary fire sources would be from the circuit's arcing and heating.

Materials and Methods

We constructed an apparatus to short-circuit a button-cell battery inside a test chamber (Hyperbaric Modular Systems, San Diego, CA) filled with 100% oxygen, pressurized to 3 atmospheres absolute (ATA). Three batteries were tested at 1 ATA air as a control, three using our test circuit at 1 ATA air, and three using our test circuit at 3 ATA HBO_2. We measured battery voltage before and after each test and measured current at one-minute intervals for 120 minutes after completing the circuit. We measured internal chamber temperature to determine if there was a spike related to the combustion of the test materials. We measured battery temperature at 1 ATA before and after creating a short circuit using a thermal camera (Teledyne FLIR, Wilsonville, OR).

Results

None of the batteries caught fire during the testing. There was no significant rise in chamber temperature to indicate combustion. Both voltage and current decreased predictably. A best-fit power curve of the current showed no significant differences between the control and test environments. Thermal imaging showed no change in battery temperature with short-circuiting at 1 ATA air.

Summary/Conclusion

We conclude that an intact button-cell battery should be safe to use while undergoing HBO_2 in a 100% oxygen environment.

E 125: Engineering of a non-touch switch for short-circuiting button batteries inside a 100% oxygen hyperbaric chamber

O: n/a

P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

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Introduction/Background

Battery-powered devices are restricted in hyperbaric chambers due to the risk of combustion. Testing of battery-powered continuous glucose monitors (CGM) in air—and oxygen-filled chambers showed that Dexcom G6 and G7 CGMs were safe to use, but this still left the possibility of fire if the CGM and its battery were damaged. We created a mechanism to safely test a worst-case scenario of a short-circuited CGM in an oxygen-filled chamber.

Materials and Methods

We were tasked with creating a system to make a short circuit at three ATA in a 100% oxygen environment. To reduce risk, we obtained a small volume mini-chamber (Hyperbaric Modular Systems, San Diego, CA) with a 2-1/4 inch inside diameter and a length of 18 inches. The switch needed to fit inside this mini-chamber and be triggered under pressure. Our circuit used the same brands of CR2032 button batteries used in the Dexcom CGMs. We designed and produced multiple prototypes using button battery holders, wire, acrylic sheets, copper tape, and ball bearings to create a device that would short-circuit a button battery on demand.

Results

We produced five designs using various mechanisms, such as Boyle's Law and gravity, to activate the switch. We settled on a design that used a piston to lift one end of the chamber, allowing copper ball bearings to roll on a seesaw to create a short circuit. The mechanism was reliable throughout testing.

Summary/Conclusion

We successfully designed a mechanism to create a short circuit in an oxygen-filled chamber pressurized to 3 ATA. Using this mechanism, we were able to short-circuit a battery repeatedly.

E 126: The HBO_2 ID System: A structure approach to hyperbaric chamber management

O: n/a

P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

Wilson A

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Introduction/Background

Hyperbaric oxygen therapy (HBO_2) facilities vary from simple single-chamber setups to complex multichamber systems across multiple locations. This diversity creates challenges in component identification, maintenance tracking, and clear communication. Without standardized nomenclature, critical components such as valves, regulators, and gas supply systems are referenced inconsistently, leading to confusion and potential safety risks.

Materials and Methods

A comprehensive identification system was developed and implemented across our hyperbaric facilities. The system's master spreadsheet catalogs all mechanical components with unique alphanumeric identifiers. Each ID relates directly to the component's function and location, creating an intuitive identification language. Implementation included:

(1) physical labeling of all components;
(2) integration of IDs into maintenance schedules and documentation;
(3) incorporation into training materials and standard operating procedures; and
(4) development of ID-based checklists for routine safety inspections.

Results

Communication between technical and clinical staff became more precise after implementation, eliminating ambiguity. Maintenance compliance improved through automated alerts for calibration schedules. Training efficiency increased with reduced time-to-competency. Documentation accuracy improved significantly, with clear records of components serviced. Financial tracking revealed patterns of component failure, informing strategic purchasing decisions.

Summary/Conclusion

The standardized identification system effectively addresses the challenges of managing hyperbaric facilities by creating a common language for component identification. This has enhanced safety protocols, streamlined maintenance, and improved staff training. The system's scalable nature makes it suitable for hyperbaric facilities of any size or complexity.

E 127: A novel method of oxygen delivery for an infant in a multiplace hyperbaric chamber

O: n/a

P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

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Introduction/Background

An eight-day-old full-term infant presented to the Children's Hospital of Philadelphia (CHOP) with a traumatic penile glans amputation due to ritual circumcision. The glans was surgically reattached emergently by urology. Hyperbaric oxygen (HBO_2) therapy was recommended post-operatively to support the surgical site, given concerns for compromise. Though effective, previously used oxygen delivery systems presented multiple logistical challenges for treatment. This included limited access to the infant for physiological interventions, and the need for multiple chamber attendants. With staff ingenuity and innovation, a type of monoplace hyperbaric chamber environment was created within a multiplace hyperbaric chamber which allowed for successful and effective treatment of the infant.

Materials and Methods

For the first treatment, the infant was placed into a silicone hyperbaric hood. Though efficient in providing the required oxygen delivery, this system did not provide easy access to the infant for the hyperbaric staff. A NICU isolette was introduced and pieces of silicone hood were cut, heated, and blended to the body of the isolette. Three valves were strategically placed to provide 100% oxygen and exhaust carbon dioxide. This structure was a de facto infant "monoplace" chamber within a multiplace chamber.

Results

The newly constructed "monoplace isolette" provided the infant with delivery of 100% oxygen during treatment, while allowing for a simple transition to air breaks as indicated. It also allowed immediate access to the infant for care, including diapering, feeding, and soothing. This simplified, unique construction allowed the patient's parents to serve as chamber attendants for the infant while conserving our facility's staffing resources for other patient care needs.

Summary/Conclusion

The "monoplace isolette" served as an efficient way to treat a compromised flap in an infant within a multiplace chamber environment. It functioned similarly to a typical monoplace chamber, yet allowed for a safe and efficient way to access the patient without significantly compromising treatment efficacy. In a population where HBO_2 is rare, finding equipment that properly fits anatomically and provides safe and efficient care is difficult. This unique construction offers a novel approach to delivering high-quality care to neonates and infants.

E 128: Amron Hood pO_2 gas analysis during air breaks

O: n/a

P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

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Introduction/Background

During the COVID-19 pandemic, we began leaving patient hoods on during air breaks to optimize respiratory isolation, with zero cross-contamination amongst our patients. We continued that practice until 18 months ago. After two successive patients had seizures during a routine U.S. Navy treatment table 9, we questioned the effectiveness of our air break protocol, and if our patients ever truly received an 'air break'.

Materials and Methods

We used a Styrofoam head attached to a manikin bust with a well-sealed Amron Hyperbaric oxygen treatment hood assembly. An Anlox HYP gas analyzer was secured to the head. Per the manufacturer's specifications, the Built In Breathing System (BIBS) flow rate was set to 30 L/minute. A total of 40 separate test cycles were carried out. We measured the time necessary to achieve 99.5% oxygen from air, and then to reach an oxygen percentage of less than 23% (air). Readings were recorded every minute, and tests were conducted at 1 ATA, 2.36 ATA, and 2.8 ATA.

Results

After 40 test cycles performed at the pressures noted in the methods, we determined it took more than five minutes to switch from 100% oxygen to less than 23% inside the hood. The lowest oxygen percentage recorded at five minutes on air was 29%. The time to attain oxygen levels below 23% ranged from eight to nine minutes. Switching from air to oxygen took four to five minutes to achieve greater than 99.5% oxygen following an air break.

Summary/Conclusion

We concluded that switching the gas supply in the BIBS while keeping the hood in place never resulted in a true air break. This practice also extended patient exposure time to elevated oxygen partial pressures, which may have contributed to oxygen toxicity events. We now remove the patients hoods to ensure a sufficient air break and have not had another oxygen toxicity event.

E 129: Short-term suborbital space flight's effects on oxidative and inflammatory status: A pilot study.

O: n/a

P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

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Introduction/Background

Suborbital spaceflight (SSF) has recently become an appealing and approachable activity for civilians and military/professional personnel. The growing number of people that approach space exposure creates new interest for training and research purposes. During the flight people are exposed to microgravity, high acceleration forces, space radiation and psychophysical stress. The investigation for biological effects of SSF requires simple and repeatable techniques which could provide reliable biomarkers of inflammation, oxidative balance, hormonal status and neurocognitive status.

Materials and Methods

Three healthy certified subjects (45-year-old average) took part in a 72-minute SSF with the Virgin Galactic SpaceShipTwo (Unity), which was deployed from 50,000 ft and reached approximately 282,000 ft of maximum altitude. The microgravity exposure lasted 3:09' and the re-entry phase 3:30'. We obtained saliva and blood samples before and immediately after the mission, with which we assayed BDNF, dopamine, and cortisol levels as well as hormones, such as ghrelin and leptin, and pro-oxidative/ inflammatory biomarkers.

Results

SF increased the cortisol and BDNF levels while dampening dopamine levels. Simultaneously, leptin increased, whereas ghrelin declined. The astronauts' saliva contained more reactive oxygen species (measured with paramagnetic resonance), higher plasma lipoperoxidation markers, such as iso-pGF2α content, and lessened total antioxidant capacity (TAC) while bearing more pro-inflammatory IL-6 and TNF-α levels.

Summary/Conclusion

Our results show that SSF reduces peripheral levels of dopamine, triggers the release of stress-related factors, such as BDNF and cortisol, imbalances hormones controlling food intake, and ignites a pro-oxidative/inflammatory status. Our study provides a methodological advancement to assess SF sequelae while presenting new molecular evidence that helps explain acute SF neurological/behavioral repercussions.

Session F – Clinical Evaluations
ABSTRACTS

F 130: Myopic changes persist 6 weeks after hyperbaric oxygen treatment course in monoplace chamber

O: Wednesday, 6/4/2025, 11:30 AM - 11:40 AM
P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM
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Introduction/Background
myopia reverts to baseline following treatment. No studies thus far have explored the extent of clinically significant vision changes and the rate of return to baseline following treatment in a monoplace chamber, which is the overwhelming treatment modality in the United States.

Materials and Methods
A chart review was performed for over ten years on patients who completed HBO_2 therapy with follow-up six to 12 weeks post-treatment. All patients received 20 or more treatments for 90-120 minutes at 2.0-2.5 ATA in monoplace chambers. Visual acuity was measured before treatment started, weekly during treatments, and at follow-up. Change from baseline acuity (defined as a change of one line or greater on the Snellen chart) and return to baseline at follow-up were determined.

Results
In our patient cohort, 75% (53/71) of patients had a vision change. Sixty patients had native lenses, of whom 56.7% (34/60) had vision worsening, and 67.6% (23/34) did not return to baseline vision. Among these patients, 74% (17/23) had no known cataracts. Eleven (11/71) patients had a history of bilateral cataract surgery (artificial lenses), of which 63.6% (7/11) had vision change, and 57.1% (4/7) did not return to baseline.

Summary/Conclusion
A large majority of our patients had a vision change. Prior evidence suggests that myopic changes result from alterations in lens media due to HBO_2 and are reversible. Our finding that 74% of patients with no known cataracts had vision worsening with no return to baseline contradicts current understanding of reversible myopic changes with HBO_2 treatment. This may be from insufficient recovery time, but it is more likely that many patients never return to their baseline vision. Further investigation is needed to determine the frequency of full return to baseline vision and average time to recovery. Interestingly, patients with bilateral artificial lenses still experienced vision changes. More research is needed to identify other factors contributing to vision change, as the presence of artificial lenses does not fully explain our current findings.

F 131: Ultrasound muscle scans collected during decompression may predict post-dive venous gas emboli loads

O: Wednesday, 6/4/2025, 11:40 AM - 11:50 AM
P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

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Introduction/Background
Decompression sickness (DCS) risk mitigation relies on probabilistic models derived from historical data, applying the same predicted risk to all divers, regardless of individual variability. While high post-dive venous gas emboli (VGE) loads are highly specific to DCS, they are a latent biomarker with poor sensitivity. In contrast, detecting bubble formation during decompression could enable personalized DCS prevention strategies. Using a research programmable ultrasound system in a hyperbaric chamber, we analyzed signal changes across various anatomical regions in humans during decompression to identify potential correlations with post-dive outcomes.

Materials and Methods
Six participants completed a dry chamber dive to 132 feet of seawater (fsw) for 20 minutes while exercising, followed by a nine-minute decompression stop at 20 fsw. Based on Navy Experimental Diving Unit data, this profile carries low DCS risk but a high likelihood of VGE. A research-programmable ultrasound system, housed in a nitrogen-isolated environment, was used to acquire and reconstruct consistent ultrasound data. Regions of interest were drawn around the calf muscle, and average pixel intensity differences were calculated between the decompression stop and pre-dive baseline. Post-dive VGE were assessed via echocardiography every 20 minutes for two hours and graded on the Eftedal-Brubakk (EB) scale.

Results
No divers developed DCS, and peak post-dive VGE grades ranged from one to three. The calf muscle proved most consistent for quantitative brightness analysis, showing an average 1.7 dB increase in five of six participants during decompression, while phantom imaging confirmed no depth-related changes. One participant showed a slight 0.2 dB decrease, of the order of the test-retest measurement error. An ascending trend linked brightness increase during decompression to peak post-dive VGE, with a 1 dB threshold perfectly separating low (≤2 EB) and high (EB=3) VGE grades.

Summary/Conclusion
Our data suggest that calf muscle ultrasound during decompression may predict VGE loads and, thus, DCS risk. Combined with our prior work on a wearable ultrasound prototype, these findings support the potential for real-time underwater monitoring to inform personalized decompression. Further studies are needed to validate and assess operational feasibility.

F 132: Divers tend to produce individually consistent venous gas emboli grades after conducting the same dive multiple times.

O: Wednesday, 6/4/2025, 11:50 AM - 12:00 PM
P: Thursday, 6/5/2025, 10:00 AM - 11:30 AM

Currens JB[1,2], Brenner RJ[3], Coombs M[3], Eltz K[1,2], Grant D[1,2], Sherman K[1,2], Kapitanov M[2,3], Papadopoulou V[1,2], Tillmans F[3]
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Introduction/Background

Venous gas emboli (VGE) are detected post-dive using echocardiography and have been used to estimate the risk of decompression sickness (DCS) for dive profiles. Several publications have reported high variability in VGE presence across study populations and for individuals completing the same exposure multiple times. One retrospective analysis has been conducted and found that within-diver differences were at least as impactful as inter-subject variability for peak post-dive VGE grades (Doolette & Murphy, DHM, 2023). This abstract reports on the primary endpoint of the first prospective study assessing intra-individual variability of post-dive VGE presence detected after independent, repeat-dive instances.

Materials and Methods

Thirty-one volunteers completed six independent open water dives following a pre-defined profile (30-meter max depth, 30-minute dive time). A minimum of five days without diving was required before each instance. After each dive, subjects were monitored for VGE following the 2015 Consensus Guidelines for a minimum of two hours. Two independent reviewers graded the captured scans retrospectively using the Eftedal-Brubakk (EB) scale. The contribution of intra vs inter-subject variability in the dataset was tested by comparing the original data's median absolute deviations (MAD) with randomly resampled data using a Mann-Whitney test. For this, the MAD of the peak-post dive grades for each subject was calculated from their six real dives. The MAD of randomly resampled data was calculated from simulations of 31 groupings of six dive instances taken randomly from the real data. Statistical significance was set a priori at p.

Results

Across 186 nearly identical dives, the median peak post-dive EB grade for the entire dataset was two (range: [0,4]). For each subject, the median post-dive grades across the six dive instances ranged from 0 to 3 (IQR: [1,3]). Intra-subject variability was found to be significantly lower than inter-subject variability ($p<0.05$ difference between real and resampled data).

Summary/Conclusion

While intra-subject variability was observed, we found that individuals were more consistent with themselves in resting peak post-dive EB grades despite a wide range of peak grades across the dataset. These factors should be considered when designing experiments and interpreting VGE grades.

THURSDAY, JUNE 5

Centennial Ballroom

8am-2pm	**Registration Open**
8am	**Announcements**
8am-9:30am	**Harry G. Armstrong/George B. Hart Memorial Lecture: Pressure Perils from Undersea to Outer Space Panel: Jonathan Clark, MD; Joseph Dervey, MD; Mitch A. Garber, MD; Michael Gernhardt, PhD; Richard Moon, MD**

About the Lecture

- Welcome and Introductions: Joseph P. Dervay, MD, MS
- An Overview of Pressure Variations and Their Effects on Human Health: From Ocean Depths to Outer Space: Richard Moon, MD
- Michael Gernhardt, MD
- Jonathan Clark, MD
- Aviation Hypoxia and Accident Investigation: Mitch Garber, MD, MPH, MSME

About the Speakers

Jonathan Clark, MD

Dr. Jonathan B. Clark is an adjunct associate professor of Neurology and Space Medicine at Baylor College of Medicine.

Dr. Clark served 26 years on active duty with the U.S. Navy, and qualified as a naval flight officer, naval flight surgeon, U.S. Navy diver, U.S. Army parachutist, and special forces military freefall parachutist. His assignments included heading a research centrifuge facility, an aeromedical department at a Marine aviation squadron, and the Neurology and Hyperbaric Medicine divisions at the Naval Aerospace Medical Institute. He flew combat medical evacuation missions in Operation Desert Storm with the U.S. Marine Corps.

Dr. Clark worked at NASA Johnson Space Center from 1997 to 2005, was a Space Shuttle Crew surgeon on six shuttle missions, chief of the Medical Operations Branch, and a senior Federal Aviation Administration (FAA) aeromedical examiner (AME). He was a member of the NASA Spacecraft Survival Integrated Investigation Team from 2004 to 2007 and a member of the NASA Constellation Program EVA Systems Project Office Standing Review Board from 2007 to 2010. He was a Space Medicine Advisor for the National Space Biomedical Research Institute from 2005 to 2017.

In 2008, Dr. Clark was an expedition physician supporting the Haughton Mars Project on Devon Island in the high Canadian Arctic. He was chief medical officer for orbital commercial space company Excalibur Almaz from 2007 to 2012, and chief medical officer for the Inspiration Mars Foundation since 2013. Dr. Clark was medical director of the Red Bull Stratos project, a manned stratospheric balloon freefall parachute flight test program, which on October 14, 2012, successfully accomplished the highest stratospheric freefall parachute jump (highest exit altitude) from 127,852 feet, achieving human supersonic flight (Mach 1.25) without a drogue chute at 843 miles per hour. In 2012, Dr. Clark joined the StratEx Space Dive project as the lead flight surgeon and medical advisor, and this project culminated in the new high altitude exit freefall record of 135,890 feet, reaching Mach 1.22 at 822 miles per hour in 2014. He is a space medicine consultant for commercial space companies, including Virgin Galactic, SpaceX, and Space Perspective. Dr. Clark is board certified in neurology and aerospace medicine and is a fellow of the Aerospace Medical Association. His professional interests focus on the neurologic effects of extreme environments, crew resilience, and crew survival in space.

Joseph Dervey, MD

Dr. Dervay is currently a flight surgeon at the NASA Johnson Space Center, having served there over 27 years. Completing undergraduate studies at Cornell University and a Doctor of Medicine at Syracuse-Upstate Medical Center, he then trained to become a Navy Flight Surgeon, serving aboard the aircraft carrier USS John F. Kennedy.

Dr. Dervay has served as crew surgeon for a multitude of missions, encompassing Space Shuttle, long-duration International Space Station and Commercial Crew, including support of the 2020 NASA/SpaceX Demo-2 test flight as the first Commercial Crew mission. His roles have included work in Russia at the Star City Cosmonaut training center and support of crewmembers during Soyuz launch and landing activities in Kazakhstan.

He has completed an Emergency Medicine Residency in Washington D.C. at The George Washington University and both a Space Medicine Fellowship and Aerospace Medicine Residency at the University of Texas Medical Branch at Galveston/NASA and Hyperbaric Medicine training at the University of Texas Health Science Center in Houston. Dr. Dervay is board certified in Emergency, Aerospace, and Undersea and Hyperbaric Medicine.

Mitch A. Garber, MD

Dr. Mitch Garber is a physician and engineer with over 35 years of military and civilian experience in transportation accident investigation. He was the first (and for 15 years the only) full-time Medical Officer at the U.S. National Transportation Safety Board (NTSB). He has participated in well over 1000 investigations in all transportation modes and has presented testimony to Congress regarding medical issues in transportation accidents. He specializes in the investigation of medical concerns in transportation and other accidents, including the evaluation of pathology, toxicology, human performance, and biomechanics in accident investigation.

Dr. Garber has a B.A. in Psychology/Sociology from Duke University, his M.D. degree from Emory University School of Medicine, an M.P.H. in Occupational and Environmental Medicine from the Harvard University School of Public Health, and an M.S.M.E. (Master of Science in Mechanical Engineering) from the Georgia Institute of Technology (Georgia Tech). Dr. Garber has addressed a wide range of medical and human factors issues in all transportation modes, including physical standards, fatigue, perception, medication use, visual impairment, obstructive sleep apnea, substance dependence, injury analysis, egress and evacuation concerns, ergonomics, and the effects of pre-existing disease on transportation operator performance, among others.

Additional work specific to aviation has included investigations of hypoxia, spatial disorientation, and visual and vestibular illusions. He has often been called upon to evaluate the potential role of subtle cognitive impairment from a variety of causes in complex transportation accidents. Dr. Garber also has expertise in the optimization of ergonomics for customized office and industrial workstations. He has held a private pilot certification since 1996.

Mitch has recently retired from full-time work to devote more time to family, travel, learning, and causes close to his heart.

Michael Gernhardt, PhD

Dr. Michael Gernhardt, born in Mansfield, Ohio, on May 4, 1956, is a unique blend of an astronaut and deep-sea diver whose life has been a journey between the stars and the sea. From a young age, diving and the allure of space captivated Gernhardt, leading him to a path where he could explore both realms extensively.

His academic journey was as diverse and deep as his professional pursuits, earning a Bachelor of Science in Physics from Vanderbilt University and furthering his studies with a Master of Science and a Ph.D. in Bioengineering from the University of Pennsylvania. His work as an undergraduate, where he juggled roles as a scuba diving instructor, boat captain, and deep-sea diver apprentice, set the stage for his later achievements.

Gernhardt's professional life is marked by his significant contributions to both oceanic and space exploration. As a professional deep-sea diver, he participated in over 700 dives, working on subsea oil field projects and developing new decompression models for safer diving. His entrepreneurial spirit led him to found Oceaneering Space Systems, aiming to bridge subsea technology with space station operations.

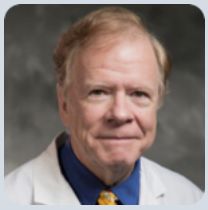
Selected by NASA in 1992, Gernhardt's astronaut career was distinguished. He flew on several Space Shuttle missions, contributing to the deployment of scientific payloads and conducting spacewalks to test equipment and procedures critical for the assembly and maintenance of the International Space Station. His expertise in decompression was invaluable in developing safer and more efficient spacewalk protocols.

Beyond his space missions, Gernhardt contributed significantly to NASA's underwater training missions through the

NEEMO program, bringing his unique perspective to prepare astronauts for long-duration space missions. His dedication to safety and efficiency in diving and space operations led him to a board position with the Divers Alert Network and spearheading initiatives like a mission to Phobos, one of Mars's moons.

Upon retiring from NASA in 2022, Gernhardt's contributions were widely recognized, earning him numerous commendations for his service and impact on crew safety and mission success. His legacy continues as he lends his expertise to Blue Origin, working on lunar surface operations and contributing to the next chapter of human space exploration with the Artemis program.

Michael Gernhardt's story is not just one of personal achievement but a testament to how passion, interdisciplinary knowledge, and a commitment to exploration can lead to a lifetime of adventure and significant contributions to our understanding of both the oceanic and space frontiers.



Richard Moon, MD

Dr. Richard Moon earned BSc and MD degrees at McGill University. He trained in internal medicine and biomedical engineering at the University of Toronto, then in pulmonary and critical care medicine, followed by anesthesiology at Duke University. He joined the Duke University faculty in 1983. He is Professor of Anesthesiology, Professor of Medicine and Medical Director of the Duke Center for Hyperbaric Medicine & Environmental Physiology. His research has included physiology of immersion and predictors of arterial PCO2 during underwater exercise. He has been particularly interested in causes and prevention of immersion pulmonary edema, use of an experimental breathing gas (perfluoromethane) to decrease decompression requirements after heliox dives, mechanisms of death during triathlons, causes of perioperative opioid-induced respiratory depression, and improved monitoring techniques for monitoring patients to detect it. His awards include the Mentorship Award from the AMA-Women Physicians Congress Physician Mentor Recognition Program, Leonard Palumbo Jr, MD Faculty Achievement Award for compassionate patient care and excellence in the teaching and mentoring of young physicians, Duke awards for Excellence in Medical Student Education and two awards as Duke Anesthesiology Teacher of the Year.

9:30am-10am **Break**

UHMS Track: Regency VI

10am-10:45am **Plenary: The most complicated monoplace chamber out of this world: Michael Harrison, MD**

About the Lecture

About the Speaker

Dr. Harrison is the Chief Medical Officer, Axiom Space, Houston TX, Associate Professor of Emergency Medicine, Departments of Emergency Medicine, Critical Care Medicine, and Aerospace Medicine, Mayo Clinic, Jacksonville FL.

Dr. Harrison is the Chief Medical Officer at Axiom Space in Houston TX and practices medicine as faculty at Mayo Clinic in Jacksonville FL in the departments of emergency medicine, critical care medicine, and aerospace medicine. He has served as a flight surgeon supporting multiple commercial spaceflight missions with companies including SpaceX, Virgin Galactic, and Axiom Space. Dr. Harrison's research interests, stemming from his graduate education in exercise physiology and hyperbaric medicine, include spaceflight; military aviation; decompression sickness; and high-altitude physiology. He has published more than 30 peer-reviewed articles and received numerous research awards. Dr. Harrison is a fellow of the Aerospace Medical Association, a three-time Ironman finisher; a NITROX-certified rescue diver; and an instrument-rated private pilot.

10:45am-11:30am **Plenary: Update: engineering and pressure - saturation tunnel working in the extremes: Justin Costello**

About the Lecture

About the Speaker
Senior Project Manager – Hyperbaric Services Division. Ballard Marine Construction

11:30am-1:30pm Lunch (On Own), Special Luncheons and Meetings

Associates Breakout Session

1:30pm-2pm **Concepts of Human Factors in Diving: Jonathan Langham**

About the Lecture

About the Speaker
Georgia Aquarium Senior Manager, Dive Safety & Training | The Human Diver Instructor | DAN & RAID Instructor Trainer | NAUI Instructor

2pm-2:30pm **Update on codes and compliance: Gus Gustavson, RN**

About the Lecture
Presentation on how codes are developed and updated, and determination of what codes will be enforced in any given jurisdiction.

About the Speaker
Richard, widely known by the nickname, "Gus", has over forty-eight years' experience in clinical, supervisory, teaching, staff and middle management positions in acute care hospitals.

This experience includes forty years as a Respiratory Therapist, twenty years as EMT-I, twenty-three years as a Naval Reserve Hospital Corpsman, twenty-three years in Hyperbaric Medicine, eighteen years' experience in wound and burn care, and nineteen years as a Registered Nurse. Experience in hyperbaric medicine has included Technical Director, Program Director, Nurse Manager and Critical Care Educator specific to hyperbaric medicine.

Member and Special Expert for the National Fire Protection Association, NFPA 99 Technical Committee, Hyperbaric and Hypobaric Facilities –March 20, 2023, to Present

Currently, Gus teaches hyperbaric medicine across the U.S. and beyond, serves as the Principle for R.B. Gustavson Consultants, LLC, and is studying with Walden University Online, looking forward to earning his Doctor of Public Health.

2:30pm-3pm **Go-No Go survey: Marc Pullis, CHT**

About the Lecture
In the hyperbaric industry there exist many different approaches for the delivery of hyperbaric oxygen therapy and the allowance of items inside Class A or Class B chambers, respectively. We will share data collected from 34 multiplace and 115 monoplace facilities on equipment use, items allowed, breathing masks, grounding procedures, cotton percentage, approval process and more.

About the Speaker
I am Marc Pullis, the Safety Coordinator at Hennepin County Medical Center (HCMC) in Minneapolis, MN. I was first introduced to diving in 2003 where I served as an EMT / Firefighter in the Marshall Island on Kwajalein atoll where I obtained my advanced SCUBA diver license. I began my professional career in hyperbaric medicine in 2007 at HCMC while working with both a Vacudyne quad-lock multiplace and ETC monoplace chambers. In 2012, I was made Safety Coordinator while installing a new Fink Engineered triple-lock multiplace chamber. My specialties include developing and implementing a preventative maintenance and education programs, design and development of hyperbaric components and ancillary equipment needed for safe and successful treatments of both chronic and emergent treatments.

3pm-3:30pm	**Break**
3:30pm-4:30pm	**Common findings or common pitfalls for Hyperbaric Facility Accreditation Panel: Derall Garrett, CHT; Monica Skarban, RN;**

About the Lecture
Panel discussion with three members for every survey to include Physician leader, CHRN and CHT. Taking an 18,000-foot view of all surveys completed since 2018 to extract significant finding and sharing lessons learned.

About the Speakers

Larry Chase, MD
Dr. Chase started in wound care in 1987 and hyperbaric medicine in 1999. He started the CoxHealth Hyperbaric Medicine and Wound Care program in 1999 and served as medical director over three clinics until 2022 upon my retirement, although he still works at two of the now four clinics on a prn basis. Cox's main clinic was accredited with distinction and served as the only such program in the state of Missouri. He has participated as an accreditation surveyor for the UHMS for over ten years and is currently a member of the faculty for Wound Care Education Partners teaching an accredited 40-hour course Introduction to Hyperbaric Medicine.

Monica Skarba, RN
Monica began her hyperbaric career in 1991 in the USAF. After retirement in 1999, she returned to California to work with HBO critical care 24/7 operations in a Monoplace program. In 2001, she moved to join the Aurora Health Care program in Milwaukee WI, as a manager of a 24/7 multiplace HBO and Wound Care Program to include critical care. As the System HBO Manager in 2008, she worked with a new Medical Director to open monoplace operations in all 9 additional Aurora Facilities in Easter Wisconsin for cross coverage for our patients. She joined the UHMS Accreditation Team as a nurse surveyor in 2001 and continues today. Monica became a CHRN in 2001 and maintains her credentials today. She is active in both the Baromedical Nurse's Association and the UHMS Associates. She is a faculty member for WCEP for both the Intro to HBO programs and the HBO Business Course. Monica retired in 2019.

Holly Manchini, RRT, CHT
Certified Hyperbaric Technician at UPMC McKeesport

4:30pm-5pm	**Cultural sensitivity in healthcare related to providing hyperbaric care: Gus Gustavson, RN**

About the Lecture

With the increasing diversity of the patient population, it is critical for the health care profession to address cultural, religious and personal patient preference health care practices while caring for those patients. Cookbook approaches do not work with every individual. An additional standard of care is appropriate communication to address patient education and informed consent when the patient primary language is not English. This lecture will discuss the scope of the issue and recommended techniques to address appropriate care for individuals from various cultures.

About the Speaker

Richard, widely known by the nickname, "Gus", has over forty-eight years' experience in clinical, supervisory, teaching, staff and middle management positions in acute care hospitals.

This experience includes forty years as a Respiratory Therapist, twenty years as EMT-I, twenty-three years as a Naval Reserve Hospital Corpsman, twenty-three years in Hyperbaric Medicine, eighteen years' experience in wound and burn care, and nineteen years as a Registered Nurse.

Experience in hyperbaric medicine has included Technical Director, Program Director, Nurse Manager and Critical Care Educator specific to hyperbaric medicine.

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Save the dates

Future Annual Meeting Dates & Locations

2026
May 17-21
Sheraton Denver Downtown Hotel

2027
May 23-28
Dallas Anatole Hotel

2028
June 11-15
Sheraton New Orleans Hotel

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