Undersea and Hyperbaric Medical Society

2016 ANNUAL SCIENTIFIC MEETING

PROGRAM & ABSTRACTS

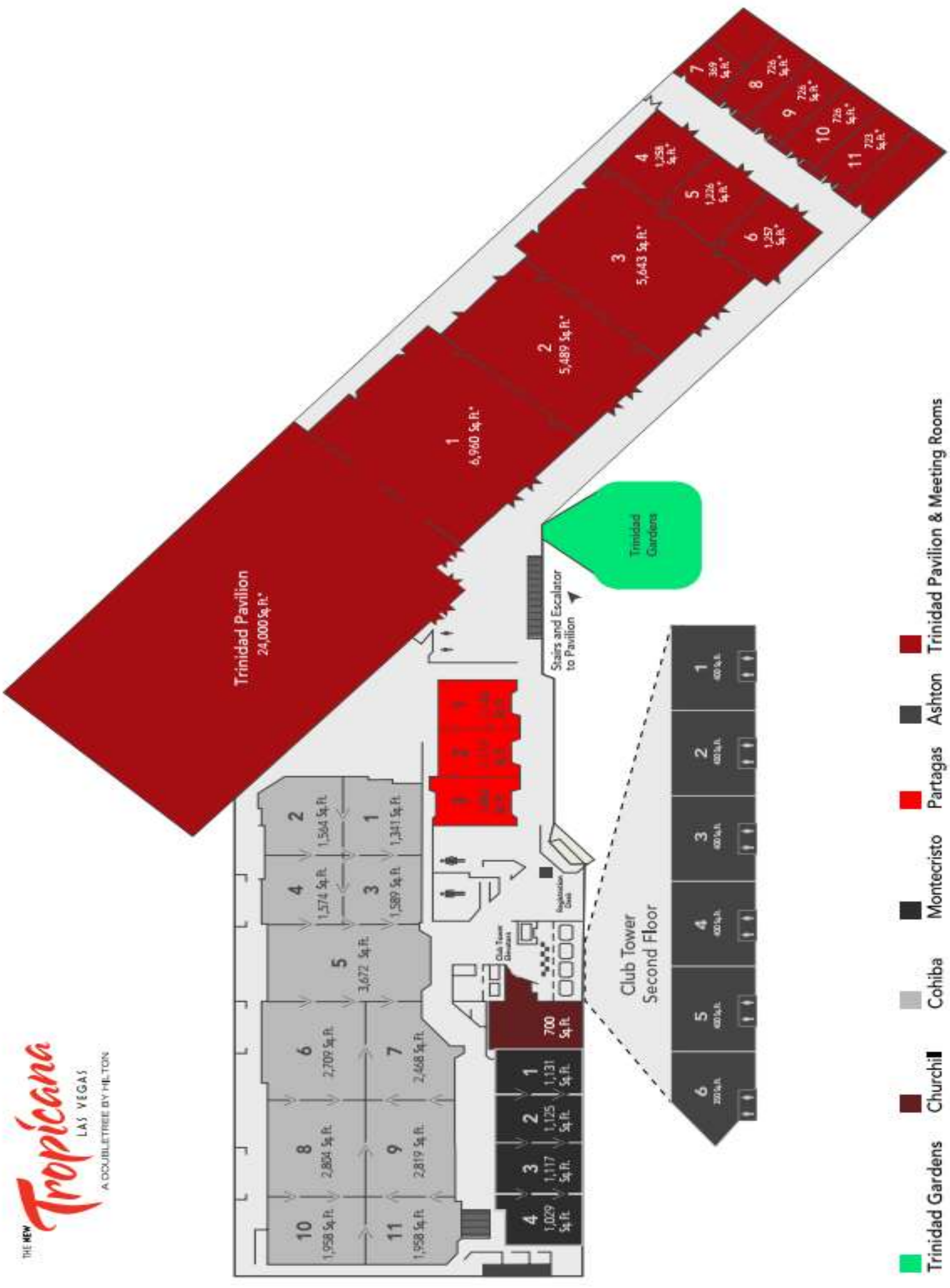
June 9-11

Tropicana Las Vegas
Casino Hotel Resort
3801 Las Vegas Blvd, South
Las Vegas, NV

2016
UHMS Scientific Meeting

June 9-11

Las Vegas, Nevada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European Underwater and Baromedical Society (EUBS)
Japanese Society for Hyperbaric Medicine (JSHM)
South Pacific Underwater Medicine Society (SPUMS)

2016 Annual Scientific Meeting Schedule

HADS Pre-Course: Cohiba 7
HYPERBARIC SKILLS: Cohiba 9
ACCREDITATION: Partagas 3
GENERAL SESSION: Cohiba 6-9
NON-PHYSICIAN TRACK (Thursday Only): Partagas
EXHIBITS/BREAKS: Cohiba 1-5
POSTER SESSIONS: A-C: Montecristo
POSTER SESSIONS: D-F: Cohiba 10-11

Plenary	Sessions/posters	Oral + poster presentation	Exhibit/Breaks	Non-Physician track

WEDNESDAY, JUNE 8

		HOURS
6:00 AM - 5:00 PM	Registration	
7:00 AM - 3:00 PM	Exhibit Company Set-Up	
7:00 AM - 3:00 PM	Exhibit Company Poster Set-Up	
3:00 PM - 6:00 PM	Exhibitors Move-In	
3:00 PM - 6:00 PM	Poster Move-In	
PRE-COURSES		
7:00 AM - 8:00 AM	Continental Breakfast	
8:00 AM - 5:00 PM	Pre-Course: Harvesting and Aquaculture Divers Safety (HADS) Workshop	**7**
8:00 AM - 5:00 PM	Pre-Course: Hyperbaric Skills and Emergency Management	**7**
8:00 AM - 5:00 PM	Pre-Course: How to Prepare for Accreditation	**7**
10:00 AM - 10:30 AM	AM Break	
3:30 PM - 4:00 PM	PM Break	
7:00 PM - 10:00 PM	Welcome Reception	

THURSDAY, JUNE 9

8:00 am – 5:45 pm **7.5**

6:00 AM - 5:00 PM	Registration			
7:00 AM - 8:00 AM	Continental Breakfast / Exhibits			
8:00 AM - 5:45 PM	**PHYSICIAN TRACK**		**NON-PHYSICIAN TRACK**	
8:00 AM - 8:30 AM	**President's Address** **James Holm, MD**			0.5
8:30 AM - 9:30 AM	**Plenary Session: "The History and Evolution of UHMS Journals and Publications"** **Enrico Camporesi, MD**		**Breakout is in PARTAGAS** **SEE PAGE 15 FOR SCHEDULE**	1
9:30 AM - 10:00 AM	AM Break			
10 AM - 11:30 AM	**SESSION A: DIVING/DECOMPRESSION ILLNESS: THEORY & MECHANISMS** **Moderators: Steve Thom, MD & Bruce Derrick, MD**			1.5
11:30 AM - 12:00 PM	**Session A: Posters**			0.5
O: 1000 - 1012 P: 1130 - 1200	**A1**	**Cardiovascular changes of open-circuit heliox divers assessed via transthoracic 2-D Doppler echocardiography.** Covington D, Bielawski A, Scalzini A, Passera M, Bedini R, Laurino M, Sotis CL, Van Hoesen K, Marabotti C		
O: 1024 - 1036 P: 1130 - 1200	**A2**	**Cardiovascular changes of closed-circuit rebreather divers assessed via transthoracic 2D-Doppler**		

		echocardiography. Covington DB, Bielawski A, Scalzini A, Passera M, Bedini R, Laurino M, Sotis CL, Van Hoesen K, Marabotti C		
O: 1036 - 1048 P: 1130 - 1200	**A3**	**Transient increase in cerebral blood flow following hypobaric exposure during routine aircrew training.** McGuire S, Sherman P, Kochunov P		
O: 1048 - 1100 P: 1130 - 1200	**A4**	**Primary cognitive task impairment due to elevated PIN_2, $PICO_2$ and PIO_2 in working divers.** Freiberger JJ, Derrick BJ, Natoli MJ, Akusevich I, Schinazi EA, Walker A, Parker K, Martina SD, Ceponis P, Guerry C, Keilman C, Stolp BW, Bennett PB, Vann RD, Moon RE		
O: 1048 - 1100 P: 1130 - 1200	**A5**	**Effects of PIN_2, $PICO_2$, PIO_2, and exercise on motor function, memory, attention and strategy in working divers.** Freiberger JJ, Derrick BJ, Natoli MJ, Akusevich I, Schinazi EA, Walker A, Parker K, Martina SD, Ceponis P, Guerry C, Keilman C, Stolp BW, Bennett PB, Vann RD, Moon RE		
O: 1100 - 1112 P: 1130 - 1200	**A6**	**Platelet activation and thrombospondin-1 contribute to decompression stress.** Yang M, Bhopale VM, Thom SR		
O: 1112 - 1124 P: 1130 - 1200	**A7**	**Microparticles and post-decompression joint inflammation: A new model of 'type I' decompression sickness?** Thom SR, Yu K, Bhopale VM, Yang M		
O: 1112 - 1124 P: 1130 - 1200	**A8**	**Carbon dioxide stimulates microparticle production.** Thom SR, Bhopale VM, Kovtun S, Yang M		
O: 1124 - 1136 P: 1130 - 1200	**A9**	**Comparison of arterial and end-tidal CO_2 in hypercarbic and hyperbaric conditions.** Freiberger JJ, Derrick BJ, Natoli MJ, Akusevich I, Schinazi EA, Walker A, Parker K, Martina SD, Ceponis P, Guerry C, Keilman C, Stolp BW, Bennett PB, Vann RD, Moon RE		
O: P: 1130 - 1200	**A10**	**Safety of high-intensity interval training with hyperbaric oxygen in a dry diving environment.** Alvarez Villela M, Dunworth SA, Kraft BD, Harlan N, Natoli MJ, Parker CK, Schinazi EA, Piantadosi CA, Moon RE		
O: P: 1130 - 1200	**A11**	**Feasibility of diagnostic 12-lead EKG during scuba exercise.** Bosco G, Camporesi EM, De Marzi E, Omar HR, Mangar D, Pieri M, Rizzato A, Schiavon M		
O: P: 1130 - 1200	**A12**	**Could commercial aviation cabin decompression cause vascular bubble formation?** Buzzacott P, Mollerlokken A		
12:00 PM - 1:15 PM	LUNCH ON OWN		Associate Business Luncheon (limited to 50) or Lunch on Own	
1:15 PM - 2:15 PM	**Lambertsen Memorial Lecture: "Investigations Into Living and Working Under the Water: Where Have We Been and Where Do We Need to Go?" Richard Moon, MD**			1
2:15 PM - 3:45 PM	**SESSION B: HBO_2 THERAPY MECHANISMS Moderators: Gene Worth, MD & Steve Orr, MD**			1.5
3:45 PM - 4:15 PM	PM Break			
4:15 PM - 4:45 PM	**Session B: Posters**			0.5

O: 1412 - 1424 P: 1615 - 1645	B13	**Hyperbaric oxygen inhibits *P. aeruginosa* growth in vitro.** Krendel M, Kliiger J, Wijewardena C, Robson R	
O: 1424 - 1436 P: 1615 - 1645	B14	**Hyperbaric and high-oxygen environments lead to macrophage infiltration, stimulate cell proliferation and accelerate muscle regeneration in contused rat skeletal muscle.** Oyaizu T, Enomoto M, Horie M, Yagishita K	
O: 1436 - 1448 P: 1615 - 1645	B15	**Evaluation of the optimal hyperbaric oxygen therapy protocol for compromised flaps – continued benefit in the face of treatment delay.** Goldman JJ, McNicoll C, Goldman JJ, Silver A, Weber R, Williams S, Yang W, Wang W, Fang XH, Baynosa R	
O: 1448 - 1500 P: 1615 - 1645	B16	**Effects of high-intensity interval training (HIT) in a hyperoxic-hyperbaric environment on exercise performance at altitude.** Dunworth SA, Alvarez Villela M, Kraft BD, Harlan N, Natoli, MJ, Parker CK, Schinazi EA, Piantadosi CA, Moon RE	
O: 1500 - 1512 P: 1615 - 1645	B17	**The role of RANKL and OPG in osteonecrosis patients treated with HBO_2 therapy.** Vezzani G, Camporesi E, Cancellara L, Quartesan S, Mangar D, Bosco G	
O: 1512 - 1524 P: 1615 - 1645	B18	**Hyperbaric oxygen treatment reverses radiation induced oxidative stress in a rat model.** Oscarsson N, Ny L, Mölne J, Ricksten S-E, Seeman-Lodding H, Giglio D	
O: 1524 - 1536 P: 1615 - 1645	B19	**Gene expression is modified by hyperbaric oxygen therapy.** Sethuraman KS, Hsieh YC, Kloyster M, Rosenthal RE, Fiskum GM	
O: P: 1615 - 1645	B20	**First insights on oxygen-induced genotoxicity and mitochondrial function in leukemia cell models – implications for diving with cancer?** Tillmans F, Radermacher P, Calzia E, Werr H, Koch A, Kaehler W, Klapa S, DeBels, D, Balestra C	
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5:45 PM - 6:45 PM		**Meet the Exhibitors – Wine & Cheese Reception**	

FRIDAY, JUNE 10

8:00 am – 6:00 pm: COMBINED TRACK

8.5

6:00 AM -5:00 PM		**Registration**	
7:00 AM - 8:00 AM		Continental Breakfast / Exhibits	
8:00 AM - 9:00 AM		**Plenary Session: "Understanding Hyperbaric Dosing" Enoch Huang, MD**	1
9:00 AM - 10:30 AM		**SESSION C: CLINICAL HBO_2 THERAPY Moderators: Tracy LeGros, MD & Jeff Mize, RRT, CHT, CWCA**	1.5
10:30 AM - 11:00 AM		AM Break	
11:00 AM - 11:30 AM		**Session C: Posters**	0.5
O: 0900 - 0912 P: 1100 - 1130	C21	**Hyperbaric oxygen therapy for central retinal artery occlusions.**	

		Akella SS, Gentile RC, Yasen J, Cherian S, Gorenstein S, Barzideh N
O: 0912 - 0924 P: 1100 - 1130	**C22**	**C-reactive protein in carbon monoxide poisoning.** Keilman C, Weaver LK, Guerry C. Tettelbach B
O: 0924 - 0936 P: 1100 - 1130	**C23**	**The higer recovery rate of cardiac enzyme after hyperbaric oxygen therapy with severe CO poisoning.** Kim H, Cha YS, Hwang SO, Lee KH
O: 0936 - 0948 P: 1100 - 1130	**C24**	**Garage carbon monoxide (CO) levels produced by co sources commonly used in intentional poisoning.** Hampson NB, Courtney TG, Holm JR.
O: 0948 - 1000 P: 1100 - 1130	**C25**	**Case series of patients with central retinal artery obstruction with the diagnosis confirmed with bedside ultrasound.** Hendriksen SM, Logue CJ, Westgard B, Walters J, Minnihan RE, Masters T
O: 1000 - 1012 P: 1100 - 1130	**C26**	**Prevalence of pineal cyst in carbon monoxide-poisoned patients with ongoing symptoms after poisoning.** Ranzenberger LR, Snyder THW, Weaver LK, Deru K, Orrison JJ, Cartwright PE, Orrison WW
O: 1012 - 1024 P: 1100 - 1130	**C27**	**Brain imaging abnormalities in acutely vs. chronically carbon monoxide-poisoned patients with ongoing symptoms at least 6 months after poisoning.** Weaver LK, Orrison WW, Deru K
O: P: 1100 - 1130	**C28**	**Carbon monoxide poisoning in Utah: 1996-2013.** Weaver LK, Deru K, Churchill S, Legler J, Snow G, Grey T
O: P:	**C29**	**WITHDREW: Long term evaluation of retinal artery occlusion patients that were applied hyperbaric oxygen treatment.** İlbasmış S, Ercan E
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O: P: 1100 - 1130	**C31**	**Hyperbaric oxygen treatment of a critical care pediatric patient: a case report.** Bielawski A, Covington D, Duchnick J, Latham E, Witucki P
O: P: 1100 - 1130	**C32**	**An urban tertiary referral center experiences in treating avascular necrosis with hyperbaric oxygen therapy: a case series.** O'Neal M, Murphy-Lavoie H, Harch P, LeGros T
O: P: 1100 - 1130	**C33**	**Adjunctive hyperbaric oxygen (HBO_2) therapy for cerebral delayed radiation injury (DRI) in a pediatric patient.** Aguilera MA, Kelly MP, Hardy KR
O: P: 1100 - 1130	**C34**	**A retrospective case review of the effect of hyperbaric oxygen therapy on central retinal artery occlusion.** Kinariwala N, Wojcik S, Heyboer M
O: P: 1100 - 1130	**C35**	**A case of non-dysbaric arterial gas embolism associated with necrotizing pneumonia and pulmonary bullae.** Ceponis P, Fox W, Moon R
O: P: 1100 - 1130	**C36**	**A case of acute CO poisoning due to tobacco smoking using a hookah with quick-light charcoal.** May TW, Ceponis P, Freiberger JJ
O: P: 1100 - 1130	**C37**	**Transcutaneous oximetry evaluation of post-radiation breast lymphedema.** Gwilliam, AM, Robins MS, Stewart JS
O: P: 1100 - 1130	**C38**	**Therapeutic outcomes among patients treated for late radiation injury in a single center hyperbaric program.** Chin W, Sprau S, Nguyen J, Atwal S, Joo E
O: P: 1100 - 1130	**C39**	**Severe unintentional carbon monoxide intoxication in a pregnant patient.** Johnson-Arbor K, Keity J
O: P: 1100 - 1130	**C40**	**Pain improvement in rheumatoid arthritis with hyperbaric oxygen: a report of 3 cases.** Slade J, Potts M, Flower A, Sit M, Schmidt T
O: P: 1100 - 1130	**C41**	**Myositis associated with carbon monoxide poisoning.** Weaver LK, Deru K, Oliver LC

O: P:	C42	WITHDREW: **Delayed hyperbaric oxygen (HBO_2) treatment of sudden sensorineural hearing loss (SSHL).** LeDez KM, Redmond E, Zbitnew G, Murphy K, Goodall CBL	
O: P: 1100 - 1130	C43	**Closure of a radiation induced recto-urethral fistula with hyperbaric oxygen therapy.** Monsour RE, David S	
O: P: 1100 - 1130	C44	**Carboxyhemoglobin half-life (COHb t1/2) during hyperbaric oxygen (HBO_2).** Weaver LK, Deru K.	
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O: 1342 - 1354 P: 1530 - 1600	D47	**Recompression treatment tables used for artisanal fishermen divers in the Yucatán peninsula: understanding depths and duration.** Chin W, Huchim-Lara O, Popa D, Nguyen P, Ninokawa S	
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O: P: 1530 - 1600	**D58**	**Nitrogen narcosis addiction in a recovering alcoholic– a case study.** McCulloch N, Morgan M, Jennings S, Santiago W, Mariani P, Heyboer M	
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O: P: 1530 - 1600	**D67**	**Understanding dive behavior: Bottom time as a function of days of the week.** Nguyen,PT, Chin W, Ninokawa S, Huchim O	
O: P: 1530 - 1600	**D68**	**Swimming-induced pulmonary edema in a tropical climate: case report.** Kwek WMJ, Ho BH, Chow WE	
O: P: 1530 - 1600	**D69**	**Self-reported physical activity and perceptions of the importance of structured exercise in certified divers.** Kovacs CR, Buzzacott P	
O: P: 1530 - 1600	**D70**	**ONR's Undersea Medicine Program efforts to mitigate decompression sickness and hyperbaric oxygen toxicity.** D'Angelo WR	
O: P: 1530 - 1600	**D71**	**ECG abnormalities detected in a commercial diver during eight- and 12-hour immersions: a case report.** Hostler D, Russo LN	
O: P: 1530 - 1600	**D72**	**Dive profiles of sea urchin fishermen divers in California.** Chin W, Nijjar J, Gonzalez A, Tran A, Nguyen T, Nguyen P, Ninokawa S, Joo E	
O: P: 1530 - 1600	**D73**	**Difference in age among artisanal fishermen divers treated for decompression illness in the Yucatán Peninsula by fishing season.** Chin W, Huchim-Lara O, Gonzalez A, George P, Tran A, Nijjar J, Atwal S, Nguyen T, Joo E, Morales M, Popa D	
O: P: 1530 - 1600	**D74**	**Data mining on Divers Alert Network DSL database, Phase 1: Classification of divers.** Yavuz C, Ozyigit T, Pieri M, Egi SM, Egi B, Altepe KC, Cialoni D, Marroni A	
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O: P: 1530 - 1600	**D76**	**A decompression sickness case provoked by flying after diving.** Yumbul AS, Kaplan MA, Toklu AS	

O: P: 1530 - 1600	D77	**A case of cerebral decompression sickness with spontaneous pneumothorax caused by hidden lung cancer.** Oh SH, Kang HD, Jung SK	
4:00 PM - 5:30 PM		**Plenary Session: "Access to Emergent Hyperbaric Therapy in the United States"** **Jim Chimiak, MD, Walter Chin, RN**	1.5
5:30 PM - 6:00 PM		**UHMS Annual Business Meeting**	

SATURDAY, JUNE 11

8:00 am – 5:00 pm: COMBINED TRACK

7

6:00 AM - 5:00 PM		Registration	
7:00 AM - 8:00 PM		Continental Breakfast / Exhibits	
8:00 AM - 9:00 AM		**Plenary Session: "New Pearls of Wisdom in the Diving and Hyperbaric Medicine Literature"** **UHM Fellows: Bradley Hickey, MD and Peter Ceponis, MD**	1
9:00 AM - 10:30 AM		**SESSION E: HBO_2 THERAPY, CHAMBERS, AND EQUIPMENT** **Moderators: James Holm, MD & Janet Bello, ACHRN**	1.5
10:30 AM - 11:00 AM		AM Break	
11:00 AM - 11:30 AM		**Session E: Posters**	0.5
O: P:	E78	**WITHDREW: Short- and long-term effects of chronic hyperbaric oxygen therapy on nasal mucociliary clearance.** Uluyol S, Demir L, Kılıçaslan S	
O: 0912 - 0924 P: 1100 - 1130	E79	**Strengths and weaknesses among recompression facilities in the DAN network.** Nochetto M	
O: 0924 - 0936 P: 1100 - 1130	E80	**Patient preference of monoplace or multiplace hyperbaric chambers.** Koumandakis G, Churchill S, Cable R, Wilson G, Deru K, Weaver LK	
	E81	**MOVED to Friday 1430-1442: Mental Health: to dive or not to dive?**	
O: 0936 - 0948 P: 1100 - 1130	D51	**Effect of immersion and rehydration timing on exercise endurance.** Hostler D, Schlader ZJ, Pendergast D	
O: P: 1100 - 1130	E82	**Implementing a nurse-driven protocol to manage diabetic patients in hyperbarics.** Stevens SL, Sorita A, Narr AJ, Claus PL, Tescher,A, Millman MP, Shields RC, Buchta WG, Haddon R, Murad MH	
O: 1012 - 1024 P: 1100 - 1130	E83	**An assessment of the performance of the Baxter Elastomeric Large Volume (LV 10) Infusor pump under hyperbaric conditions.** Perks S, Blake DF, Young DA, Hardman J, Brown LH, Lewis I	
O: 1024 - 1036 P: 1100 - 1130	E84	**Allocation concealment in a blinded, randomized trial of hyperbaric oxygen for post-concussive symptoms.** Churchill S, Miller RS, Deru K, Weaver LK	
O: P: 1100 - 1130	E85	**Altmetric scores and cited times of publications in Undersea and Hyperbaric Medicine.** Lee CH, Wang KC	
O: P:	E86	**WITHDREW: Unexpected decompression sickness in a hyperbaric inside attendant.** Demir L, Uymur E.	
O: P: 1100 - 1130	E87	**Stroke due to hyperbaric oxygen-induced seizure.** Warchol J, Cooper J	
O: P: 1100 - 1130	E89	**Rapid deterioration of visual acuity with hyperbaric oxygen treatment for failing flap after radiation for mycoses fungoides.** LeDez KM, Redmond E, Zbitnew G, Murphy K, Goodall CBL	
O: P: 1100 - 1130	E90	**Prospective study of mucosal atomizer device use on myringotomy patency.** Walter J, Minnihan RE, Westgard B, Logue C, Hendriksen S, Masters TC	
O: P: 1100 - 1130	E91	**Knowledge, attitude and practice of hyperbaric O_2 therapy in the treatment of chronic non-healing wounds among physicians in the Saudi Armed Forces Hospitals.** Darandari J	
O: P: 1100 - 1130	E92	**Hyperbaric oxygen (HBO_2) treatment schedule changes to reduce effects on visual acuity.** LeDez KM, Redmond E, Zbitnew G, Murphy K, Goodall CBL.	

O: P: 1100 - 1130	**E93**	**Go/No-Go Survey: finding common ground and developing a reference guide.** Pullis M	
O: P: 1100 - 1130	**E94**	**Blood glucose fluctuation in a non-diabetic patient during hyperbaric oxygenation.** Johnson-Arbor K, Kelty J	
O: P: 1100 - 1130	**E95**	**A systematic quality improvement program for improving patient care and satisfaction.** Nolting V	
11:30 AM - 12:30 PM		**Plenary Session: "Guidelines for Prehospital Management of Diving Injuries"** **Simon Mitchell, MD**	1
12:30 PM - 1:30 PM		LUNCH (on own)	
1:30 PM - 3:00 PM		**SESSION F: CLINICAL AND DIVING-RELATED HBO_2 THERAPY** **Moderators: Mike Bennett, MD & Connie Hutson, RN**	1.5
3:00 PM - 3:30 PM		PM Break	
3:30 PM - 4:00 PM		**Session F: Posters**	0.5
O: 1330 - 1342 P: 1530 - 1600	**F96**	**Misdiagnosed cases as neurologic decompression illness – the importance of neurologic examination in diving medicine.** Kohshi K, Kohshi K, Murata U	
O: 1342 - 1354 P: 1530 - 1600	**F97**	**Efficacy of hyperbaric oxygen therapy in ischemic stroke early rehabilitation and evaluation of health economics.** Kuang XY, Xiao PT	
O: 1354 - 1406 P: 1530 - 1600	**F98**	**Indocyanin green angiography results pre- and post-hyperbaric oxygen exposure.** Huang ET, Nichols TE	
O: 1406 - 1418 P: 1530 - 1600	**F101**	**Vascular studies do not correlate with indocyanin green angiography results pre- and post-hyperbaric oxygen exposure.** Huang ET, Nichols TE	
O: 1418 - 1430 P: 1530 - 1600	**F99**	**Use of In-chamber TCOM to determine optimal treatment pressure.** Heyboer M, Byrne J, Wojcik S	
O: 1430 - 1442 P: 1530 - 1600	**F100**	**Long-term follow-up (LTFU) after hyperbaric oxygen or sham chamber sessions in military post-concussive syndrome.** Skipper LD, Churchill S, Wilson SH, Deru K, Labutta RJ, Hart BB	
O: 1442 - 1454 P: 1530 - 1600	**F102**	**Echocardiographic evaluation of intracardiac venous gas emboli following in-water recompression.** Whelan HT, Dituri J, Siddiqi F, Sadler C, Javeed N, Annis H	
O: P: 1530 - 1600	**F103**	**Adjuvant use of hyperbaric oxygen (HBO_2): treatment of complications following orthotopic liver transplantation (OLT) in human: report of 29 cases.** Maffi L, Salizzoni M, Cocchis D, Lupo F, Tandoi F, Patrono D , Zanon V	
O: P: 1530 - 1600	**F104**	**The use of indocyanine green fluorescence angiography to assess perfusion of chronic wounds undergoing hyperbaric oxygen therapy.** Kim D, Kaplan S, Baksh F, Fishbein J, Caprioli R, Haight J, Ferguson R, Pliskin M, Oropallo A	
O: P: 1530 - 1600	**F105**	**The use of hyperbaric oxygen therapy in the treatment of a traumatic thumb amputation and a review of the literature.** Engle J, Harch P, Van Meter K, Murphy-Lavoie H, LeGros T	
O: P: 1530 - 1600	**F106**	**Photographic tissue characterization applied to relative quantification related to hyperbaric oxygenation of diabetic foot ulcer: case report.** Maran CA, Salles-Cunha SX, Faria PS, Acioli P, Castro IJL, Neto JRD	
O: P: 1530 - 1600	**F107**	**Patient outcomes and factors associated with healing in calciphylaxis patients undergoing adjunctive hyperbaric oxygen therapy.** McCulloch N, Heyboer M, Wojcik S	
O: P: 1530 - 1600	**F108**	**Mystery gas embolism: a case report.** Bielawski A, Covington D, Savaser D	
O: P: 1530 - 1600	**F109**	**Arterial gas embolism after bone marrow biopsy successfully treated with hyperbaric oxygen therapy: a case study.** McCulloch N, Morgan M, Jennings S, Santiago W, Mariani P, Heyboer M	
O: P: 1530 - 1600	**F110**	**Use of indocyanine green fluorescent angiography in a hyperbaric patient with soft tissue radiation necrosis.**	

		Johnson-Arbor K, Barbour J, Kelty J	
O: P: 1530 - 1600	F111	**Use of hyperbaric oxygen therapy for vasopressor-induced ischemic necrosis.** Johnson-Arbor K, Evans K, Attinger C	
O: P:	F112	**WITHDREW: The impact of hyperbaric oxygen therapy on the vegetative state patients with different ages and duration of disease.** Qingle L, Zhao L, Hang X, Zheng C, Yi H, Zhou L	
O: P: 1530 - 1600	F113	**Successful treatment of cutaneous nocardiosis with hyperbaric oxygen therapy.** Johnson-Arbor K, Kelty J	
O: P: 1530 - 1600	F114	**Serious concerns with Toronto hyperbaric oxygen (HBO_2) treatment for diabetic foot ulcer (DFU) study: use and abuse by health institutions and authorities.** LeDez KM, Linden R	
O: P: 1530 - 1600	F115	**Serious concerns with Toronto hyperbaric oxygen (HBO_2) treatment for diabetic foot ulcer (DFU) study: science and ethics.** LeDez K	
O: P: 1530 - 1600	F116	**Implantable cardioverter-defibrillator placement complicated by cerebral arterial gas embolism.** Siegel MW, Covington DB, Bielawski A, Duchnick J, Snyder B	
O: P: 1530 - 1600	F117	**Hyperbaric oxygen use in cancer treatment.** LaMar DL, Dodson WW	
O: P: 1530 - 1600	F118	**Hyperbaric oxygen therapy: role in skin grafting.** Millman MP, Claus PL	
O: P: 1530 - 1600	F119	**Hyperbaric oxygen therapy for osteomyelitis.** Kawashima M, Kawashima M, Tamura H, Nagayoshi I, Motoyama T, Furue Y, Sasaki T, Goto T, Watanabe Y, Takao K, Yamaguchi T, Miyata K	
O: P: 1530 - 1600	F120	**Fluorescence microangiography to guide management of non-healing wounds.** Minnihan RE, Masters T, Walter J, Hendriksen S, Logue C, Westgard B	
O: P: 1530 - 1600	F121	**Endoscopic bubble trouble: hyperbaric oxygen therapy for cerebral gas embolism during upper endoscopy – case reports and literature review.** Cooper J, Thomas J, Singh S, Brakke T	
O: P: 1530 - 1600	F122	**Early treatment of frostbite with hyperbaric oxygen.** Robins MS, Gwilliam AM, Stewart JR	
O: P: 1530 - 1600	F123	**Early institution of hyperbaric oxygen therapy for decreasing complication of air embolism.** Hall Y, Shah JB	
O: P: 1530 - 1600	F124	**Carbon Monoxide Poisoning Rates and Median Household Income in Philadelphia.** Chiu J, Lambert D, Kelly M, Shofer F	
4:00 PM - 5:00 PM		**Plenary Session: “International Perspectives on Hyperbaric Oxygen Therapy”** **Folke Lind, MD; Jacek Kot, MD, Gerardo Bosco MD, Nicklas Oscarsson, MD**	1
7:00 PM - 7:30 PM		Annual Awards Banquet Reception	
7:30 PM – 10:00 PM		Annual Awards Banquet	
10:00 PM – 1:00 AM		Annual Banquet “After Party”	
TOTAL CONTINUING EDUCATION CREDITS: 3 DAYS			**23**

SUNDAY, JUNE 12

8:00 AM - 5:00 PM	Surveyor Training (contact Tom Workman) MONTECRISTO 1	

Non-Physician Track

"Associate's Breakout"

PARTAGAS ROOM

Thursday, JUNE 9

7:00 AM - 8:00 AM	Continental Breakfast / Exhibits
8:00 AM - 8:30 AM	**President's Address** **James Holm, MD**
Breakout Sessions: Moderators: Monica Skarban & Valerie Short	
8:30 AM – 8:40 AM	Welcome Comments
8:40 AM - 9:05 AM	UHMS Associate's Update Matt Schweyer, BA, CHT-A
9:05 AM – 9:30 AM	BNA, Then and Now Connie Hutson, ACHRN, CHWS, CWCN, RN, MS & Laura Josefsen, RN, ACHRN
9:30 AM - 10:00 AM	AM Break
Breakout Sessions: Moderators: John Duffy & Bradley Walker	
10:00 AM – 10:20 AM	Management of Cardiac Arrest in a Multiplace Hyperbaric Chamber Ginny Nolting, RN, CHRN & Marc Pullis, EMT, CHT
10:20 AM – 10:40 AM	CO Awareness in Your Community Can Help Save Lives Deb Critz, RN, BSN, ACHRN
10:40 AM – 11:00 AM	Case Report: Erectile Dysfunction & HBOT Jolene Cormier, RN, BSN, CHT
11:00 AM – 11:30 PM	Scholarship Winner Lecture: Recent investigations at the Duke Hyperbaric Center Assessing the cognitive effects of diving narcosis; A role for hyperbaric oxygen in exercise performance improvement? Mike Natoli, MS, CHT
11:30 AM – 12:00 PM	Medical Necessity Documentation to Support ICD-10 Laura Josefsen, RN, ACHRN
12:00 PM – 1:15 PM	Associate's Luncheon
1:15 PM - 2:15 PM	**Lambertsen Memorial Lecture: "Investigations into Living and Working under the Water: Where Have We Been and Where do We Need to Go?"** **Richard Moon, MD**
Breakout Sessions: Moderators: Laura Josefsen & Matt Schweyer	
2:15 PM – 3:00 PM	Leadership Alphabet From Z to Y and Back Again R. B. Gustavson, MPH, RN
3:00 PM – 3:45 PM	Current Environment of Audits & Surveys Bradley Walker, ASE, PE, MBA, RN, EMTP, CHT, DMT
3:45 PM - 4:15 PM	PM Break
Breakout Sessions: Moderators: Deb Critz & Valerie Short	
4:20 PM – 4:50 PM	Quality Improvement In Hyperbaric Medicine Centers: Looking Beyond Statistics To Find Change Janet Bello, RN, BSN, ACHRN
4:50 PM – 5:30 PM	LEAN & Rapid Improvement Events (concepts how can we apply them to Hyperbaric Specialty) Walter Chin, BSN

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: The Undersea and Hyperbaric Medical Society designates this live activity for a maximum of **23** AMA PRA Category 1 Credit(s)™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.
Nursing CEU is approved by the Florida Board of Registered Nursing Provider #50-10881. Northeast Chapter Credit hours **23**. Licenses Types Approved: Advanced Registered Nurse Practitioner; Clinical Nurse Specialist; Licensed Practical Nurse; Registered Nurse; Certified Nursing Assistant; Respiratory Care Practitioner Critical Care; Respiratory Care Practitioner Non-Critical Care; Registered Respiratory Therapist; Certified Respiratory Therapist
NBDHMT: This live activity is approved for **23** Category A credit hours by National Board of Diving and Hyperbaric Medical Technology, 9 Medical Park, Suite 330, Columbia, South Carolina 29203.
Full Disclosure Statement: All faculty members and planners participating in continuing medical education activities sponsored by Undersea and Hyperbaric Medical Society are expected to disclose to the participants any relevant financial relationships with commercial interests. Full disclosure of faculty and planner relevant financial relationships will be made at the activity.
Disclaimer: The information provided at this CME activity is for Continuing Medical Education purposes only. The lecture content, statements or opinions expressed however, do not necessarily represent those of the Undersea and Hyperbaric Medical Society.

EVALUATION

In an effort to "GO GREEN" and improve the efficiency in evaluating our CME Program, we now offer the evaluation form online. A hard-copy evaluation form can be provided upon request. Thank you for supporting our efforts to help reduce our carbon footprint**.** The evaluation link will also be emailed to you once the meeting is over.

ANNUAL SCIENTIFIC MEETING EVALUATION LINK (INCLUDES NON-PHYSICIAN TRACK):
https://www.surveymonkey.com/r/EvalASM16

MAINTENANCE OF CERTIFICATION (MOC):

"MOC ABPM: This activity has been approved by the American Board of Preventive Medicine for up to 23 MOC credits. Claiming ABPM MOC credit is appropriate for those who are ABPM diplomates."

ONLINE LINK TO THE MOC QUESTIONS: https://www.surveymonkey.com/r/MOCASM16

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Disclosures

All individuals in control of content for this educational activity with their relevant financial relationship disclosed are listed below. ACCME defines a relevant financial relationship "as financial relationships in any amount occurring within the past 12 months that create a conflict of interest." An individual who refuses to disclose relevant financial relationships will be disqualified from being a planning committee member, a teacher, or an author of CME, and cannot have control of, or responsibility for, the development, management, presentation or evaluation of the CME activity.

Planners: The following planners had no relevant financial relationships with commercial interests to disclose.

James Holm, MD, Seattle, WA	Guy Dear, MB FRCA: Durham, NC	John Feldmeier, DO, San Antonio, TX
Debbie Pestell, MD, Halifax, NS Canada	Laurie Gesell, MD, Brookfield, WI	Bruce Derrick, MD, Durham, NC
Valerie Short, ACHRN, San Antonio, TX	Matt Schweyer, CHT, Dallas TX	Heather Murphy-Lavoie, MD, CME Rep, New Orleans, LA
Stacy Rupert, UHMS CME Coordinator	Lisa Tidd, Administrator, UHMS Office	

Planners: The following planners had relevant financial relationships with commercial interests to disclose.

Name of Individual	Individuals Role in Activity	Name of Commercial Interest (If Applicable)	Nature of Relationship
Enoch Huang, MD	Faculty	Novadaq	Speakers Bureau

Faculty/Moderators: The following faculty/moderators had no relevant financial relationships with commercial interests to disclose.

Steve Thom, MD	Bruce Derrick, MD	Gene Worth, MD	Monica Skarban, RN
Steve Orr, MD	Tracy LeGros, MD	Jeff Mize, RRT, CHT, CWCA	Richard Gustavson, RN
Neal Pollock, PhD	Annette Gwilliam, ACHRN	James Holm, MD	Laura Josefsen, ACHRN
Janet Bello, ACHRN	Michael Bennett, MD	Connie Hutson, RN	John Duffy, RN
Enrico Camporesi, MD	Richard Moon, MD	Richard Baynosa, MD	Bradley Walker, CHT
Hele Gelly, MD	Jim Chimiak, MD	Walter Chin, RN	Ginny Nolting, RN
Bradley Hickey, MD	Peter Ceponis, MD	Simon Mitchell, MD	Marc Pullis, CHT
Folke Lind, MD	Nicklas Oscarsson, MD	Gerardo Bosco, MD	Deb Critz, RN
Jacek Kot, MD	Jolene Cormier, RN	Mike Natoli, CHT	

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Name of Individual	Individuals Role in Activity	Name of Commercial Interest (If Applicable)	Nature of Relationship
Enoch Huang, MD	Faculty	Novadaq	Speakers Bureau
Caroline Fife, MD	Faculty	Intellicure	Employment/Leadership/Stock/Investment
Marc Robins, DO	Faculty	KCI	Consultant/Speaker Bureau

The following presenters had no relevant financial relationships with commercial interests to disclose:

Acioli P: F106; Aguilera MA: C33; Akella SS: C21; Akusevich I: A4, A5, A9; Alleman T: D54, D63; Altepe KC: D74; Alvarez Villela M: A10, B16; Annis H: F102; Attinger C: F111; Atwal S: C38, D66, D73; Baeza L: D52; Baksh F: F104; Balestra C: B20; Barbour J: F110: Barlow JL: D55; Barzideh N: C21; Baynosa R: B15; Becker C: C88; Bedini R: A1, A2; Bennett PB: A4, A5, A9; Bhopale VM: A6, A7, A8; Bi T: D66; Bielawski A: A1, A2, C31, F108, F116; Blake DF: E83; Bosco G: A11, B17; Brakke T: F121; Brown LH: E83; Buchta WG: E82; Buckey JC: C45; Buzzacott P: A12, D48, D69; Byrne J: F99; Cable R: E80; Calzia E: B20; Camara-Koyoc I: D75; Camporesi EM: A11, B17; Cancellara L: B17; Canche-Varguez A: D75; Caponis P: C36; Caprioli R: F104; Cardenas-Dajdaj R: D57; Carrillo-Arceo L: D56; Cartwright PE: C28; Castro IJL: F106; Ceponis P: A4, A5, A9, C35, C36, D62; Cha YS: C23; Chabal S: D49; Cherian S: C21; Chi-Mendez GC: D56; Chin W: C38, D47, D50, D52, D56, D57, D61, D66, D67, D72, D73, D75; Choi SC: D65; Chow WE: D68; Churchill S: C28, D62, E80, E84, F100; Cialoni D: D74; Clarke JM: D49; Claus PL: E82, F118; Cocchis D: F103; Conway RM: E81; Cooper J: E87, F121; Cordero-Romero S: D57; Courtney TG: C24; Covington DB: A1, A2, C31, F108, F116; D'Angelo WR: D70; Darandari J: E91; David S: C43; Davis R: D46; De Marzi E: A11; DeBels D: B20; Demir L: E78, E86; Denoble PJ: D46, D48; Derrick BJ: A4, A5, A9; Deru K: C26, C27, C28, C41, C44,E80, E84, F100; Dituri J: F102; Dodson WW: F117; Dogre Sansores O: D57; Domoto H: D53; Driscoll S: D49; Duchnick J: C31, F116; Dunworth SA: A10, B16; Duquet R: C88; Egi B: D74; Egi SM: D74; Engle J: F105; Enomoto M: B14; Ercan E: C29; Evans K: F111; Fang S: D66; Fang XH: B15; Faria PS: F106; Ferguson R: F104; Fishbein J: F104; Fiskum GM: B19; Flower A: C40; Fothergill DM: D49; Fox W: C35; Franberg O: D64; Freiberger JJ: A4, A5, A9, C36; Furue Y: F119; Garbino A: D60; Gentile RC: C21; George P: D66, D73; Gerbino AJ: D55; Giglio D: B18; Goldman JJ: B15; Gonzalez A: D50, D56, D72, D73; Goodall CBL: C42, E89, E92; Gorenstein S: C21; Goto T: F119; Grey T: C26; Guerry C: A4, A5, A9, C22; Gwilliam AM: C37, F122; Haddon R: E82; Haight J: F104; Hall Y: F123; Hampson NB: C24; Hang X: F112; Harch P: C32, D59, F105; Hardman J: E83; Hardy KR: C33; Harlan N: A10, B16; Hart BB: F100; Hendriksen SM: C25, E90, F120; Heyboer M: C34, D58, F99, F107, F109; Hickey B: D59; Ho BH: D68; Holm JR: C24, D55; Horie M: B14; Hostler D: D51, D71; Hsieh YC: B19; Huchim-Lara O: D47, D50, D52, D56, D57, D61, D66, D67, D73, D75; Huh JH: D65; Hwang SO: C23; İlbasmış S: C29; Inoue K: D53; Iwakawa T: D53; Javeed N: F102; Jennings S: D58, F109; Jeong HH: D65; Johnson-Arbor K: C39, E94, F110, F111, F113; Joo E: C38, D66, D72, D73; Jung SK: D77; Kaehler W: B20; Kang HD: D77; Kaplan MA: D76; Kaplan S: F104; Kawashima M: F119; Kawashima M: F119; Keilman C: A4, A5, A9, C22; Kelly MP: C33; Kelty J: C39, E94, F110, F113; Kılıçaslan S: E78; Kim D: F104; Kim H: C23; Kim JY: D65; Kinariwala N: C34; Klapa S: B20; Kliiger J: B13; Kloyster M: B19; Koch A: B20; Kochunov P: A3; Kohshi K: F96; Koshi K: D46; Koumandakis G: E80; Kovacs CR: D69; Kovtun S: A8; Kraft BD: A10, B16; Krendel M: B13; Kuang XY: F97; Kwek WMJ: D68; Labutta RJ: F100; LaMar DL: F117; Latham E: C31; Laurino M: A1, A2; LeDez KM: C42, E89, E92, F114, F115; Lee CH: E85; Lee KH: C23; Legler J: C26; LeGros TL: C32, D54, D59, D63, F105; Lewis I: E83; Linden R: F114; Logue CJ: C25, E90, F120; Lupo F: F103; Maffi L: F103; Mangar D: A11, B17; Marabotti C: A1, A2; Maran CA: F106; Mariani P: D58, F109; Marroni A: D74; Martina SD: A4, A5, A9; Masters TC: C25, E90, F120; May TW: C36; McCulloch N: D58, F107, F109; McGuire S: A3; McNicoll C: B15; Mendez N: D56, D57, D75; Miller RS: E84; Millman MP: E82, F118; Minnihan RE: C25, E90, F120; Miyata K: F119; Mollerlokken A: A12; Mölne J: B18; Monsour RE: C43; Moon RE: A4, A5, A9, A10, B16, C35; Morales N: D73; Morgan M: D58, F109; Motoyama T: F119; Murad MH: E82; Murata U: F96; Murphy K: C42, E89, E92; Murphy-Lavoie H: C32, D54, D59, D63, F105; Nagayoshi I: F119; Narr AJ: E82; Natoli MJ: A4, A5, A9, A10, B16; Neto JRD: F106; Nguyen J: C38; Nguyen PT: D47, D66, D67, D72; Nguyen T: D50, D72, D73; Nichols TE: F98, F101; Nijjar J: D66, D72, D73; Ninokawa S: D67, D72; Nochetto M: E79; Nolting, V: E95; O'Neal M: C32; Oh SH: D77

The following presenters had relevant financial relationships with commercial interests to disclose.

Name of Individual	Individuals Role in Activity	Name of Commercial Interest (If Applicable)	Nature of Relationship
Huang ET:	F98, F101	Novadaq	Speakers Bureau

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x	No relevant relationship(s) to resolve		Provided talking points/outline
	Restricted presentation to clinical data		Data, slides added or removed
	Reassigned faculty's lecture/topic	x	Reviewed content – free of commercial bias

Signature of Activity Director/Coordinator

Date: 6/9/2016

THERE WERE NO RELEVANT RELATIONSHIP(S) TO RESOLVE

UHMS CME Coordinator

COMMITTEE MEETING SCHEDULE

TUESDAY, JUNE 7			ROOM
4:00 PM	11:00 PM	Board Meeting	**ASHTON 2**
WEDNESDAY, JUNE 8			**ROOM**
9:00 AM	3:00 PM	NATO Meeting (Bill D'Angelo)	**ASHTON 2**
10:00 AM	11:00 AM	MOC Committee	**ASHTON 1**
11:00 AM	3:00 PM	WCEP Board Meeting	**ASHTON 3**
1:00 PM	4:00 PM	ABPM EXAM	**ASHTON 1**
3:00 PM	7:00 PM	Editorial Board Meeting	**ASHTON 3**
4:45 PM	7:45 PM	HBO Therapy Committee Meeting	**ASHTON 1**
5:30 PM	7:30 PM	Associate's Council Meeting	**ASHTON 2**
THURSDAY, JUNE 9			**ROOM**
7:00 AM	8:00 AM	Safety Committee Meeting	**ASHTON 1**
12:00 PM	1:15 PM	GME Committee	**ASHTON 3**
12:00 PM	1:00 PM	DCI / Adjunctive Therapy Committee	**ASHTON 1**
1:00 PM	3:00 PM	Subcommittee: ED & QUARC Meeting (Marc Robins)	**ASHTON 2**
3:00 PM	5:00 PM	Education Committee	**ASHTON 2**
6:00 PM	8:00 PM	Accreditation Council Meeting	**ASHTON 2**
6:30 PM		BNA Board Meeting	**ASHTON 3**
FRIDAY, JUNE 10			**ROOM**
7:00 AM	8:00 AM	UHMS President's Breakfast	**ASHTON 3**
7:00 AM	8:00 AM	NBDHMT Breakfast	**ASHTON 2**
8:00 AM	12:00 PM	NBDHMT Board Meeting	**ASHTON 1**
9:00 AM	12:30 PM	Safety Subcommittee Work Group (LeGros/Alleman)	**ASHTON 2**
12:30 PM	1:30 PM	CPG Committee Meeting	**ASHTON 3**
2:00 PM	3:30 PM	QUARC Committee Meeting	**ASHTON 3**
3:00 PM	4:00 PM	BNA General Meeting	**ASHTON 1**
3:15 PM	4:00 PM	ACEP UHM Section Meeting	**ASHTON 2**
3:30 PM	4:30 PM	Publication Committee	**ASHTON 3**
5:00 PM	6:00 PM	UHMS Annual Business Meeting	**General Session Ballroom**
5:00 PM	7:00 PM	Specialty Council Meeting (Claus) "Private Meeting"	**ASHTON 3**
SATURDAY, JUNE 11			**ROOM**
9:00 AM	10:00 AM	Chapter President's Committee	**ASHTON 1**
10:00 AM	11:00 AM	Membership Committee	**ASHTON 1**

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Exhibitors

American Board of Preventive Medicine, Chicago, IL: TABLE # 4: The American Board of Preventive Medicine, Incorporated (ABPM) is a member board of the American Board of Medical Specialties. ABPM originated from recommendations of a joint committee comprised of representatives from the Section of Preventive and Industrial Medicine and Public Health of the American Medical Association and the Committee on Professional Education of American Public Health Association. www.theabpm.org

Anacapa Technologies, Inc, San Dimas, CA: TABLE # 9: Anacapa Technologies, Inc. is a market leader and innovator in the formulation of antiseptic wound care products. Our offering has been expanded to serve the veterinarian. Our manufacturing site is in San Dimas, California. http://anacapa-tech.net/

Baromedical Nurses Association, Crystal River, FL: TABLE # 2: The *BNA* provides nurses with a professional organization in order to maintain and promote the status and standards of practice in hyperbaric nursing. **http://www.hyperbaricnurses.org/**

Best Publishing Company, Palm Beach Gardens, FL: BOOTH # 105: Best Publishing Company was founded in 1966 and has become the largest and one of the most respected publishers of educational books on diving, wound care, and hyperbaric medicine. We produce educational books along with professional periodicals such as the *Wound Care & Hyperbaric Medicine Magazine*, a peer reviewed quarterly publication that covers all aspects of wound care, diving medicine, and hyperbaric oxygen therapy (HBOT). We also produce the Wound Care & Hyperbaric Medicine Calendar that promotes diving, wound care, and hyperbaric education courses worldwide. **www.bestpub.com**

Cox Health, Springfield, MO: TABLE # 8: CoxHealth is the region's only locally owned, not-for-profit health system. OUR MISSION - To improve the health of the communities we serve through quality health care, education and research.
OUR VISION - To be the best for those who need us. OUR VALUES - Safety, compassion, respect and integrity. **http://www.coxhealth.com/**

Divers Alert Network, Durham, NC: Booth # 100: The largest association of recreational scuba divers in the world, DAN is supported by membership dues and donations. DAN's mission is to help divers in need of medical emergency assistance and to promote dive safety through research, education, products and diving services. The benefits of DAN membership include emergency medical evacuation assistance through DAN *Travel Assist*, a subscription to *Alert Diver* magazine and access to DAN's insurance services. **www.dan.org**

Fink Engineering, PTY, LTD, Warana, Australia: TABLE # 11: Fink Engineering Pty Ltd (a subsidiary of Fink International) was established in Victoria, Australia in 1987 to provide engineering design and consultancy to the offshore oil and diving industries. We have developed a world class set of Rectangular Hyperbaric Chamber Systems that are just beginning to be appreciated overseas as evidenced by systems shipped to New Zealand, Singapore, Canada and our recently completed projects in the USA. **www.fink.com.au**

Globo-SA, Inc., Las Vegas, NV: TABLE # 7: Transcutaneous Electrical Nerve Stimulator). A TENS unit is designed to modulate pulse width, frequency, and intensity and is used by doctors, chiropractors, physical therapists, and sports rehabilitators. Its primary functions are pain relief and muscle relaxation but it can also be used for strengthening a muscle (abs, arms, hips), removing cellulites, and losing weight. IQ Massager Pro 2 employs low electrical frequency with an intensity that produces motor contraction. It has six modes that simulate the most typical therapeutic massages such as deep tissue and pulsing. They can be used to get rid of muscle knots, stiff neck, cramps, soreness, tension, and headache. Another benefit is increased blood circulation that improves tonus and sleep. Furthermore, IQ Massager Pro 2 has an acupuncture mode that can be used effectively for pain relief. www.iqmassager.com

Hydrospace Group Inc., Claremont, CA: Booth # 102: Hydrospace Group is dedicated to providing cost effective, innovative, high precision and reliable solutions for components, systems and vehicles designed to work underwater, from 20 to 20,000 feet. The dedication is rooted in the realization that the future will continue to demand new tools and methods to increase subsea productivity. These solutions will inherently combine a wide range of manned and unmanned technologies that need to work in concert. The harsh nature of this environment across the globe's oceans demands the highest levels of performance to achieve safety and reliability that will ensure commercial viability. **http://hydrospacegroup.com/**

Intellicure, The Woodlands, TX : TABLE # 10: , Intellicure was developed by clinicians for clinicians. Our expertise and understanding empowered us to create a wound care software system that is built around your work flow needs. Intellicure provides clinicians with the tools they need to deliver evidence based care, ease concerns regarding billing and coding, facilitate clinical research, and make life easier. Intellicure is also at the forefront of research and development in the Wound Care and Hyperbaric community, working alongside healthcare professionals and vendors alike. By providing enormous amounts of quality data, Intellicure is a valued resource in its industry. **http://www.intellicure.com/**

International ATMO, Inc., San Antonio, TX: TABLE # 7: International ATMO, Inc. is one of the oldest continuous providers of hyperbaric medicine education services including hyperbaric consulting, hyperbaric safety training, hyperbaric oxygen treatment, wound center consulting, wound care education and wound center management. International ATMO's continuing education courses in hyperbaric medicine, wound center management, wound care center education and safety training attract an international attendance of physicians, nurses, and technicians annually. The Hyperbaric Medicine Team Training Course is the original UHMS-Designated Introductory Course in Hyperbaric Medicine that meets the requirements of all Medicare Intermediaries. We also offer various hyperbaric education books, wound care center books as well as books from NFPA and UHMS. **www.hyperbaricmedicine.com**

Kyoui, Las Vegas, NV: TABLE # 15: Kyoui™ is an innovative manufacturer of oral care products that are simply effective.™ Kyoui™ owns numerous oral care patents, including the Kyoui™ angle-neck toothbrush. The Angled Toothbrush was first patented in France in 1989. After years of research with patients and dentists, the model was improved and patented in 2011 in Canada, where the Kyoui™ Sonic Angled Toothbrush was launched. Since then, Kyoui is acquiring more and more adepts to the effectiveness of the angled toothbrush. **http://www.kyoui.com/**

New Cardiovascular Horizons, Lafayette, LA: TABLE # 14: NCVH is an educational nonprofit foundation focused on multidisciplinary accredited conferences to advance the field of cardiovascular care using endovascular technologies, pharmacotherapy treatments, peripheral interventions and amputation prevention techniques. With a goal to empower healthcare providers with knowledge of head-to-toe vascular treatments, NCVH strives to promote interdisciplinary teamwork and collaboration to address the continuum of patient care. **http://www.ncvh.org/**

Novadaq Technologies, Mississauga, ON, Canada: BOOTH # 300: Enabling surgeons with clinically-relevant, innovative fluorescence imaging solutions to enhance the lives of patients and their surgeons, while reducing health care costs, is Novadaq's global mission. SPY fluorescence imaging technology provides surgeons with real-time visualization, leading to improved outcomes and reduced costs without exposing the patient to radiation. More than 65 peer-reviewed publications demonstrate that the use of SPY during complex surgery, leads to fewer post-operative complications and lower hospital costs. **www.novadaq.com**

OIC Advance, Las Vegas, NV: TABLE # 12: OIC Advance caters to the needs of our clients. Our unit helps our clients feel more comfortable and efficient thus enhancing work productivity and results. And this is what it's all about, helping our clients thrive in their workplace. HealthmateForever combined TENS & PMS units are nerve stimulators for pain relief and muscle stimulators for muscle conditioning that use self-adhesive electrode pads to target specific nerve and muscle areas. Our electrode pads do not require gel or creams to be applied to the skin and can be used up to 100 times with proper maintenance. We offer a wide variety of high quality replacement electrode pads in varying sizes, shapes, and colors to allow for effective pain treatment and muscle conditioning. **http://www.healthmateforever.com/**

OxyHeal Medical Systems, Inc., National City, CA: BOOTH # 301: OxyHeal Medical Systems, Inc. creates, designs, engineers and manufactures multipatient hyperbaric and diving medical systems. OxyHeal Medical Systems, Inc. is based in National City, California. **http://www.oxyheal-international.com/**

Pan-America Hyperbarics, Inc., Richardson, TX: TABLE # 6: Pan-America Hyperbarics, Inc., "The Highest-Value Provider in Hyperbaric Technology" is a worldwide supplier of monoplace and multiplace hyperbaric chambers. Our expertise is not only in designing and building bold new cost effective hyperbaric treatment systems, but also in developing partnerships with our clients. To assist our clients in providing the best standard of care to their patients, Pan-America Hyperbarics, Inc. offers unprecedented purchase, finance, and lease options for our products. For more information please contact our Partnership Care Team: 1-888-PAHI-HBO, or visit **www.panamericahbo.com**

Perimed, Inc., North Royalton, OH: TABLE # 5: With over 25 years of development, Perimed AB manufactures and markets state-of-the-art Laser Doppler Instruments for the measurement of microvascular perfusion. As a leader in the Wound Care and Hyperbaric Medicine departments, Perimed, Inc., offers the only combined Laser Doppler and Transcutaneous multi-channel monitor, the PeriFlux 5000 system. This system allows the user friendly flexibility of multiple site monitoring. PeriFlux instruments represent a commitment that begins with quality and performance, and continues with technical and applications support. Please visit our website at **www.perimed-instruments.com**

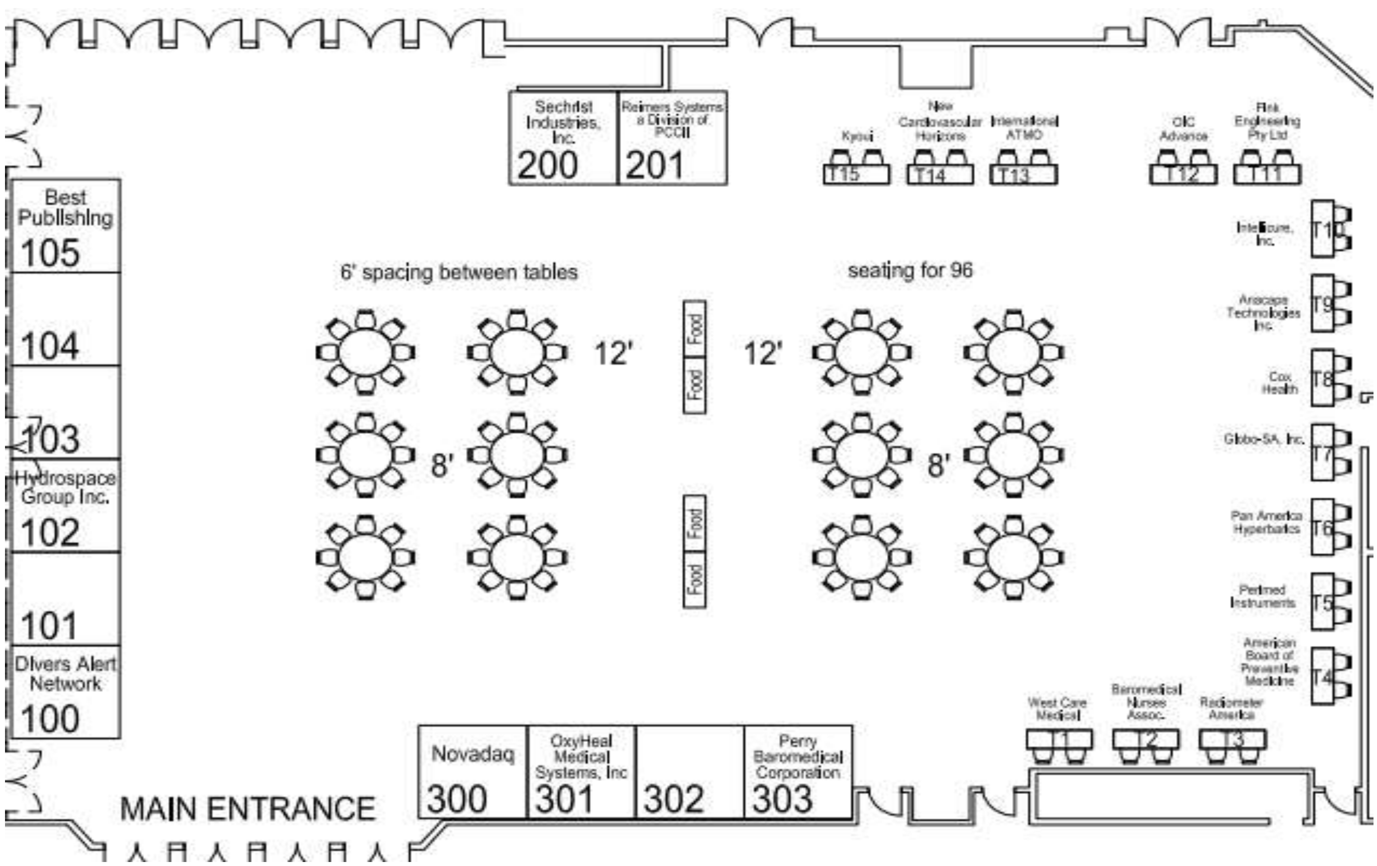
Perry Baromedical, Riviera Beach, FL: BOOTH # 303: Perry Baromedical is the only company in the world which designs, manufactures, installs and services monoplace, dualplace and multiplace hyperbaric chambers. We provide the highest quality product, and are focused on assisting hospitals with a comprehensive Hyperbaric Oxygen Therapy department. For further information visit our website at www.perrybaromedical.com or call us at 561-840-0395. **www.perrybaromedical.com**

Radiometer America, Westlake, OH: TABLE # 3: Radiometer is a leading provider of technologically advanced acute care solutions that simplify and automate all phases of acute care testing. Radiometer offers solutions for blood gas analysis, transcutaneous monitoring and immunoassay testing. **http://www.radiometeramerica.com/**

Reimers Systems Division of PCCI, Inc., Alexandria, VA: BOOTH # 202: With decades of experience, we offer hyperbaric chambers, research chambers, altitude chambers, oxygen service solutions, manifolds and other accessories like hood drivers, gas selection panels and utility penetrators, site development and engineering services, chamber installation and maintenance. Our sister company, Hyperbaric Clearinghouse, offers quality pre-owned chambers and equipment. **www.reimersystems.com**

Sechrist Industries, Anaheim, CA: BOOTH # 200: For over 30 years, Sechrist Industries, Inc., continues to be a leading worldwide manufacturer of hyperbaric chamber systems, neonatal, infant and pediatric intensive care ventilators, and air/oxygen mixers along with other ancillary accessories. All products are manufactured in accordance with FDA and GMP regulations. **www.sechristusa.com**

West Care Medial Ltd., Coquitlam, BC Canada: TABLE # 1: West Care Medical was established in 1996 and employs 29 full time staff members. We offer a range of services for our customers in both the health care industry, as well as individual homecare recipients. Our sales and service team brings a combined 170 years of medical experience to our health care customers in British Columbia, Alberta, Saskatchewan and Manitoba. **http://westcaremedical.com/Pages/home.php**



THURSDAY, JUNE 9

“PRESIDENT’S ADDRESS”
James Holm, MD
8:00 AM – 8:30 AM

Dr. James R. Holm is currently the Medical Director of the Center for Hyperbaric Medicine at Virginia Mason Medical Center in Seattle, Washington. Dr. Holm received his medical degree from Georgetown University School of Medicine in 1985. He completed a combined residency and served as chief resident in Emergency Medicine and Internal Medicine at Northwestern University in 1989. He is triple board-certified in Emergency Medicine, Internal Medicine as well as Undersea and Hyperbaric Medicine. He maintains Fellow status in all three specialties.

Dr. Holm has been a member of the UHMS since 1996. He has served on the UHMS Board of Directors as a Member-at-Large, President Elect, and will be finishing his term as President this June. He has served on the UHMS Annual Scientific Meeting Program Committee for over 10 years and remains active with many society educational/scientific programs. He has been active in local and regional hyperbaric activities and was President of the Pacific Chapter of the UHMS in 2005. He has been faculty and program co-chair for the Winter Symposium in Hyperbaric Medicine and Wound Management since 2005He has been a faculty member for the NOAA/UHMS Physician Diving Medicine Course in Seattle and is now that program’s director. He completed that course in in 1996. He has been a frequent faculty member for both the UHMS and DAN diving and hyperbaric medicine courses.

Dr. Holm has been working in Hyperbaric Medicine since 1997 and has extensive experience in routine and emergency hyperbaric practice. This includes both multiplace and monoplace chamber systems. His clinical activity and research interests include decompression illness, carbon monoxide poisoning, and treatment of late effect of radiation tissue injury.

Dr. Holm grew up in Southern California and became a certified diver 1969 at the age of 13. He became a NAUI and PADI Instructor in 1978 and taught SCUBA while attending the University of California at Santa Barbara. He later worked as a divemaster and instructor on Grand Cayman Island from 1980 to 1981 before going to medical school. He is still an active diver and enjoys underwater photography and videography.

ABOUT THE LECTURE: The President's Address is intended to welcome meeting participants, provide an overview of the UHMS Annual Scientific Meeting's organization and planned presentations, and discuss topics of contemporary interest to the UHMS membership. These topics will primarily include identification of ongoing challenges to the Undersea and Hyperbaric Medicine profession and updates regarding current UHMS strategic initiatives.

PLENARY:
“The History and Evolution of UHMS Journals and Publications”
Enrico Camporesi, MD
8:30 AM – 9:30 AM

Dr Camporesi is a medical graduate of the University of Milano, Italy, in 1970: originally he pursued a career in physiology in Milano, Rochester NY (Fenn Fellow, 1972) and SUNY Buffalo (72-73) in cardiopulmonary research during water immersion. He continued his training in pulmonary medicine and anesthesiology at Duke University, where he served as faculty in Anesthesiology and in the Hyperbaric Center. He was a leading researcher for the deep dives "Atlantis series" supported by the Navy and NIH and provided medical services and leadership to the growing field of hyperbaric medicine at Duke Hyperbaric Center and the creation of DAN. He served for a time as medical director of both and as consultant for the ACCME supported formation for the examination system and the creation of the added year qualification for fellowship in Undersea Medicine through ABPM. He moved to Syracuse to chair and direct the residency program for the Department of Anesthesiology in 1989 and was the founder of SUNY Syracuse hyperbaric facility, now one of the approved locations for Undersea Medicine fellowship. He moved to the University of South Florida in Tampa in 2005 to continue as Chair and program director of Anesthesiology and graduated more than 360 residents and fellows in anesthesia and related specialties. In all academic locations he trained and collaborated with many researchers and clinicians. He was appointed FUHM, served as President of UHMS (2000-2002), treasurer (2014-2015) and presently is the appointed Editor In Chief of the UHM journal (2016-present). His contributions were recognized by our society when he received the Shilling award in 1994. He continues a very productive publishing career at Tampa General Hospital, where he was recently appointed Research Director for TEAMHealth Anesthesia, the large national physician group.

ABOUT THE LECTURE:

Dr Camporesi has been involved since early times with the Journals of the Society and will retrace the evolution of the publications, the changes of name and contents, the list of other niche publications of the society, like Workshops and abstracts collections, in the areas of Diving, Hyperbaric Medicine, codification of the O2 therapy indications and the yet incompletely addressed problem of archiving all publications for the future.

SESSION A
DIVING & DECOMPRESSION ILLNESS: THEORY & MECHANISMS

Moderators: Steve Thom, MD & Bruce Derrick, MD

THURSDAY, JUNE 9

10:00 AM – 12:00 PM

A 1

ORAL PRESENTATION TIME: 1000 - 1012
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: Yes

Cardiovascular changes of open-circuit heliox divers assessed via transthoracic 2-D Doppler echocardiography.

Covington D, Bielawski A, Scalzini A, Passera M, Bedini R, Laurino M, Sotis CL, Van Hoesen K, Marabotti C
University of California - San Diego, Department of Undersea and Hyperbaric Medicine, 200 W. Arbor Drive, MC 8676, San Diego, CA 92103
abielawski@ucsd.edu

Introduction/Background: Cardiovascular disease may play a role in nearly one-third of all diving-related deaths.[1] Previous research utilizing 2-D Doppler echocardiography to examine open-circuit SCUBA divers breathing air found diastolic dysfunction during and persisting after diving.[2] The authors of this work postulate these diastolic changes could be secondary to an increase in the work of breathing (WOB). To further test this hypothesis, we studied the cardiovascular changes of open-circuit SCUBA divers utilizing heliox breathing mixtures.

Materials and Methods: Twenty male, non-smoking, experienced divers with no evidence of hypertension, cardiac disease, or pulmonary disease were randomized to either 80% oxygen and 20% helium (80/20) [N=10, age 45.6 +/- 11.7 years] or 20% oxygen and 80% helium (20/80) [N=10, age 47.4 +/- 7.7 years]. These subjects completed a dive profile consisting of 15 minutes at 10 meters and then 15 minutes at 5 meters while resting in a freshwater pool with a temperature of 35C. Basic transthoracic 2-D echocardiograms were performed before diving and immediately after surfacing.

Results: A statistically significant reduction of right ventricle (RV) A peak and increase in RV E/A ratio was found in the 20/80-group. The 80/20-group demonstrated a statistically significant increase in left ventricle (LV) diastolic and systolic volumes and mean arterial pressure (MAP).

Summary/Conclusions: Our study shows contrasting findings for the two study groups, which suggests that the physiologic manifestations of the breathing gases are different. Specifically, improved RV diastolic function via accelerated relaxation was observed in the 20/80-group. This finding could result from a decrease in the WOB or from the cardioprotective properties of helium. [3] Meanwhile, the increase in MAP observed in the 80/20-group likely lead to the compensatory increase in LV volumes, which may stem from increased oxygen tensions that induce vasoconstriction. Further research will help elucidate if different breathing gases are advantageous for divers with minimal cardiac reserve.

References:

1. Smith N. Scuba diving: how high the risk? *J Insur Med*. 1995. 35;15-24.
2. Marabotti C, Scalzini A, Menicucci D, Passera M, Bedini R, L'Abbate A. Cardiovascular changes during SCUBA diving: an underwater Doppler echocardiographic study. *Acta Physiol (Oxf)*. 2013 Sep;209(1):62-68.
3. Gezina T, Weber N, Hollmann M, Preckel B. Cellular effects of helium in different organs. Anesthesiology 2010; 112:1503-1510.

A 2

ORAL PRESENTATION TIME: 1024 - 1036
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: Yes

Cardiovascular changes of closed-circuit rebreather divers assessed via transthoracic 2D-Doppler echocardiography.

Covington D, Bielawski A, Scalzini A, Passera M, Bedini R, Laurino M, Sotis CL, Van Hoesen K, Marabotti C
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Introduction/Background: It is estimated that up to 31% of SCUBA diving deaths stem from a cardiac etiology.[1] Further, the mortality rate of divers utilizing closed-circuit rebreathers (CCR) is four to ten times higher than those using open-circuit equipment.[2] To better understand the cardiovascular effects CCR diving, we assessed the heart via transthoracic echocardiography before and after a dive.

Materials and Methods: Eight CCR certified, non-smoking, male divers aged 50 +/- 9.7 years with no evidence of hypertension, cardiac disease, or pulmonary disease were studied. These subjects completed a dive profile consisting of 15 minutes at 10 meters and 15 minutes at 5 meters while resting in a freshwater pool with a temperature of 35C. They utilized a Megalodon CCR and maintained a 1.2 bar partial pressure of oxygen (ppO2). Transthoracic 2-D echocardiograms were performed before diving and immediately after surfacing.

Results: We found no statistically significant difference in pre and post-dive vital signs nor echocardiogram measurements, which included ventricle volumes, ventricular filling velocities, tricuspid annular plane systolic excursion, RR interval, left ventricle stroke volume, cardiac output, left ventricular ejection fraction, and heart rate. Derived systemic vascular resistance (SVR) values were also not significantly different.

Summary/Conclusions: Our study shows no echocardiographic evidence of heart changes before or after the dive. Interestingly, previous research on open-circuit air divers utilizing the same dive profiles found evidence of diastolic dysfunction during the dive and afterwards.[3] Despite a higher ppO2, which could lead to an increase in SVR and diastolic dysfunction, no diastolic changes were detected. The lack of these findings in these CCR divers may be secondary to the decrease in work of breathing compared to that required for open-circuit equipment. These results support the hypothesis that the increased mortality rate in CCR divers is not due to unfavorable cardiovascular effects of rebreathers.

References:

1. Smith N. Scuba diving: how high the risk? *J Insur Med*. 1995. 35;15-24.
2. Fock AW. Analysis of recreational closed-circuit rebreather deaths 1998-2010. *Diving Hyperb Med*. 2013 43(2): 78-85.
3. Marabotti C, Scalzini A, Menicucci D, Passera M, Bedini R, L'Abbate A. Cardiovascular changes during SCUBA diving: an underwater Doppler echocardiographic study. *Acta Physiol (Oxf)*. 2013 Sep;209(1):62-68.

A 3

ORAL PRESENTATION TIME: 1036 - 1048
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Transient increase in cerebral blood flow following hypobaric exposure during routine aircrew training.

McGuire S[1,3], Sherman P[1], Kochunov P[2]
[1]U.S. Air Force School of Aerospace Medicine, Aerospace Medicine Consultation Division, Wright-Patterson AFB, OH; [2]University of Maryland School of Medicine, Baltimore; [3]Department of Neurology, Lackland AFB, TX
dr.stephen.mcguire@gmail.com

Introduction/Background: We previously reported increased subcortical white matter injury associated with repetitive occupational exposure to non-hypoxic hypobaric conditions. We hypothesized that a single hypobaric hypoxic occupational exposure would induce transient magnetic resonance imaging (MRI) changes.

Materials and Methods: Subjects underwent high-resolution MRIs 24 hours prior to exposure and 24 and 72 hours after exposure with quantification of findings. No subject experienced decompression sickness symptoms. To date 60 U.S. Air Force aircrew undergoing standard occupational altitude chamber training exposure to 25k feet (5.45 psi) and 23 age-controlled control subjects not exposed to hypobaria have been evaluated. Statistical analysis was performed with a two-tailed T-Test.

Results: At 24 hours after exposure white matter cerebral blood flow (CBF) increased by 6% ($p=0.004$) while gray matter CBF increased by 5% ($p=0.062$). At 72 hours after exposure CBF remains significantly elevated (white matter 6%; $p=0.012$; gray matter 6%; $p=0.005$), with no statistical difference in CBF between the 24hr and 72hr MRI. No significant change in CBF was observed in the control subjects.

Summary/Conclusions: These results demonstrate an upregulation of both gray and white matter CBF following exposure to routine aircrew occupational hypobaric training which persists up to 72 hours following exposure. This increase in CBF may suggest a transient cerebral injury has occurred and furthermore suggests that repetitive injury with repetitive exposure might be the underlying basis for the permanent white matter change previously reported. This study lends additional support for a diffuse process inciting cerebral injury following hypobaric exposure.

A 4

ORAL PRESENTATION TIME: 1048 - 1100
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Primary cognitive task impairment due to elevated P_IN_2, P_ICO_2 and P_IO_2 in working divers.

Freiberger JJ, Derrick BJ, Natoli MJ, Akusevich I, Schinazi EA, Walker A, Parker K, Martina SD, Ceponis P, Guerry C, Keilman C, Stolp BW, Bennett PB, Vann RD, Moon RE
Duke Center for Hyperbaric Medicine and Environmental Physiology, Durham, North Carolina
john.freiberger@duke.edu

Introduction: Diving associated cognitive impairment (narcosis), is commonly attributed to the effects of a single gas (nitrogen or CO_2 narcosis, oxygen toxicity), but likely results from the complex interaction of gases, activities and environmental conditions. This NAVSEA funded project aimed at determining the degree of cognitive impairment attributable to various narcotic gases.

Methods: NASA's MATB-II flight simulator was chosen as the cognitive testing platform. Forty non-pilot subjects were studied while performing the primary TRACKING task under variable conditions. Increased tracking distance equals poorer performance. Inspired P_IN_2 of 0, 0.78, 4.5 and 5.6ATA and P_IO_2 levels of 0.21, 1.0 and 1.2ATA were tested. The scrubber failure scenario added 7.5% surface equivalent CO_2 (P_ICO_2 = .075ATA) to half of these conditions.

Results: P_iCO_2 of .075ATA during surface trials increased TRACKING distance from target by 9% at rest and 44% with exercise ($p<.001$). Substituting .925ATA O2 for air decreased the performance decrement by 1% at rest and 25% with exercise ($p<.001$). TRACKING performance at both 4.5 and 5.6ATA P_IN_2 was unchanged from surface trials without added CO_2 or O_2. Addition of .075ATA P_ICO_2 increased TRACKING distance by 29% and 106% ($p<.001$) during normoxic exercise at 4.5 and 5.6ATA P_IN_2 respectively. During constant P_IN_2 (4.5ATA) with normocapnic exercise, increasing P_IO_2 from .21 to 1.22ATA was associated with increased TRACKING distance of 9% ($p=.003$). Subjects were profoundly impaired by combined hyperapnic and hyperoxic exposure at 4.5ATA P_IN_2 resulting in 138% increased TRACKING distance ($p<.001$). This particular stage was associated a 38% completion failure and frequent verbal unresponsiveness by subjects necessitating termination of the trial.

Conclusions: O_2 and CO_2 independently impair performance under diving conditions where P_IN_2 is elevated. The triple combination of elevated P_IN_2, P_ICO_2 and P_IO_2 is dangerously impairing and may represent incipient O_2 toxicity as well as narcosis.

Acknowledgments: Funding provided by NAVSEA Deep Submergence Biomedical Contract #N0463A-12-C-0001.

A 5

ORAL PRESENTATION TIME: 1048 - 1100
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Effects of P_IN_2, P_ICO_2, P_IO_2, and exercise on motor function, memory, attention and strategy in working divers.

Freiberger JJ, Derrick BJ, Natoli MJ, Akusevich I, Schinazi EA, Walker A, Parker K, Martina SD, Ceponis P, Guerry C, Keilman C, Stolp BW, Bennett PB, Vann RD, Moon RE
Duke Center for Hyperbaric Medicine and Environmental Physiology, Durham, North Carolina
john.freiberger@duke.edu

Introduction: Diving associated cognitive impairment (narcosis) likely results from the complex interaction of gases, activities and environmental conditions. Various components of cognitive function may be affected differently depending on the above conditions. NASA's MATB-II flight simulator tests visual-motor function, memory, attention and strategy simultaneously.

Methods: Forty non-pilot subjects performed the MATB-II under baseline and narcosis-inducing conditions. Inspired P_IN_2 of 0, 0.78, 4.5 and 5.6ATA and P_IO_2 levels of 0.21, 1.0 and 1.2ATA were tested with and without exercise. The scrubber failure scenario added 7.5% surface equivalent CO_2 (P_ICO_2 = .075ATA) to half of these conditions. A multiple regression model was used to assess the relative effects of breathing gases and other variables.

Results: Visual-motor performance error was affected only by high CO_2 and exercise at surface conditions (P<.001). Under hyperbaric conditions, visual-motor performance was affected by elevated CO_2, exercise **and** high O_2 (P<.001), while N_2 had the smallest effect. Attention and distraction were most profoundly affected by elevated N_2 (P<.001). Elevated N_2 was also strongly associated with auditory memory impairment (P<.001), while diving and video game experience was associated with improved memory performance (P<.001). Strategy and planning were most affected by elevated N_2 followed by elevated CO_2 (P<.001).

Elevated CO_2 (P<.001), exercise (P=.008) and greater age (P=.025) were associated with decreased reaction time for responding to auditory memory tasks at surface pressures while performance improved with high O_2 (P=.007) and diving experience (P=.001). Under hyperbaric conditions, elevated N_2, O_2, CO_2 and age trended toward slower reaction time to memory tasks although only N_2 was statistically changed compared to surface conditions (P=.037).

Conclusions: The narcotic effect of nitrogen, carbon dioxide, oxygen and the environment is complex and multifactorial. Moreover, individual gases/conditions appear to influence certain components of cognition (visual-motor function, memory, attention and strategy) differently.

Acknowledgments: Funding provided by NAVSEA Deep Submergence Biomedical Contract #N0463A-12-C-0001.

A 6

ORAL PRESENTATION TIME: 1100 - 1112
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Platelet activation and thrombospondin-1 contribute to decompression stress.

Yang M, Bhopale VM, Thom SR
Department of Emergency Medicine, University of Maryland School of Medicine, Baltimore MD 21201
myang@em.umaryland.edu

Introduction: Blood-borne microparticles (MPs), 0.1- 1 µm diameter vesicles produced by all vascular cells, are elevated during virtually all diving activities and appear to be responsible for vascular injuries in a murine model. We hypothesized that platelet activation with liberation of thrombospondin-1 (TSP) is an early event and may be linked to progression of pathological events. TSP interacts with endothelium via multiple binding sites. MPs membranes have high surface phosphatidylserine (PS) and, because TSP binds to PS and this is inhibited by heparin, we hypothesized that heparin would abrogate MPs-mediated inflammatory changes.

Materials and Methods: Mice were exposed for 2 hours to 790 kPa air and euthanized at 2 or 13 hours post-decompression to study blood-borne MPs and vascular changes. Heparin was used as a prophylactic measure injected 30 minutes prior to pressurization at a dose of 500U/kg IP.

Results: Pressure/decompression cause ~3-fold elevations in circulating MPs. There was evidence of significant neutrophil activation, platelet-neutrophil interactions and vascular injury to brain, omentum, psoas and skeletal muscles assessed as leakage of high molecular weight dextran. Platelet activation assessed as fraction expressing membrane surface CD62P and TSP was 2-fold elevated at 2 hours post-decompression. Prophylactic heparin injection diminished capillary leak and platelet activation, but there was persistent evidence for neutrophil activation in decompressed mice.

Summary: We conclude that platelet activation and release of TSP may play a role in post-decompression inflammatory events by tethering MPs to the vascular lining where oxidants may trigger vascular damage.

A 7

ORAL PRESENTATION TIME: 1112 - 1124
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Microparticles and post-decompression joint inflammation: a new model of 'Type I' decompression sickness?

Thom SR, Yu K, Bhopale VM, Yang M
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Introduction: Circulating pro-inflammatory microparticles (MPs), 0.1 – 1.0 µm vesicles, are elevated in animals and humans after simulated or *bona fide* underwater diving. We hypothesized that inflammatory changes can be identified in knee joints of decompressed mice, the changes will correlate with circulating levels of MPs, and changes diminished by interventions that reduce circulating MPs.

Materials and Methods: Mice were exposed for 2 hours to 790 kPa air and euthanized at 2 or 13 hours post-decompression to study blood-borne and articular changes.

Results: Pressure/decompression cause a 6.2 $\pm$ 0.5 (n=4, $p<0.05$)-fold elevation in circulating MPs and 4.4 $\pm$ 0.3 ($p<0.05$)-fold increase in intra-articular neutrophils at 13 hours post-exposure. There was 11.5 $\pm$ 0.3 ($p<0.05$)-fold elevation in periarticular ferritin and 2.5 $\pm$ 0.2 ($p<0.05$)-fold increase in thrombospondin expression in decompressed mice. Prophylactic ascorbic acid (500 mg/kg IP) administration prevented MPs elevations and intra-articular neutrophil recruitment.

Summary: The findings support the idea that MPs production that occurs with high pressure exposures to elevated gas pressure is an oxidative stress response. Evidence suggests that thrombospondin, a protein that can bind phosphatidylserine (which is highly expressed on MPs) may tether MPs to extravascular sites and thus enhance inflammatory responses.

A 8

ORAL PRESENTATION TIME: 1112 - 1124
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Carbon dioxide stimulates microparticle production.

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Introduction: There is a tendency toward hypercapnia during diving, with several potential causes that may lead to slight elevations of carbon dioxide (CO_2) on the order of 0.3 kPa. Blood-borne microparticles (MPs), 0.1- 1 µm diameter vesicles produced by all vascular cells, are elevated during virtually all diving activities. In a murine model, platelet and neutrophil-derived MPs have been shown to be the principal etiological agents causing tissue damage post-decompression. Because small elevations of CO_2 perturb mitocondrial respiration we hypothesized that exposures would stimulate MPs production due to oxidative stress.

Materials and Methods: Neutrophils were isolated from the blood of healthy volunteers and mice. MPs production was measured after cells were placed in buffer equilibrated with different partial pressures of CO_2. Follow-up studies were done with mice exposed to 0.4% CO_2 for up to 2 hours.

Results: Murine and human neutrophils responded in virtually the same fashion showing a bell-shaped curve of MPs generation as CO_2 increased from ambient (~0.03%) to 1%, with a maximal response at ~ 0.4% CO_2. Brief exposures for 30 minutes triggered MPs production lasting over 6 hours due to an autocatalytic series of reactions set into motion by mitochondrial reactive oxygen species production. For example, whereas control (air-only) suspensions exhibited 0.3 $\pm$ 0.1 MPs/neutrophil, prior exposures to 0.4% CO_2 resulted in 5.2 $\pm$ 0.1 (n=8, $p<0.05$) MPs/neutrophil. Mice exposed to 0.4% CO_2 exhibited a 3.5 $\pm$ 0.4 (n=4, $p<0.05$)-fold elevation in circulating MPs.

Summary: CO_2 retention may pose a heretofore unrecognized health risk, possibly increasing the propensity for decompression injuries in diving and in situations where environmental CO_2 is elevated. For example, the average CO_2 level in nuclear submarines is 0.4%. Consequences from elevations of circulating MPs need further investigation.

A 9

ORAL PRESENTATION TIME: 1124 - 1136
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Comparison of arterial and end-tidal CO_2 in hypercarbic and hyperbaric conditions.

Freiberger JJ, Derrick BJ, Natoli MJ, Akusevich I, Schinazi EA, Walker A, Parker K, Martina SD, Ceponis P, Guerry C, Keilman C, Stolp BW, Bennett PB, Vann RD, Moon RE
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Introduction: Prior work by Cherry and Moon demonstrated that P_aCO_2 exceeded mean $P_{ET}CO_2$ during normoxic exercise at depth without added CO_2. As part of a larger study of CO_2 narcosis in working divers, we evaluated the correlation between measured arterial (P_aCO_2) with inspired (P_ICO_2) and end-tidal ($P_{ET}CO_2$).

Methods: Forty non-pilot subjects were studied in stages breathing P_IN_2 of 0, 0.78, 4.5 and 5.6ATA and P_IO_2 levels of 0.21, 1.0 and 1.2ATA with and without exercise. A scrubber failure scenario added 7.5% surface equivalent CO_2 (P_ICO_2 = .075ATA) to half of these stages. Arterial blood gases were drawn after 4 minutes at each stage to allow for stabilization from the previous gas switch. Breathing mixture (inspired) CO_2 was confirmed by mass spectrometry at the beginning of each stage and end-tidal CO_2 was continuously recorded.

Results: Exercise significantly increased $PaCO_2$ in the normal and the scrubber failure scenarios (P<.001 ANOVA). Arterial and end tidal gas partial pressures were correlated with the inhaled values (R^2=0.894, p<0.001 Pearson). Exercise $P_{ET}CO_2$ values exceeded their arterial counterparts by 3.5 mmHg (95% CI 1.44, 5.54) as expected. When 0.075 ATA CO_2 was added to the breathing gases the mean $P_{ET}CO_2$ values exceeded P_aCO_2 by 4.02 mmHg (95%CI 2.57, 4.56) on the surface and by 1 mmHg (95%CI -2.09, 3.66) during dives. During normoxic exercise at depth without added CO_2, the mean $PaCO_2$ exceeded mean $P_{ET}CO_2$ by 2 mmHg (95%CI -5.3, 1.3).

Conclusions: Mean $P_{ET}CO_2$ was consistently elevated compared with P_aCO_2 on the surface when higher (7.5% surface equivalent) CO_2 was inspired, but $P_{ET}CO_2$ was less consistent at depth. As expected, $P_{ET}CO_2$ values exceeded P_aCO_2 values during exercise stages except during normoxic exercise at depth. Further investigation is warranted as equipment designed to alert divers to elevated P_ICO_2 could provide warning to impending narcosis.

Acknowledgments: Funding provided by NAVSEA Deep Submergence Biomedical Contract #N0463A-12-C-0001.

A 10

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Safety of high-intensity interval training with hyperbaric oxygen in a dry diving environment.

Alvarez Villela M, Dunworth SA, Kraft BD, Harlan N, Natoli, MJ, Parker CK, Schinazi EA, Piantadosi CA, Moon RE
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Introduction: Short-term exposure to high partial pressures of oxygen can result in CNS or pulmonary toxicity in humans. The safety of short, repeated exposures to high partial pressures of oxygen in a dry diving environment while performing high-intensity interval training (HIT) is unknown.

Methods: In the setting of a randomized study designed to assess the effects of HIT with HBO_2 on exercise performance at high-altitude, we collected clinical and spirometric data on all participants during their training program to assess the safety of this type of oxygen exposure. Each subject completed six, 30-minute sessions of individualized HIT on a stationary bicycle while breathing 1.4 ATA of O_2 or normobaric air. Subjects were monitored for signs and symptoms of oxygen toxicity continually. Hand-held spirometry was performed by experienced personnel before and after the 1^{st} and 6^{th} training sessions. FVC and FEV1 values within and between groups were compared using repeated measures ANOVA.

Results: Subject characteristics

Group	N (Male/Female)	Mean Age ± SD
Control	10 (4/6)	27.3 ± 5.7
HBO_2	10 (8/2)	24.2 ± 4.6

No subjects experienced seizures while training. There were no complaints of burning substernal pain or tracheal tickling after any of the HBO_2 sessions.

Spirometry Data

FEV1 (L) means

	FEV1 Pre T1	FEV1 Post T1	FEV1 Pre T6	FEV1 Post T6	
Control	4.03	4.02	4.0025	4.02	
HBO_2	3.87	3.80	3.86	3.91	p= 0.734

FVC (L) means

	FVC Pre T1	**FVC Post T1**	**FVC Pre T6**	**FVC Post T6**	
Control	4.85	4.88	4.89	4.91	
HBO_2	4.86	4.82	4.84	4.81	p= 0.92

Conclusions: Repeated exposures to HBO_2 during high-intensity exercise in a dry dive environment did not produce any signs or symptoms of oxygen toxicity in this study and appears to be safe in normal healthy individuals.

A 11

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Feasibility of diagnostic 12-lead EKG during SCUBA exercise.

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[1]Physiological Laboratory, Department of Biomedical Sciences, University of Padova, Italy; [2]TEAMHealth Research Institute, Tampa, Florida, USA; [3]Project FMSI- Scuola Superiore Sant'Anna and Sports Medicine and Physical Activities Unit: "aiColli" Social Health Department, Padova, Italy; [4]Internal Medicine Department, Mercy Medical Center, Iowa, USA.; [5]DAN Europe Research Division, Roseto degli Abruzzi, Italy.
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Introduction: Underwater activity is a cardiovascular system stressor that can lead to myocardial ischemia. We have previously recorded high quality 12-lead EKG underwater tracings [1]. Here, we report 12-lead EKG data from two volunteers during underwater exercise utilizing bicycle ergometry.

Methods: The test was performed on a diving volunteer with prior CABG surgery 2 years earlier (who still had EKG changes during dry exercise) and a control healthy volunteer. The experiment was conducted in a thermal swimming pool (Y40, Montegrotto-Italy), with a water temperature of 30±2°C. Water immersion was at 15m sea water [2.5 atmospheres-absolute (ATA)] with a 20-minute bottom time. The divers breathed compressed air from SCUBA. The ascent rate was set at 10 m/min, with a decompression stop at 5m for 3min. Both subjects were asked to perform the same mild workload on an underwater bicycle (OKEO, GE-Italy) at 25 rpm to ensure similar ventilation and gas exchange, set to a Borg level-3 category (0-10). After each dive, as soon as the divers surfaced, precordial bubbles were measured at 20 and 50-min.

Results: We obtained good quality tracings with minimal artifacts. For the healthy volunteer and the patient post-CAD, there were no exercise-induced EKG ischemic changes nor any differences in bubble detection; however, we purposefully did not reach the target age-predicted heart rate since our main goal was to demonstrate feasibility of the method.

Conclusion: Further studies are mandatory to evaluate the role of EKG changes during cardiac stress in the water.

References

1. Bosco G, et al. Diving Hyperb Med.2014;44(4):202-207.

A 12

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1130 - 1200
RESIDENT/TRAINEE COMPETITION: No

Could commercial aviation cabin decompression cause vascular bubble formation?

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Background: Aviation Deep Vein Thrombosis (DVT) is a challenge poorly understood in modern aviation. The aim of the present project was to determine if cabin decompression during commercial flights might favor formation of vascular bubbles in air travelers.

Methods: Thirty commercial flights were taken across Europe, Asia, Australasia and North America. Cabin pressure was noted at take-off and at every minute following until the pressure stabilized. These time-pressure profiles were imported into the statistics program R and analyzed using the package SCUBA. Pressure differentials between tissues and cabin pressures were estimated for 20, 40, 60, 80 and 120 minute half-time compartments in one-minute increments.

Results: Time to decompress the cabins ranged from 11 to 47 minutes. The greatest drop in cabin pressure occurred during a flight from Perth to Sydney, Australia, from 1022 mBar to 776 mBar, equivalent to a saturated diver ascending from 2.46 msw depth. Mean pressure drop in flights >2 hrs duration was 193 mBar, while mean pressure drop in flights <2 hrs was 15% less at 165 mBar. The greatest drop in pressure over one minute occurred during a flight from Brest to Paris, France of 28 mBar, equivalent to a saturated diver ascending at a rate of 0.28 msw/minute.

Discussion: Over 30 commercial flights it was found that the drop in cabin pressure was commensurate with that found to cause bubbles in man. Both the US Navy and the Royal Navy mandate far slower decompression from states of saturation, being 1.7 and 1.9 mBar/min respectively. The median overall rate of decompression found in this study was 8.5 mBar/min, five times the rate prescribed for USN saturation divers. The tissues associated with hypobaric bubble formation are likely slower than those associated with bounce diving, with 60 minutes a potentially useful reference halftime.

CHRISTIAN J. LAMBERTSEN, MD, DSc (Hon) MEMORIAL LECTURE
THURSDAY, JUNE 9: 1:15 pm - 2:15 pm

GUEST SPEAKER: Dr. Richard Moon
LECTURE TITLE: "Investigations into Living and Working under the Water: Where Have We Been and Where do We Need to Go?"

ABOUT THE LECTURE: In the 19th century, application of compressed-air technology developed for caisson in work to diving revolutionized efficiency of divers by increasing bottom time. However, the switch from breath-holding to compressed air use led to decompression sickness, for which procedures had to be developed to minimize its occurrence. Although recompression had been observed to relieve symptoms (published by Pol and Watelle in 1854), systematic treatment of DCS with pressure was adopted slowly, in part due to reluctance to place injured patients back into the environment that had caused the injury. After routine use of recompression was accepted around 1900, for several years there was an ongoing debate as to whether the diver should be recompressed to the depth of the preceding dive, depth of relief or an arbitrary depth. Oxygen administration had been shown to be effective in animals by Paul Bert, who published his results in 1878, but was not tested systematically until the 1930s by Behnke, Shaw and Yarbrough, who found it to be superior to air recompression. Another 30 years elapsed before use of oxygen under pressure became routine and then standard of care. Because of consensus on bubbles as the cause of DCS, therapy had been directed at reducing bubble volume, although secondary effects of bubbles occur. Some of these have been described, such as extravasation of plasma and reduction in cerebral blood flow, but to date, there are few adjunctive therapies for secondary effects. Diving results in increased work of breathing due to higher gas density. The resulting hypercapnia can impair cognition and augment inert gas narcosis. At depths beyond 150-200 meters, pressure per se has effects on tissues, especially the central nervous system (CNS), causing high pressure nervous syndrome (HPNS), an operational challenge for deep diving. Submersion causes redistribution of blood from the periphery to the thorax, causing increased pulmonary artery and pulmonary capillary pressures. In susceptible individuals this can precipitate pulmonary edema, especially during heavy exertion. Recent investigations have identified various cardiac pathologies as predisposing factors. In clinically normal individuals, mild impairment of left ventricular diastolic compliance can be a cause. Heat loss to the water has presented engineering challenges in order to maintain normothermia, tactile performance and manual dexterity. Tasks for the future include elucidation of mechanisms of oxygen toxicity. Development of a preventive agent could substantially reduce or eliminate DCS by replacing inert gas with O_2 in the breathing mix. Use of pharmacological agents to enhance tissue blood flow during decompression could also reduce decompression risk. Additional work on mechanisms of DCS might lead to new adjunctive therapies that could be used in place of or in addition to hyperbaric oxygen. For the aging diver, safety might be enhanced by an understanding of the influence of cardiovascular and pulmonary comorbidities and their treatments on inert gas uptake and washout, and hence DCS risk. For the military diver, improved exercise performance and reduced arterial PCO_2 might be achievable by development and application of enhanced training methods, especially for the respiratory muscles, using inhaled agents that increase mitochondrial biogenesis.

ABOUT DR. MOON:

POSITION TITLE:
Professor of Anesthesiology
Professor of Medicine
Duke University Medical Center, Durham, NC

EDUCATION/TRAINING:

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
McGill University, Montreal, Canada	BSc	1971	Physics
McGill University, Montreal, Canada	MD, CM	1973	Medicine
Toronto General Hospital, Toronto, Canada	Interne	1973-74	Internal medicine
Toronto General Hospital, Toronto, Canada	Resident	1974-75	Internal Medicine
Sunnybrook Medical Centre, Toronto, Canada	Resident	1977-78	Internal Medicine
University of Toronto, Toronto, Canada	MSc	1980	Bioengineering
Duke University Medical Center, Durham, NC	Fellow	1979-81	Pulmonary Medicine
Duke University Medical Center, Durham, NC	Resident	1981-83	Anesthesiology

A. Personal Statement.
My academic interests include pulmonary physiology, perioperative pulmonary complications, control of breathing and the physiology of extreme environments. In these areas I have mentored more than 40 medical students, residents, graduate students, fellows and junior faculty members. Many of my medical student mentees are now academic anesthesiologists and developing their own careers. In recent years I have been tasked by the hospital administration to investigate episodes of respiratory depression at our institution and develop monitoring strategies. I participated in both APSF conferences on postoperative respiratory depression.

B. Positions and Honors.
Positions and Employment
- Medical Research Council Fellow, Institute of Biomedical Engineering, University of Toronto, Toronto, Canada, 1975-79
- Research Associate, Dept. of Otolaryngology, University of Toronto, Toronto, Canada, 1978-89
- Lecturer, Dept. of Medicine, University of Toronto, Toronto, Canada, 1978-89
- Assistant Professor, Dept. of Anesthesiology, Duke University Medical Center, Durham, NC, 1983-9
- Associate, Division of Pulmonary Medicine, Dept. of Medicine, Duke University Medical Center, Durham, NC, 1984-90
- Medical Director, Divers Alert Network, Durham, NC, 1989-2009
- Medical Director, Center for Hyperbaric Medicine & Environmental Physiology, Duke University Medical Center, Durham, NC, 1989-Date
- Associate Professor, Dept. of Anesthesiology, Duke University Medical Center, Durham, NC, 1990-98
- Professor, Dept. of Anesthesiology, Duke University, Durham, NC, 1998-Present
- Assistant Professor, Division of Pulmonary Medicine, Dept. of Medicine, Duke University, Durham, NC, 1990-95
- Associate Professor, Dept. of Medicine (Div. Pulmonary Medicine), Duke University, Durham, NC, 1995-2007
- Professor, Dept. of Medicine (Div. Pulmonary Medicine), Duke University, Durham, NC, 2007-Present

Honors
- Medical Research Council Fellow, Medical Research Council of Canada, 1975-79
- Alpha Omega Alpha, 1999
- Oceaneering Award for Contributions to Diving Safety (Undersea & Hyperbaric Medical Society), 1993

- Boerema Award for exceptional contributions to the field of hyperbaric medicine, 2007
- Mentorship Award, AMA-Women Physicians Congress Physician Mentor Recognition Program, 2007
- Leonard Palumbo Jr, MD Faculty Achievement Award for compassionate patient care and excellence in the teaching and mentoring of young physicians, 2012

CHRISTIAN J. LAMBERTSEN, MD, DSc (Hon) MEMORIAL LECTURE

ABOUT DR. LAMBERTSEN

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.

SESSION B
HBO_2 THERAPY MECHANISMS
Moderators: Gene Worth, MD & Steve Orr, MD

THURSDAY, JUNE 9
2:15 PM – 4:45 PM

B 13

ORAL PRESENTATION TIME: 1412 - 1424
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: Yes

Hyperbaric oxygen inhibits *P. aeruginosa* growth in vitro.

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Introduction/Background: 0.4% of patients in U.S. hospitals are infected with the biofilm-producing environmental pathogen *P. aeruginosa.* It is the most common infection among patients who have been in the hospital for at least one week. Especially in immune compromised and/or hospitalized patients, *P. aeruginosa* can cause fatal, acute fulminant infections such as bacteremic pneumonia, meningitis, burn wound infections, and sepsis (Medscape, 2015). The current literature on the effect of hyperbaric oxygen on *P. aeruginosa* growth lacks definitive answers about the direct effects of hyperbaric oxygen on *P. aeruginosa* biofilm production and growth (Cimsit, et al. 2009; Park, et al. 1991; and Luongo, et al. 1999). Because previous research suggested that hyperoxic conditions could promote *P. aeruginosa* growth (Park, et al., 1991), it was hypothesized that hyperbaric, hyperoxic conditions would also promote *P. aeruginosa* growth. This would be visualized by increased biofilm production.

Materials and Methods: *P. aeruginosa* cultures were plated on blood agar plates and incubated overnight at 37̊ C. Cultures were exposed to hyperbaric hyperoxic, normobaric hyperoxic, hyperbaric normoxic, and normobaric normoxic conditions to see if increased pressure and/or oxygen would promote the biofilm production of *P. aeruginosa*. The color, opacity, and adherence of the biofilms in each sample were used as parameters to measure microbial growth.

Results: Hyperbaric hyperoxic conditions significantly inhibited the biofilm production of *P. aeruginosa*.

Summary/Conclusions: This indicates that contrary to our hypothesis, increased pressure and oxygen together directly inhibit the biofilm production of *P. aeruginosa* more effectively than hyperbaric, normoxic conditions; hyperoxic normobaric conditions; or normoxic normobaric conditions. This suggests that hyperbaric hyperoxic conditions have a direct inhibitory effect on *P. aeruginosa* growth. It would be interesting to see if adjunctive hyperbaric oxygen therapy would benefit patients with acute fulminant *P. aeruginosa* infection.

B 14

ORAL PRESENTATION TIME: 1424 - 1436
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: Yes

Hyperbaric and high-oxygen environments lead to macrophage infiltration, stimulate cell proliferation and accelerate muscle regeneration in contused rat skeletal muscle.

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Introduction: Hyperbaric oxygen treatment (HBO_2) tries to be used to promote rapid recovery from sports-related soft tissue injuries. HBO_2 has been previously reported to accelerate muscle volume reduction and recovery from hypoxia in rats' contused muscle (UHMS 2015). However, whether these changes were in fact due to HBO_2 and the mechanism of these changes is unclear. In this study, histological analysis of injured muscle using the drop mass method was performed to determine if HBO_2 influenced macrophage infiltration, cell proliferation, and myofiber regeneration.

Materials and Methods: A muscle contusion on the calf was performed by the drop mass method. Rats were divided into non-treated (NT) and HBO_2 group. The HBO_2 protocol consisted of 2.5ATA 100% oxygen for 120 minutes. HBO_2 was performed once per day for 5 days. Injured calf muscles were dissected sequentially 6 hours, 24 hours, 3 days, 5 days, and 7 days after injury. Transverse sections were obtained with a cryostat. Myofibers with centrally located nuclei were counted as regenerating fiber. CD68 (a macrophage marker) and Ki67 (a cell proliferation marker) were used as primary antibodies.

Results: Following HBO_2 treatment, CD68-positive cell numbers significantly increased 3 days after injury, and significantly decreased 5 days after injury. Quantitative analysis showed that the peak of macrophage infiltration was 2 days earlier in HBO_2 group. The number of Ki67-positive cells was significantly increased both 24 hours and 3 days after HBO_2 treatment. Five days after HBO_2 treatment, the number of regenerating myofibers was significantly higher than that of the NT group ($p<0.01$).

Conclusions: The current findings in a preclinical model of muscle injury indicate that HBO_2 significantly accelerates macrophage infiltration and stimulates cell proliferation. HBO_2 could lead to early regeneration of skeletal muscles and be a useful treatment for muscle injury recovery.

B 15

ORAL PRESENTATION TIME: 1436 - 1448
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: Yes

Evaluation of the optimal hyperbaric oxygen therapy protocol for compromised flaps – continued benefit in the face of treatment delay.

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Introduction/Background: The use of HBO_2 therapy for compromised flaps/grafts is one of 14 indications approved by the UHMS. Failed flaps have significant clinical implications including flap loss, persistence of the original defect, requirement of another donor site with associated morbidity, and psychosocial sequelae. These situations are common after trauma resulting in degloving and avulsion injuries. Many patients present to clinic for evaluation in a delayed fashion. Our laboratory sought to define the post-insult time-point at which HBO_2 still provides benefit to the threatened flap.

Materials and Methods: A dorsal rat random flap model was used with subjects divided into two groups (N=30): 1) Post-operative Day (POD) 1 Treatment, and 2) POD 3 Treatment where HBO_2 was performed with 100% O_2 @ 2.4 ATA for 90 minutes QD beginning on the groups' respective POD and continued until POD 10. These groups were also compared to our previously obtained data on treatment immediately after surgery (Immediate) and a control group that did not receive HBO_2 after surgery (Control). On POD 10, area and percentage of flap necrosis were measured. Statistical analysis was performed with T-test and P value <0.05 was considered significant.

Results: We found $p<0.05$ for the pair Control vs. Immediate HBO_2 and Control vs. HBO_2 POD 1. While no significant difference is found between Immediate HBO_2, POD 1, and POD 3, they do follow a time dependent curve demonstrating a mean increase in necrosis the later post-injury HBO_2 is initiated.

Summary/Conclusions: Preliminary data suggest that the benefit of HBO_2 therapy decreases in a time-dependent manner starting at POD 3. After POD 1 the benefit is not found to be statistically significant, but the small percentage in benefit may prove to be clinically significant as maintenance of small amounts of tissue can drastically change the required complexity of reconstruction.

B 16

ORAL PRESENTATION TIME: 1448 - 1500
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: Yes

Effects of high-intensity interval training (HIT) in a hyperoxic-hyperbaric environment on exercise performance at altitude.

Dunworth SA, Alvarez Villela M, Kraft BD, Harlan N, Natoli, MJ, Parker CK, Schinazi EA, Piantadosi CA, Moon RE
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Introduction/Background: Oxygen consumption during maximum exercise (VO_2max) is determined by the movement of oxygen along a series of resistors from atmosphere to mitochondria. This "oxygen cascade" consists of two central resistors at the lung and cardio-circulatory level, and two peripheral resistors at the tissue and mitochondrial level (Di Prampero, *J Exp Biol*, 1985;115:319). At altitude, peripheral components play a greater role in determining VO_2 (Di Prampero, *Eur J Appl Physiol*, 2003;90:270). Similar to CO, hyperbaric oxygen (HBO) could affect the peripheral components of VO_2 by potentiating the effects of exercise on mitochondrial biogenesis through ROS signaling (Gutsaeva, *Neuroscience*, 2006;137:493). We hypothesized that high-intensity interval training (HIT) with HBO would be superior at improving exercise performance at high-altitude when compared to HIT alone.

Materials and Methods: After institutional review and informed consent, twenty healthy subjects underwent vastus lateralis muscle biopsy then VO_2max testing at 0.12 ATA before and after a two-week HIT program. Four subjects were excluded due to equipment errors. Subjects were randomized to train at either 1.4 ATA breathing 100% oxygen (n=7) or at 1.0 ATA breathing room air (n=9). Each subject completed six, thirty-minute training sessions over a two-week period. We compared pre- and post-training VO_2max for all subjects and then for less fit subjects only (surface VO_2max<50mL/[kg*min]).

Results:

Training Condition	**VO_2max (mL/[kg*min])** (mean±SEM)		
	Surface:	**Pre-training:**	**Post-training**
Control (n=9)	41.72±3.30	29.00±3.06	33.18±2.53
HBO (n=7)	45.50±3.09	31.53±1.73	35.27±1.34
Treatment mean difference: 0.43; p-value: 0.8678			
Less fit subjects:			
Control (n=7)	37.37±2.11	24.83±1.56	29.93±1.56
HBO (n=5)	41.08±1.61	29.42±1.49	35.32±1.29
Treatment mean difference: -0.8; p-value: 0.7112			

Summary/Conclusions:
Training with HBO is similar to exercise alone at improving VO_2max at altitude. However, HBO may still induce mitochondrial biogenesis. Muscle biopsy results are pending.

B 17

ORAL PRESENTATION TIME: 1500 - 1512
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: No

The role of RANKL and OPG in osteonecrosis patients treated with HBO_2.

Vezzani G[1], Camporesi EM[2], Cancellara L[3], Quartesan S[3], Mangar D[2], Bosco G[3]
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Introduction: To clarify the role of RANKL and OPG as possible mechanism of action in the hyperbaric oxygen therapy and osteonecrosis.

Materials and Methods: Prospective study of 23 patients (age = 54.2 ± 10.1 years; F = 11, M = 12) suffering from femoral head necrosis (FHN), PT-FHN (post-traumatic femoral head necrosis), PS-FHN (post steroid therapy femoral head necrosis), FCN (femoral condyles necrosis) and OABN (other aseptic bone necrosis) treated for one year with hyperbaric oxygen therapy. MRIs were performed at the beginning and at the end of the cycles of treatments, blood samples were performed at various times: T0 (beginning of the treatments), T1 (after 15 treatments), T2 (after 30 treatments), T3 (resume of the second cycle of treatments after 30 days stop) and T4 (end of the second cycle of treatments). 19 of 23 subjects admitted to the study completed the experimental protocol. Plasma concentration of OPG and RANK-L were analysed according to kits ELISA protocols (BioVendor, Cat. No.: RD194003200 and RD193004200R). A standard curve is constructed by plotting absorbance values against concentrations of standards, and concentrations of unknown samples are determined using this standard curve.

Results: The results show increased levels of plasmatic OPG. In detail, OPG concentrations progressively raise from T1 to T3 and T4. On the contrary, RANK-L values seem to decrease in response to HBO_2 treatments until T3 in most patients. At the end of the second cycle (time T4) RANK-L concentrations remain almost constant and only in few subjects return to the initial values.

Conclusion: Our findings seem to reveal that HBO_2 therapy influences OPG and RANK-L plasmatic values shifting their balance in a direction that promotes bone repair, but there is also an important individual variability between subjects.

B 18

ORAL PRESENTATION TIME: 1512 - 1524
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: No

Hyperbaric oxygen treatment reverses radiation-induced oxidative stress in a rat model.

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Introduction/Background: Radiotherapy induces increased production of reactive oxygen species (ROS) and activation of the innate immune response leading to an inflammatory response. These reactions can induce extensive cellular death, development of fibrosis and chronic inflammation, which significantly impairs organ function. We assessed whether HBO_2 can affect subacute radiation-induced changes with particular focus on oxidative stress of rat urinary bladder.

Materials and Methods: Sprague-Dawley rats (n=40) were randomly assigned to one out of four study arms. Group A: No treatment. Group B: 20 sessions of HBO_2 (100% oxygen at 200 kPa for 90 minutes). Group C: Radiation (20 Grey to the urinary bladder). Group D: Radiation and after 14 days, 20 sessions of HBO_2. Immunohistochemistry and q-PCR was used to analyze changes in the urinary bladder.

Results: 8-hydroxy-deoxyguanosine (8-OHdG) and heme oxygenase (HO-1) was used as markers for oxidative stress. Group C showed a significant elevation of 8-OHdG compared to group A (p=0.04) In Group D the elevation of 8-OHdG was reversed to the same level as observed in the group A. There was no significant difference between the group A and group B (p=0.66). The expression of the anti-oxidant markers super oxide dismutase 1 (SOD 1) and 2 (SOD 2) and nuclear factor erythroid 2 (NRF2α) were also analyzed. Group C had a significant increase in both NRF2α and SOD 2 ($p<0.05$). This elevation was completely reversed in Group D.

Summary/Conclusions: Elevated oxidative stress alone can cause physiological alterations of the bladder with can lead to progressive fibrosis and permanent dysfunction. Radiation induces a significant elevation of both oxidative stress and anti-oxidants. Both these sub-acute changes are completely reversed when HBO_2 is applied. HBO_2 may restore the balance between oxidative stress and anti-oxidative defense in radiated tissue and thus preventing development of late radiation adverse effects.

B 19

ORAL PRESENTATION TIME: 1524 - 1536
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: No

Gene expression is modified by hyperbaric oxygen therapy.

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Introduction: Hyperbaric oxygen therapy is indicated for a growing list of clinical conditions, suggesting several mechanisms of action. Changes in gene expression by HBO_2 have been studied in animal models. We hypothesize that similar modifications in gene expression will be seen in human subjects.

Methods: Three healthy male subjects between the ages of 18 to 30 were exposed to two treatments of hyperbaric oxygen at 2.0 ATA for 120 minutes on two consecutive days. Blood was drawn at baseline, after each treatment, and 24 hours after the 2nd treatment (5 total). Microarray analysis of gene expression was performed. The rank-product-generated gene lists using a 7% false discovery rate (FDR) were utilized as input data. The Kyoto Encyclopedia of Gene and Genomes (KEGG) pathways were used for this analysis using the 7% FDR. Statistics for functional analysis were carried out by Fischer's exact test. Cutoff values were set at 2-fold change, significance $p \leq 0.05$ was used in the analysis.

Results: There was a significant difference of gene expression pattern in 193 genes and 75 different molecular pathways between the baseline and immediately after the second HBO_2 treatment (blood draw #4). Most of the altered genes were small nuclear RNAs (42 snoRNAs) and microRNAs (12 microRNAs), suggesting that either altered genes are involved in the modification of transcription pathways or suggesting that modifications to transcription pathways occur rapidly and are a major physiological response to oxidative stress. Pathways involved with RNA degradation, DNA repair, metabolic process, cellular translocations and phagocytosis were modified by hyperoxia.

Conclusions: HBO_2 has a varied effect on gene expression after two treatments at 2.0 ATA for 120 minutes. Studies on gene expression in patients that receive multiple HBO_2 treatments over several weeks need to be conducted to determine if these modifications are persistent over time and clinically relevant.

B 20

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1615 - 1645
RESIDENT/TRAINEE COMPETITION: Yes

First insights on oxygen-induced genotoxicity and mitochondrial function in leukemia cell models – implications for diving with cancer?

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Introduction/Background: Leukemia accounts for 10% of cancer deaths worldwide. Many therapeutic approaches involve the induction of reactive oxygen species (ROS) but paradoxically also scavenging overproduced ROS. The mechanisms triggered by oxygen exposure on cancerous cells independent of pressure or medications remain incompletely understood. We hypothesize that normobaric hyperoxia will produce enough ROS to interfere with mitochondrial respiration and cause DNA-damage, both of which can potentially induce apoptosis.

Materials and Methods: To investigate the effect of 65% normobaric oxygen (equivalent to a 69fsw air dive) on acute lymphocytic leukemia (ALL) we exposed T- and B-lymphocytes (T-ALL, B-ALL) for 2h, and examined genotoxic effects (alkaline version of the comet assay), induction of apoptosis (western blot) and mitochondrial function (high-resolution respirometry) directly after exposure and within a 24 hours recovery interval.

Results: Table 1 describes the response pattern of the 2 cell lines after 2h of 65% O_2 when compared to normoxia. [↑] = up-regulation/increase, [≈] = no changes.

	B-ALL	T-ALL
DNA-damage	↑ after O_2 ($p<0.0001$), reversible within 24h	↑ 24h after O_2 ($p=0.0018$)
mitochondrial function		
- Routine Respiration	≈	↑ 6h after O_2 (1.4-fold)
- Complex I activity	↑ delayed after 6h recovery (B: 1.4-fold | T: 1.6-fold)	
- Complex II activity	≈	↑ persisting (>3.4-fold)
apoptotic pathways		
- Caspase-3	≈	
- Caspase-8 (extrinsic)	≈	
- Bax/Bcl_{xL} (intrinsic)	≈	Temporary anti-apoptotic (Bcl_{xL}) reaction after O_2

Summary/Conclusions: The impact of normobaric pO_2-changes on leukemic cells – considered harmless in healthy human subjects with respect to genotoxicity or cell death – is obvious, yet inconclusive. While B-ALL cells seem reversibly affected by the pO_2-changes tested, T-ALL cells react with delayed DNA-damage and increased mitochondrial activity. These regulatory processes, however, do not lead to apoptosis. This study opens further questions that await additional investigation before recommendations for the diving community can be made.

The study was funded by the PHYPODE project, financed by the European Union under a Marie Curie Initial Training Network.

Plenary Session:
"Flaps, Grafts and Hyperbaric Oxygen Therapy"
Richard Baynosa, MD

4:45 PM – 5:45 PM

ABOUT THE LECTURE:

FRIDAY, JUNE 10

Plenary Session:
"Understanding Hyperbaric Dosing"
Enoch Huang, MD

8:00 AM – 9:00 AM

ABOUT THE LECTURE:

SESSION C
CLINICAL HBO_2 THERAPY
Moderators: Tracy LeGros, MD & Jeff Mize, RRT, CHT, CWCA

FRIDAY, JUNE 10
9:00 AM – 11:30 AM

C 21

ORAL PRESENTATION TIME: 0900 - 0912
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

Hyperbaric oxygen therapy for central retinal artery occlusions.

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Background: Central retinal artery occlusions (CRAO) have a poor prognosis despite treatment. The treatment and treatment window are controversial, with no consensus on the best way to manage such patients. The purpose of our study was to evaluate our experience using hyperbaric oxygen therapy (HBO_2) to treat CRAOs.

Materials and Methods: A retrospective chart review of consecutive patients with a diagnosis of CRAO treated with HBO_2 over a 5-year period at one hospital was performed. HBO_2 was performed within 24 hours of vision loss. Diagnosis was confirmed on ophthalmoscopic examination. Snellen visual acuities were recorded before and after HBO_2 and converted to decimal equivalents for statistical analysis.

Results: 6 patients with a CRAO were identified with one patient having cilioretinal artery involvement. Mean time of HBO_2 from vision loss was 11.5 hours (range 2.5-15.0 hours). Mean decimal equivalent visual acuities before and after HBO_2 were 0.0015 (range NLP to HM) and 0.013 (range NLP to 20/300), respectively (t-test, p=0.3621). Of the 3 patients whose vision improved post-HBO_2, two improved by 1 line and 1 by two lines. Mean time to HBO_2 treatment for those patients that improved vs. those who did not was 9.83 hours vs. 13.17 hours, respectively (t-test, p=0.4779).

Conclusions: Visual acuity improved in 50% of CRAO eyes treated with HBO_2 and those patients with visual acuity improvement had earlier HBO_2 treatment compared to those that did not have visual acuity improvement. Despite these positive findings in favor of HBO_2 and earlier HBO_2, the differences were not found to be statistically significant. Further investigation is needed to further clarify the role of HBO_2 in the treatment of CRAO, including the most effective timing for this treatment.

C 22

ORAL PRESENTATION TIME: 0912 - 0924
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

C-reactive protein in carbon monoxide poisoning.

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Introduction: Carbon monoxide (CO) poisoning is common, causing inflammation that result in neuropsychological and occasionally cardiac adverse sequelae. C-reactive protein (CRP) is a nonspecific biomarker of acute systemic inflammation. Following inflammatory insults CRP levels increase in 6 hours and peak at 48 hours. Since CO poisoning causes inflammation, we sought to inspect CRP levels in poisoned patients.

Methods: The CRP was measured clinically in CO-poisoned patients. We performed a retrospective chart review of 66 poisoned adult patients from January 2014 - December 2015. We excluded patients with comorbidities that might elevate CRP. Of the 66, 43 patients were evaluated (age=18-87 years; 74% male, 40% loss of consciousness (LOC); 7% intubated). We compared statistically the carboxyhemoglobin (COHb) levels when the CO exposure ended (from Carboxy-Calculator; NoBendum) and the white blood count (WBC) to the CRP levels.

Results: The CRP levels were elevated following CO poisoning. The COHb levels did not correlate with a rise in CRP when analyzed by Logistic Regression while controlling for smoking status and age. Elevated CRP levels showed no statistical correlation with headache, nausea, LOC, or mental confusion. Smokers were found to have statistically higher CRP levels compared to non-smokers. Elevations in CRP and the WBC were statically significant when outliers were excluded.

Conclusion: Our results support that CO poisoning-causes inflammation. As expected, the CRP did not correlate with the COHb level (an unreliable marker of symptoms or sequelae after CO poisoning)., Since the CRP is a marker of inflammation, and inflammation may contribute to long-term adverse sequelae after poisoning, future studies could determine if the CRP levels are associates with outcomes.

C 23

ORAL PRESENTATION TIME: 0924 - 0936
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

The higher recovery rate of cardiac enzyme after hyperbaric oxygen therapy with severe co poisoning.

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Introduction/Background: This study was to investigate the recovery rate of cardiac enzyme, systolic dysfunction and the clinical characteristics of CO-induced cardiomyopathy after hyperbaric oxygen therapy in severe CO intoxication in South Korea.

Methods: We conducted a retrospective and observational study of 43 patients (male 27, mean age 60 years) who came to the emergency department with severe CO intoxication during the period August 2013 and May 2014. Measurements of troponin-I, left ventricular ejection fraction and wall motion abnormalities were performed to evaluate cardiac function and measured cardiac function at the time of initial, Day 1, Day 2, and once within seven days of hospitalization. Patients were divided into two group: hyperbaric oxygen therapy (HBO_2) group (n=33), and non-hyperbaric oxygen therapy (non-HBO_2) group (n=10).

Results: The incidence of cardiomyopathy was as high as 74.4% (32 of 43 patients) in CO-poisoned patients with myocardial injury based on initial ED results. The recovery rate of troponin-I within 72 hours was higher with the HBO_2 than the non-HBO_2 group (24.24% vs. 0%, p=0.04). The recovery rate of systolic dysfunction within 72 hours was not differed between two group (50.0% vs. 45.45%, p=0.72).

Summary/Conclusions: The recovery rate of cardiac enzyme was faster after hyperbaric oxygen therapy with severe CO poisoning and myocardial injury patients.

C 24

ORAL PRESENTATION TIME: 0936 - 0948
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Garage carbon monoxide (CO) levels produced by CO sources commonly used in intentional poisoning.

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Introduction/Background: The incidence of intentional carbon monoxide (CO) poisoning, both fatal and nonfatal, declined dramatically over the past four decades (Hampson NB, Holm JR. *UHM* 2015). It has been speculated that this is related to strict US federal CO emissions standards for motor vehicles and the uniform application of catalytic convertors (CC). We sought to compare ambient CO levels resulting from the operation of automobiles with and without catalytic convertors in a residential garage, as well as from other CO sources commonly used for intentional CO poisoning (Hampson NB, et al. *UHM* 2012).

Materials/Methods: CO levels were measured inside a freestanding 73 m^3 one-car garage, constructed of interior gypsum wallboard and exterior wood siding. Measurements were performed and recorded using a personal industrial CO gas monitor (Biosystems Toxipro-Single-Sensor Gas Monitor, Model 54-45-01D, Honeywell Inc.). CO sources tested included a 1971 Volkswagen Super Beetle (1500cc engine, no CC), 2003 BMW Z4 (2500cc engine, with CC), charcoal grill (1.25 kg fuel), gasoline-powered electrical generator (196 cc engine, 4 cycle), lawnmower (190cc engine, 4 cycle), and leaf blower (27cc engine, 2 cycle).

Results:

	Garage CO Level (PPM)				
CO Source	0 min	5 min	10 min	15 min	20 min
1971 VW Super Beetle (-CC)	0	49	111	202	253
2003 BMW Z4 Roadster (+CC)	0	27	47	36	30
Charcoal Grill	0	64	112	159	200
Electrical Generator	0	151	374	>999	>999
Lawnmower	0	48	100	141	198
Leaf Blower	0	182	335	447	580

Summary/Conclusions: Emissions controls on motor vehicles have reduced intentional CO poisonings by minimizing CO production and thereby the likelihood of achieving acutely toxic exposure levels. Alternate sources, however, may produce CO at levels of the same magnitude as motor vehicles manufactured prior to the use of catalytic convertors. Those involved in the care of potentially suicidal individuals should be aware of this.

C 25

ORAL PRESENTATION TIME: 0948 - 1000
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Case series of patients with central retinal artery obstruction with the diagnosis confirmed with bedside ultrasound.

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Introduction/Background: Central retinal artery obstruction (CRAO) is a rare diagnosis but often results in sudden severe permanent vision loss. It is one of the newest indications for hyperbaric oxygen therapy, but time to treatment may be important with current recommendations stating patients should be treated within 24 hours. The purpose of this study was to confirm that bedside ultrasound may play a role in the diagnosis of CRAO.

Materials/Methods: A retrospective chart review was conducted to include all CRAO cases from January 2016 to March 2016 that were evaluated for CRAO with a bedside ultrasound. The diagnosis of CRAO was confirmed by Ophthalmology. Bedside ultrasound was conducted on the patient's eyes bilaterally.

Results: 4 cases of CRAO were documented, 3 of which were later treated with hyperbaric oxygen because they were within the 24-hour treatment window. All patients had objective findings of decreased blood flow or possible emboli within the central retinal artery that was detectable by ultrasound.

Summary/Conclusions: Bedside ultrasound may be an important tool to hasten the diagnosis of central retinal artery occlusion to decrease the time to hyperbaric oxygen treatment.

C 26

ORAL PRESENTATION TIME: 1000 - 1012
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Prevalence of pineal cyst in carbon monoxide-poisoned patients with ongoing symptoms after poisoning.

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Introduction: Pineal cysts (≥2.0 mm) and pineal cystic changes (<2.0 mm) are common incidental findings on high resolution (1.0 mm) MRI, reported at a rate of 23% and 13% in healthy individuals, respectively. Pineal cysts are sometimes associated with headaches, visual symptoms, dizziness, sleep disturbances, and ataxia. We report the incidence of pineal cysts and cystic changes in a self-selected cohort of carbon monoxide (CO)-poisoned patients who presented for evaluation of continuing problems.

Methods: We performed a retrospective chart review of 105 patients who underwent neuroimaging from 2004-2016, using 3.0 Tesla (1.0 mm) magnetic resonance imaging (MRI), with ongoing symptoms after CO poisoning. MRI was examined for pineal cystic changes or pineal cysts and compared to symptoms at the time of evaluation. Data are presented as mean±1SD (range).

Results: Of 105 patients with MRI; 52 (50%) were female, mean age 32±14 (3-71) years. The interval from CO poisoning to imaging was 2.2±1.5 (0.1-11.6) years. Pineal cyst was present in 51 patients (49%); pineal cystic change in 14 (13%). Of 65 patients (62%) with pineal findings (29 women/36 men), mean cyst diameter was 3.3 ±1.7 mm (1.1 - 10.6 mm); 9 cysts were ≥5.0 mm in diameter. Patients with pineal findings complained of headaches (54, 83%), vision changes (23, 35%), dizziness (39, 60%), sleep problems (48, 74%), and balance problems (39, 60%); in comparison, patients without pineal findings reported these symptoms at the following rates: of headaches (29, 73%), vision changes (19, 48%), dizziness (18, 45%), sleep problems (32, 80%), and balance problems (21, 53%).

Conclusions: In this cohort of CO-poisoned patients with clinical sequelae, pineal cyst was present on neuroimaging performed months to years after poisoning at twice the incidence of the normal population. The possible role of pineal cyst in brain-injury symptoms after CO poisoning may warrant further study.

C 27

ORAL PRESENTATION TIME: 1012 - 1024
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Brain imaging abnormalities in acutely vs. chronically carbon monoxide-poisoned patients with ongoing symptoms at least six months after poisoning.

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Introduction: Carbon monoxide (CO) poisoning can cause brain injury symptoms that persist for years after poisoning, with brain damage evident on neuroimaging. We report neuroimaging findings by poisoning type (acute vs. chronic) in a self-selected cohort of CO-poisoned patients who presented for evaluation of continuing problems.

Methods: We performed a retrospective chart review of patients who underwent neuroimaging (3.0 Tesla magnetic resonance imaging [MRI]) after CO poisoning for ongoing symptoms ≥6 months after poisoning. Some had diffusion tensor imaging (DTI) across the corpus callosum, functional MRI, MR spectroscopy, and CT angiography (whole brain, Toshiba 320-detector). Poisonings were categorized as acute (continuous, single-event exposure), chronic (intermittent, >24 hours, without emergent care), or acute-on-chronic (intermittent, >24 hours, culminating in acute event requiring emergent care). Data are presented as mean±1SD (range).

Results: From 2004-2016, 176 patients had MRI and 41 had CT. Interval from CO poisoning to imaging was 2.3±1.6 (0.6-12.6) years. Clinical interpretation:

	Acute	Chronic	Acute-on-Chronic	All Patients
Patients with MRI, n(%)	124 (70%)	36 (20%)	16 (9%)	176
Female, n(%)	56 (45%)	23 (64%)	8 (50%)	87 (49%)
Age, years	32±14 (3-64)	47±16 (12-73)	38±12 (16-60)	35±16 (3-73)
Heating source, n(%)	117 (94%)	31 (86%)	14 (88%)	162 (92%)
Engine, n(%)	7(6%)	5(14%)	2(12%)	14(8%)
Neuroimaging findings, n(%)				
Hippocampal atrophy	93(75%)	26(72%)	7(44%)	126(72%)
Dilated PV spaces	65(52%)	15(42%)	6(38%)	86(49%)
White matter hyperintensities	51(41%)	24(67%)	7(44%)	82(47%)
Decreased fiber tracks (DTI)	80/100 (80%)	24/32 (67%)	7/16 (44%)	111/148 (75%)
fMRI abnormal	41/71 (58%)	17/24 (71%)	7/13 (54%)	65/108 (60%)
MRS abnormal	24/59 (40%)	12/25 (48%)	6/13 (46%)	41/97 (43%)
CT angiography abnormal	15/28 (54%)	3/6 (50%)	4/7 (57%)	22/41 (54%)
No neuroimaging findings, n(%)	6(5%)	1(3%)	3(19%)	10(6%)

Conclusions: In both acutely and chronically CO-poisoned patients with clinical sequelae, neuroimaging abnormalities were common years after poisoning.

C 28

ORAL PRESENTATION TIME: 1000 - 1012
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Carbon monoxide poisoning in Utah: 1996-2013.

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Introduction: The true incidence of carbon monoxide (CO) poisoning is not clearly known, but a description of possible trends could aid in prevention.

Methods: Investigators searched Utah state databases for emergency department (ED) visits and admissions for CO poisoning and medical examiner records for CO-related fatalities. Data is presented as victim counts and percentages and mean±1 standard deviation. Trends were examined by Poisson regression and change point models.

Results: From 1996-2013 (18 years), 7,590 individuals were diagnosed with CO poisoning: 6,469 were treated and released from EDs; 596 were admitted; 525 died. Victims of fatal poisoning were more likely to be older (43±18 vs. 30±18 years) and male (78% vs. 53%) compared to those with non-fatal poisoning.

Of 7,065 non-fatal poisonings, 5,950 (84%) were accidental, and 498 (7%) were suicide attempts. 9.7% of poisonings were treated with hyperbaric oxygen. For accidental poisonings, internal combustion engines accounted for 43%, smoke inhalation, 34%, and heating sources, 22%. Internal combustion engines were implicated in 97% of suicide attempts. Non-fatal poisoning rates declined by 50% over the study interval, from 20.4 cases per 100,000 residents in 1996 to 10.4 in 2013. Change point models fit significantly better than simple linear Poisson regression ($P<0.0001$), dropping more steeply after 2008 when new legislation required CO alarms in residences.

141 (27%) fatal poisonings were accidental, 361 (70%) suicides, and 2 (0.4%) homicides. Victims with cardiovascular autopsy findings/past cardiovascular history had lower carboxyhemoglobin levels (mean 51.2%, n=53) compared to those without (70.8%, n=472). Mean post-mortem carboxyhemoglobin was highest in ages 20-29 years (72.5%).

Conclusions: The incidence of CO poisoning in Utah is declining, but CO poisoning is still common. Alarm legislation may aid prevention efforts. An educational campaign addressing the many causes and circumstances of CO poisoning is required for prevention.

C 29

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Long-term evaluation of retinal artery occlusion patients who were applied hyperbaric oxygen treatment.

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WITHDREW

C 30

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

Successful healing and improvement of tracheal stenosis with hyperbaric oxygen therapy after tracheal anastomotic resection.

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Introduction: Hyperbaric oxygen is effective in the preservation of flaps and grafts in many settings. It promotes healing, and improves microvascular proliferation in non-healing wounds/flaps where vascular compromise is present. Recent animal studies suggest improvement in the healing of tracheal anastomoses of rats exposed to hyperbaric oxygen therapy in addition to improvement of tracheal anastomoses in a limited number of reported human cases.

Case Description: A 26-year-old male was referred to our hyperbaric department due to worsening stridor and shortness of breath for a compromised tracheal resection graft complicated by multiple episodes of tracheal restenosis and hypergranulation. Just 5 months prior to presentation, he required intubation following a motorcycle accident, remaining intubated for 2 weeks with subsequent development of tracheal stenosis. Bronchoscopic evaluation revealed a complex band of scarring and inflammation of the trachea. Secondary to the location of stenosis, tracheal stenting would be difficult. Tracheal resection and anastomotic graft was eventually undertaken by the pulmonary specialist. Despite the resection and flap, stenosis recurred, manifested by stridor, difficulty breathing and hypergranulation with tracheal narrowing seen on bronchoscopy. Following bronchoscopic debridement, the patient was referred for hyperbaric oxygen therapy to attempt to prevent hypergranulation and restenosis. After just 14 treatments, repeat bronchoscopy revealed significant improvement and prevention of restenosis of the trachea with achievement of 75% patency of the airway. A follow-up visit 3 weeks later revealed no further symptoms of stridor or shortness of breath by the patient.

Discussion: This case illustrates the adjunctive role of hyperbaric oxygen in preservation and treatment of a compromised tracheal resection and anastomotic flap of a human subject following treatment for tracheal stenosis. While only a handful of cases have been reported, we provide this case report to the body of literature supporting the use of hyperbaric oxygen therapy for this pathology.

C 31

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

Hyperbaric oxygen treatment of a critical care pediatric patient: a case report.

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Introduction: Thermal burns are a well-known indication for hyperbaric oxygen (HBO_2) therapy. However, few centers treat critical care pediatric patients with involved mechanical ventilation, sedation, IV drips, thermal concerns, and transport issues. We present the case of a pediatric critical care patient and the involved logistics during 26 hyperbaric treatments.

Case: A 5-year-old boy was rescued from a house fire with resulting 90% TBSA burns. Indications for HBO_2 included not only thermal burns but also invasive fungal infections including aspergillus and mucor, the latter playing an important role in decision to treat. In the initial weeks of HBO_2 the patient was on continuous renal replacement therapy (CRRT). To verify stability for several hours off CRRT, an ABG was drawn during HBO_2. This value was used to verify potassium within a safe range and allow for ventilator setting adjustments. The ventilator used was the Uni-Vent Eagle. For both ease and safety, the patient was bagged during transport, descent, and ascent in the chamber. A Portex 4.5 mm tracheostomy tube with water filled cuff was utilized to minimize cuff adjustments with pressure changes.

Sedation during treatment was handled via continuous IV pump infusion, using an Alaris MedSystem III. Combinations of dexmedetomidine, ketamine, lorazepam, fentanyl, and hydromorphone were used at various times to achieve comfort. Hypothermia prevention was achieved by use of sodium acetate therapeutic warming devices.

Discussion: Acute renal failure resolved and the patient was quickly able to cease CRRT. Immune status improved. Mucor disappeared and aspergillus greatly reduced. Tissues became more viable. Surgeons noted a significant increase in the amount of granulation tissue and improved allograft incorporation.

The patient successfully completed 26 hyperbaric chamber treatments. No complications were experienced. We conclude hyperbaric oxygen treatment of a pediatric critically ill patient is both safe and effective with the appropriate staff and preparation.

C 32

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

An urban tertiary referral center experiences in treating avascular necrosis with hyperbaric oxygen therapy: a case series.

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Introduction: Avascular necrosis (AVN) of the femoral head is a devastating disease process, with few hip sparing management options. The interruption of normal blood flow results in edema and inflammation of the femoral head compartment and bone necrosis. Hyperbaric oxygen therapy (HBO_2): has shown benefit in treating early stages of AVN: lessening pain, obviating surgery, and preservation of the unaffected hip. Nationwide, most centers are not treating AVN with HBO_2, as it is not a reimbursable diagnosis. Our institution began treating femoral head AVN in 2013, when our state Medicaid began covering this diagnosis for HBO_2 treatment.

Materials and Methods: We conducted a retrospective chart review of all patients receiving HBO_2 therapy for AVN from 2013 – 2016. We evaluated pain scores, imaging studies, orthopedic interventions, and side effects of HBO_2 therapy.

Results: Our patients tolerated HBO_2 therapy well, with significant reductions in pain and improved mobility. Even patients with financial and social challenges that precluded complete treatment adherence showed improvement.

Conclusion: HBO_2 is a novel treatment for AVN. Our institution has had success in the treatment of this challenging and resistant disease process.

C 33

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

Adjunctive hyperbaric oxygen (HBO_2) therapy for cerebral delayed radiation injury (DRI) in a pediatric patient.

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Introduction: There is limited, anecdotal documentation on the benefits of hyperbaric oxygen (HBO_2) therapy in the pediatric patient population suffering cerebral Delayed Radiation Injury (DRI). This is a case report of an 11-year-old female with a history of ependymoma s/p resection followed by Proton Beam Therapy to the head with 57 CGE in 2008. She presented to Children's Hospital of Philadelphia (CHOP) with worsening nystagmus, oscillopsia, ataxia and left side weakness in October 2015. MRI/MRA on admission demonstrated focal area of restricted diffusion involving left cerebellar peduncle consistent with acute cerebellar infarct in middle cerebellar peduncles; no recurrence or new lesions. Radiation Oncology team confirmed the lesion was in field previously irradiated. Patient was admitted to PICU with concern for CVA related to DRI. She was treated with aspirin and steroids, and started on HBO_2. Patient completed 30 HBO_2 treatments at 2.0 ATA, 120 minutes. Early clinical improvement was noted midway through her therapy. Upon completion, all symptoms had improved and she was resuming her previous daily activities. Repeat MRI/MRA two months post HBO_2 revealed resolution of restricted blood diffusion involving the left cerebellar peduncle with persisting T2/FLAIR signal abnormality in the region, consistent with prior infarct. Three months post HBO_2, patient was back to her baseline.

Conclusion: HBO_2 resulted in improvement of DRI related vasculopathy and cerebral injury as manifested by marked improvement in clinical symptomatology and resolution of radiographic abnormalities consistent with acute infarct. This case shows significant benefit associated with HBO_2 for this type of injury. Hopefully, it may encourage further observation and reporting of this benefit in the pediatric population and encourage future clinical trials.

C 34

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

A retrospective case review of the effect of hyperbaric oxygen therapy on central retinal artery occlusion.

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Introduction/Background: Central retinal artery occlusion (CRAO) is a devastating condition with a grim prognosis despite early conventional treatment. Hyperbaric oxygen (HBO_2) therapy is a UHMS-recognized indication for CRAO. Several reports have demonstrated improvement in patients treated with HBO_2. We sought to determine outcomes in patients presenting with CRAO and treated with HBO_2 at our institution.

Materials and Methods: We performed a retrospective review of patients treated with HBO_2 for CRAO from 7/1/2012 to 12/31/2015 in a university hospital with 24/7 HBO_2 coverage. De-identified data collected included visual acuity, time to HBO_2, and other interventions. All patients were treated following the same standardized treatment protocol. Patients were treated < 24 hours after symptom onset. They received HBO_2 to 2.8 ATA twice daily until plateau in response. All patients had documentation of visual acuity following a 5-point scale: 1 - no light perception, 2 - positive light perception, 3 - hand motion, 4 - counting fingers and with distance, and 5 - standard Snellen chart.

Results: Seven patients were identified. One patient was discontinued after only 3 treatments despite early response due to confinement anxiety. 5 of 7 patients had objective improvement in their visual acuity immediately following HBO_2 #1. 5 of 6 patients had objective improvement in their visual acuity at completion of HBO_2 (2 improved by 1 point, 1 improved by 2 points, and 2 improved by 3 points). Six-week data was available on 3 of 5 patients who had improved upon completion of HBO_2. All 3 patients were still improved (1 patient – 1 point, 2 patients – 2 points).

Summary/Conclusions: CRAO is a UHMS-recognized indication for HBO_2. Our study demonstrates benefit from HBO_2 that was sustained at 6-week follow-up. As such, our study supports the continued use of HBO_2 for emergent CRAO.

C 35

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

A case of non-dysbaric arterial gas embolism associated with necrotizing pneumonia and pulmonary bullae.

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Introduction: Arterial gas embolism (AGE) is usually caused by changes in atmospheric pressure or medical instrumentation. Here we present a rare case of spontaneous AGE.

Materials and Methods: N/A

Results: Case: A 78-year-old man with a history of COPD, 120 pack years smoking, chronic necrotizing pneumonia with Enterobacter cloacae, hypertension, atrial fibrillation, type 2 diabetes, hypothyroidism, dyslipidemia and recent coryza presented to an outside hospital (OSH) with this sequence of neurological events: bilateral upper extremity shaking, tingling and left shoulder pain after standing from waking that resolved with supine rest; recurrence in a self-limiting manner 4hr later; and, uncontrolled arm flailing and bilateral leg weakness at home later that night while standing. Initial MRI head/neck at OSH were normal. Symptoms resolved and he was discharged on anti-seizure medication. However, at home he experienced right arm shaking that generalized. In hospital he could not purposefully move or speak, though he was awake and protecting his airway. Non-contrast CT revealed necrotizing pneumonia and pulmonary bullae, and left atrial, chest wall vasculature and cerebral gas. Treatment with intravenous lidocaine and US Navy Treatment Table 6 were initiated for arterial gas emboli. After the first oxygen period, neurological exam revealed orientation to place and family; normal speech; following commands; bilateral grip strength 4/5, left arm deltoid and bicep 3/5, and bilateral hip flexors at 2/5 power. He was transferred back to the MICU, suffered another neurologic insult during the night and died later that day.

Summary: We report a unique AGE associated with necrotizing pneumonia and bullae. While the pathophysiology is unclear, it may be related to regional stretch injury while coughing in an infected lung, or infectious erosion into a pulmonary vein.

C 36

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: Yes

A case of acute CO poisoning duet tobacco smoking using a hookah with quick-light charcoal.

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Introduction: Carbon monoxide (CO) poisoning is responsible for up to 40,000 ED visits and over 5000 deaths annually in the U.S. Common causes include smoke inhalation, malfunctioning furnaces, and exhaust from heaters, generators, or automobiles. We report a case of hookah smoking as a cause of CO poisoning.

Case Description: A 23-year-old male with history of Ehlers-Danlos syndrome, ocular migraine and mild depression (recently restarted SSRI) presented with syncope while at a commercial hookah site. He smoked tobacco (0.5% nicotine versus his normal 0.05%) via hookah using quick-light charcoal for 1 hour. He subsequently suffered loss of consciousness for ~10 seconds. Upon waking he complained of headache, lightheadedness and difficulty ambulating. Five minutes later he again lost consciousness for ~20 seconds. On EMS arrival, CO-oximetry showed a carboxyhemoglobin (COHb) level of 56%, so the patient was placed on 100% oxygen and transported to the ED. Ongoing symptoms included persistent headache and "not quite feeling right". Physical exam was unremarkable, including coordination. COHb level on venous blood gas at the ED was 30.4%. Hyperbaric oxygen (HBO_2) therapy was administered at 2.8 ATA for 85 minutes with resolution of headache during the treatment and return of cognition back to baseline. The following day two more HBO_2 sessions were delivered at 2 ATA for 120 minutes each. There were no complications during HBO_2 and the patient reported no symptoms at the time of discharge, with intention to quit hookah.

Discussion: From 2000-2015 there were 28 reported cases of hookah-related CO poisoning. How many involved quick-light charcoal, capable of producing twice as much CO as natural charcoal, is unknown. Despite public health, scientific and media exposure, quick-light charcoal and hookah continue to be a preventable risk factor for acute CO poisoning.

C 37

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Transcutaneous oximetry evaluation of post-radiation breast lymphedema.

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Introduction /Background: Hyperbaric oxygen (HBO_2) therapy is an established treatment for tissue injury due to soft tissue radionecrosis (STRN). Breast-conserving surgery and radiation therapy is common treatment for breast cancer leaving patients at increased risk for delayed wound healing and/or breast lymphedema with chronic pain[1]. STRN can result from radiation damage to tissues causing an obliterative endarteritis with reduced perfusion leading to tissue hypovascularity, hypoxia and fibrosis[2]. "Because hyperbaric oxygen has been shown to enhance angiogenesis in hypoxic tissues, the hyperbaric community has postulated that the enhancement of angiogenesis was the primary if not the sole therapeutic effect of hyperbaric oxygen in radiated tissue"[3]. Transcutaneous oximetry ($TcPO_2$) has been used as a "diagnostic tool to assess periwound oxygen tension. $PtcO_2$ has been increasingly used as a screening tool to predict benefit from subsequent hyperbaric oxygen therapy"[4]. A published study (2014) involving head and neck cancer radiated patients showed that "transcutaneous oxygen tension was significantly increased in irradiated cheek skin after HBO_2, [with] normal values of $TcPO_2$ in non-irradiated cheek skin."[5] We question whether these results can be replicated in irradiated breast tissue? Will $TcPO_2$ be a useful diagnostic and prognostic tool with significant improvement in $TcPO_2$ results following hyperbaric oxygen therapy?

Case Study: 59-year-old breast lymphedema patient with severe pain in the irradiated breast and no open ulcers. $TcPO_2$ test pre-hyperbaric treatments then repeated post 40 HBO_2 treatments. Before treatment, the most painful area of the irradiated breast showed the lowest results (61 baseline increasing to 91 with O_2 challenge). After 40 HBO_2, pain was almost non-existent and the $TcPO_2$ results increase to 109 (room air) and 156 (O_2).

Summary/Conclusion: Hyperbaric oxygen therapy has already been shown to significantly decrease pain associated with breast lymphedema. We postulate that $TcPO_2$ may have a role in diagnosis/prognosis, but more research is needed.

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C 38

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Therapeutic outcomes among patients treated for late radiation injury in a single-center hyperbaric program.

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Introduction Background: Hyperbaric oxygen therapy (HBOT) is considered an adjunctive therapy for late radiation-induced injury (STRI). We aimed to examine therapy outcomes among patients treated for this indication in a single center hyperbaric program over a two-year period.

Methods: This study underwent expedited review and approval by UCLA IRB # 14-001543. A retrospective chart review of all patients treated for STRI from January 2014 to January 2016 was conducted. From the HBOT progress notes, outcomes of therapy were classified as complete, partial, or no relief of symptoms. From February to March 2016, patients were contacted by phone to confirm diagnosis, symptoms, and therapy outcome.

Results: 59 out of the 89 patients (66%) included in the study had completed their HBOT plan, receiving an average of 37 treatments. 39 out of the 89 patients (44%) responded to the phone survey. 19 reported experiencing symptom improvement while undergoing HBOT. 40% of therapy outcomes determined by phone surveys were different from outcomes determined by medical chart review.

			Irradiated Site				
Patients Who Completed HBOT Plan	**Symptom Resolution**	**N**	**Head/Neck**	**Pelvic**	**Breast**	**Leg**	**% of Total**
Chart Review (N=59)	Complete	8	5	2	1	0	14%
	Partial	42	13	20	1	8	74%
	No	7	4	2	0	1	12%
Call Survey (N=25)	Complete	7	5	0	1	1	28%
	Partial	11	4	5	0	2	44%
	No	7	2	3	0	2	28%

Discussion: The time period between the end of HBOT and the post-treatment call varied among patients. Sources of inaccuracy in the call survey data include lapses in patient's memory, patients' misinterpretation of survey questions, and speech barriers in cases of osteoradionecrosis of the mandible. Patient responses were classified subjectively by the researchers into a symptom resolution group. The distribution of outcomes from both the chart review and call study demonstrates the variability in HBOT outcomes for STRI, with partial resolution being the largest group. Clinicians should use a standardized assessment tool to record symptom severity before, during, and after HBOT.

C 39

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Severe unintentional carbon monoxide intoxication in a pregnant patient.

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Introduction: The fetus is uniquely susceptible to the effects of carbon monoxide (CO) exposure. Administration of hyperbaric oxygen (HBO_2) therapy may reduce the incidence of delayed neurologic sequelae in the mother, and may also improve fetal outcomes. We present a case of severe unintentional CO poisoning in a pregnant patient which was treated with HBO_2.

Case Report: A 23-year-old female, at 11 weeks gestation with a desired pregnancy, was helping her husband shovel snow away from their car when she decided to sit inside the car with the engine idling. Thirty minutes later, the patient's husband found her to be unresponsive and exhibiting seizure-like activity. He drove her to a hospital, where she was noted to be somnolent. Tachycardia and inferior T-wave inversions were present on her electrocardiogram. An initial carboxyhemoglobin (COHb) concentration was 47.1%. She was administered 100% normobaric oxygen and transferred to a tertiary hospital where she underwent compression in a monoplace chamber to 2.5 ATA. Fetal heart tones remained reassuring during hospitalization; her troponin-I peaked at 0.111 ng/mL (range <0.045 ng/mL). She was discharged home after two HBO_2 treatments. At 6 week follow up, she reported having occasional bitemporal headaches and blurry vision, but no cognitive impairment, vaginal bleeding, or contractions.

Discussion: Fetal hemoglobin binds to CO more tightly than adult hemoglobin does, and fetal COHb levels are reported to exceed maternal COHb levels. In addition, fetal elimination of CO is slower than maternal elimination. In one multicenter study, severe maternal CO toxicity was associated with adverse fetal outcomes such as fetal demise or cerebral palsy, whereas mild or moderate maternal toxicity was not.

Conclusion: Fetal survival after CO exposure is possible even with maternal COHb concentrations approaching 50%. Significant and permanent neurocognitive disorders may be present in survivors of severe fetal CO exposure.

C 40

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Pain improvement in rheumatoid arthritis with hyperbaric oxygen: a report of 3 cases.

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Introduction/Background: Rheumatoid arthritis (RA) is a chronic, erosive, symmetrical inflammatory disease that can progress to synovial destruction, severe disability and premature mortality. Immunotherapies, while beneficial, can cause significant adverse events.

Methods: Three patients with active RA treated for non RA-related diagnoses, received a total of 7 of HBO_2 ranging from 7 to 55 sessions, and one course of hyperbaric air for 30 sessions, all at 2 atmospheres absolute (atm abs) for 90 minutes daily Monday through Friday. One patient was off all her RA meds throughout the courses of HBO_2. One patient remained on his RA meds throughout. The last patient stopped his RA meds intermittently for minor surgeries. There were no HBO_2-related complications. Each patient individually and voluntarily reported noticeable, significant clinical improvement after three to four sessions. There were no objective measures of improvement. In each case, after a flare or worsening of disease, the clinical improvements were reproduced with additional HBO_2 treatments. HBO_2 has generally been shown to suppress stimulus-induced proinflammatory cytokine production. The significant symptomatic improvement in these patients led us to hypothesize that HBO_2 for patients with RA may result in decreased joint pain, increased activity level, improvement in sleeping patterns and possibly a decreased need for standard rheumatologic medications, effectively reducing or avoiding the effects of immunosuppression.

Summary/Conclusion: If HBO_2 consistently relieved the joint pain and stiffness associated with RA, led to an increase in exercise tolerance, activity level and sleep quality there could be a significant role for the use of HBO_2 as an adjunct to traditional DMARD therapy, biologics or alternative therapy for select patients. A clinical trial is planned to more objectively assess these findings.

Disclaimer: The views expressed in this material are those of the authors and do not reflect the official policy or position of the U.S. Government, the Department of Defense, or the Department of the Air Force.

C 41

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Myositis associated with carbon monoxide poisoning.

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Introduction: Carbon monoxide (CO) poisoning causes hypoxia and inflammation, which may adversely affect muscle tissue. Patients with CO poisoning can have rhabdomyolysis acutely and can complain during or after poisoning. There is no literature about CO poisoning causing myositis.

Case Report: A 53-year old previously healthy female truck driver had carbon monoxide poisoning from a faulty engine exhaust. Her CO exposure was intermittent for 3 months, with an acute event resulting in brief unconsciousness after exiting the truck. Twenty-two hours later, her carboxyhemoglobin was 9%. She had neuropsychological symptoms following poisoning. Two months after poisoning she developed progressive weakness and myalgia leading to a diagnosis of "polymyositis" four months after poisoning. Diagnostic findings then were: C-reactive protein 104 mg/L; creatinine kinase 2553 mg/L; aspartate aminotransferase 139; alanine aminotransferase 164; and acute myopathic process and no associated neuropathic findings on nerve conduction study. Her electromyogram showed pure myopathy without any sensory abnormalities. Occult malignancy was ruled out by computed tomography and colonoscopy. The biopsy of her thigh revealed brisk severe inflammatory myopathy with myonecrosis consistent with an inflammatory myopathy. Muscle specialists and senior pathologist interpreted the biopsy as toxic or viral myopathy, not polymyositis, with the most likely etiology CO poisoning. She was treated initially with steroids, then also with mycophenolate. Eighteen months later, a repeat muscle biopsy showed no evidence of an active inflammatory or myopathic process. Two months later, mycophenolate was discontinued. Over the next 3 years, myositis did not recur. Alternative diagnoses were ruled out by her course and clinical investigation.

Conclusions: To our knowledge this is the first case report of CO poisoning potentially associated with inflammatory myositis. This patient's presentation, course, and extensive evaluations support that the myositis was either idiopathic, post-viral (without evidence of a causative virus), or due to CO poisoning.

C 42

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: WITHDREW
RESIDENT/TRAINEE COMPETITION: No

Delayed hyperbaric oxygen (HBO_2) treatment of sudden sensorineural hearing loss (SSHL).

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WITHDREW

C 43

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Closure of a radiation-induced recto-urethral fistula with hyperbaric oxygen therapy.

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Introduction/Background: The mechanism of injury from radiation therapy is multifactorial. Irradiated tissue is hypoxic, hypocellular and hypovascular. Radiation therapy releases cytokines causing a fibroatrophic affect. Hyperbaric oxygen (HBO_2) therapy is a treatment for radiation-induced injury through angio/vasculogenesis and intracellular matrix formation. HBO_2 has been used to treat soft tissue injury of abdomen and pelvis; however, to our knowledge, we present the first case to use HBO_2 for closure of a radiation induced recto-urethral fistula.

Materials and Methods: This is a case report of an 80 y.o. male who was referred for hyperbaric oxygen (HBO_2) therapy for a recto-urethral fistula and recto-prostatic fistula that he developed after 5040 cGy radiation therapy for adenocarcinoma of the anus. Previously he had brachytherapy for prostate cancer. He underwent laparoscopic colostomy, closure of fistulae and bilateral gracilis muscle flaps to close the perineal defect. Five days later, after delayed effects of radiation was confirmed by pathology of anal biopsy, HBO_2 was initiated. He was treated at 2.4 ATA for 90 minutes with 100% oxygen with two 5 minute air breaks. At HBO_2 24 of 40, the fistula size had decreased to 2 X 2 cm from 3 X 3.5 cm. Bilateral nephrosotomy tubes were placed at 31 of 40 HBO_2 to divert urine from the fistula site. A cystoscopy was done at session 40 HBO_2 and was decided to continue for an additional 30 sessions. At 54 of 70 cystoscopy report read “ did not note large fistula.”

Results: By 68 of 70 HBO_2, closure was confirmed by fluoroscopic cystogram; therefore, HBO_2 was terminated. One month later, colostomy take down was completed. One week later he was discharged from the hospital.

Summary/Conclusion: To our knowledge this is the first reported case of closure of a radiation induced recto-urethral fistula by HBO_2 after bilateral gracilis muscle flaps, diversion of stool and delayed diversion of urine.

C 44

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Carboxyhemoglobin half-life (COHb $t_{1/2}$) during hyperbaric oxygen (HBO_2).

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Introduction: Information about COHb $t_{1/2}$ during HBO_2 is limited. The mean COHb $t_{1/2}$ in two volunteers breathing HBO_2 at 3 atmospheres absolute (ATA) was 23.3 minutes,[1] and 26.3 minutes in 12 volunteer smokers (1.58 ATA).[2] In 5 carbon monoxide (CO)-poisoned patients with HBO_2 at 3 ATA, mean COHb $t_{1/2}$ was 42.2 minutes.[3]

Case Report: An 81-year old male using an improperly ventilated gas-powered heater, comatose and intubated, was treated with HBO_2.[4] His initial COHb was 34.1%. Eighteen minutes before HBO_2, his PaO_2/FiO_2 ratio on 100% oxygen was 283 due to lung injury/aspiration and COHb was 5.9%. Compression interval to 3 ATA was 17 minutes. COHb measured after 22 minutes at 3 ATA was 3.3% (by arterial catheter).

Results: Assuming exponential decay, and using methods described elsewhere,[4,5] his COHb $t_{1/2}$ before HBO_2 was 95 minutes. We do not know the COHb upon reaching 3 ATA. Using empirical techniques (assuming mean COHb $t_{1/2}$ during compression must be less than 95 minutes and greater than the COHb $t_{1/2}$ at 3 ATA), we estimate the range for COHb $t_{1/2}$ during compression as 62-81 minutes and for the 3 ATA interval, 58 to 49 minutes, respectively. The mid-point estimate of COHb $t_{1/2}$ at 3 ATA was 53 minutes.

Conclusions: The COHb $t_{1/2}$ we measured is greater than that observed by Myers, et al., but may be longer in our patient because of concomitant respiratory failure, lung dysfunction, and mechanical ventilation. The often-cited COHb $t_{1/2}$ of 23 minutes, likely underestimates the actual COHb $t_{1/2}$ in CO-poisoned patients, especially those with cardiopulmonary dysfunction.

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C 45

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

An international hyperbaric oxygen treatment consortium and registry.

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Introduction/Background: Lack of outcomes data for HBO_2 therapy limits its use for both established and new indications. Published HBO_2 outcomes data tend to focus on small case series, often because few patients with a given condition are treated at a single center. To solve this problem, the HBO_2 community needs a multi-center registry to collect and pool data systematically from multiple institutions and to provide the infrastructure for clinical trials, quality of life studies, and other outcomes research.

Materials and Methods: We have pilot tested a registry at the Center for Hyperbaric Medicine at Dartmouth for 3 years. We have obtained IRB approval, worked through the legal issues involved in a Data Use Agreement (DUA), and established a DUA with one other center (Elliott Hospital, NH). A set of outcome measures has been devised and built into the registry for all UHMS approved indications. Originally developed in a custom database, the registry has been moved to REDCap, a freely available system that can be installed at institutions worldwide.

Results: We have collected high quality data on 234 patients referred to our center for hyperbaric treatment; the data are used for quality assurance and research.

Summary/Conclusions: We are poised to expand this registry to develop, publicize, and grow an international hyperbaric research-focused consortium and registry. The registry can answer questions the hyperbaric community has been asking for many years about HBO_2 treatment effectiveness for both established and emerging indications. The registry will collect and analyze high quality data on health outcomes and provide the platform to enroll patients for translational research, clinical trials and long-term follow-up. Potential partners are invited to obtain further information about joining the Consortium by contacting our center.

C 88

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Retrospective review of 10 diabetic patients receiving hyperbaric oxygen therapy and the effect of this therapy on blood glucose with and without drinking Glucerna.

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Introduction: Martin Health System's Hyperbaric Department staff attended the annual UHMS conference in St. Louis, Missouri in 2014. There they learned about providing the insulin dependent diabetic patients having a blood glucose below 150, with an 8 oz. can of Glucerna to drink prior to their HBO_2 treatment to maintain normo-glycemia.

Objectives: We conducted this retrospective review of 10 diabetic patient's records who received hyperbaric oxygen (HBO_2) therapy. We evaluated 3 measures:

1. The average change in blood glucose caused by HBO_2 without drinking Glucerna
2. The average change in blood glucose caused by HBO_2 with drinking Glucerna
3. To validate the study showing that Glucerna is successful in preventing the likely drop in blood glucose caused by HBO_2

Methods: 10 diabetic patient charts were selected and reviewed. Of these 10 there were 3 patients who were deemed ineligible for our study. Of the remaining 7 patients, we monitored their pre-HBO_2 blood glucose by finger stick. We provided the patients with blood glucose less than 150 with a can of glucerna to drink prior to their HBO_2 treatment. We then checked blood glucose via finger stick when they were removed from the chamber.

Results:

1. The average change in blood glucose in diabetic patients receiving HBO_2 without drinking Glucerna was a decrease of 22 points.
2. The average change in blood glucose in patients who drank Glucerna prior to receiving HBO_2 was an increase of 26 points.
3. We have validated the study showing that Glucerna stabilizes blood glucose in patients receiving HBO_2.

Conclusion: Insulin dependent diabetics' blood glucose almost always drops during HBO_2 therapy. In order to stabilize this blood glucose, we have validated that giving an 8 oz. can of Glucerna for the patient to drink prior to HBO_2 if their blood glucose is less than 150, is successful in maintaining normo-glycemia and preventing hypoglycemia.

ERIC P. KINDWALL, MD MEMORIAL LECTURE
FRIDAY, JUNE 10: 11:30 am - 12:30 pm

GUEST SPEAKER: PROFESSOR MICHAEL BENNETT, MD
LECTURE TITLE: "Medicine or Marketing? What we need to do to survive in the 21st Century"

ABOUT THE LECTURE: The Undersea Medical Society (UMS) was conceived in 1966 and delivered after a relatively trouble-free confinement in 1967. As an adolescent in the 1970s, the organization began to experiment with a heady mixture of oxygen and pressure in order to achieve the rush that can only be experienced with healing the sick. Becoming deeply immersed in this hyperbaric counter-culture, the organization even changed its name and the UHMS swaggered across the stage, enthusiasm almost unlimited. Life has been difficult at times. Mature branches of medicine have never really accepted this brash young tearaway, and the leaders in the field struggled hard to convince the skeptics that hyperbaric oxygen (HBO_2) therapy really did have a place in modern medicine. The field suffered from the need to hurdle a high bar of evidence in order to be accepted as a reimbursable treatment option. Somewhat disillusioned and resentful, our leaders set about pulling the field into the mainstream. Through hard work, good science and relevant research they made a great deal of progress in the late 20th Century. By then we had seen just how common problem wounds are in the community. Comprehensive, physician-based hyperbaric facilities offering 24/7 coverage were suddenly hard to find, while stand-alone wound-care facilities multiplied like rabbits and were seized upon by the corporate health sector. Remuneration-driven admission and treatment protocols, specifically designed to service the non-emergent 'walking wounded', replaced the approach where teaching and research were valuable activities that complemented patient care. This presentation will discuss where this story is going and how we might continue to pursue and refine the appropriate use of high pressure oxygen for therapeutic purposes. I will explore the dangers we face as a professional group, as well as the opportunities. Does the future lie in aggressive marketing for those common conditions with which we are already familiar – or in the pursuit of medicine as a dynamic interaction of basic science, clinical acumen and clinical research? Should we settle into our comfortable middle-age, or does this young field still have the fire in the belly needed to realize our full potential?

ABOUT DR. BENNETT:

Professor Bennett is the Academic Head of the Department of Anaesthesia, a Senior Staff Specialist in diving and hyperbaric medicine at Prince of Wales Hospital and Conjoint Professor in the faculty of Medicine, University of New South Wales in Sydney, Australia. He graduated from the University of New South Wales in 1979 and spent his early post-graduate training at the Prince Henry/Prince of Wales Hospitals before undertaking training in Anaesthesia in the UK. He returned to Sydney in 1990 as a retrieval specialist on the Lifesaver Helicopter and here developed an interest in both diving and hyperbaric medicine. He also has a strong interest in clinical epidemiology and is an experienced clinician and researcher. In 2002 he was the recipient of the Behnke Award for outstanding scientific achievement from the Undersea and Hyperbaric Medical Society.

Since 2004 he has been highly involved in the teaching of Evidence-based Medicine within the Medical faculty at UNSW and in 2005 was appointed co-director of the Quality Medical Practice Program there. Prof. Bennett was the convenor of the Australia and New Zealand Hyperbaric Medicine Group Introductory Course in Diving and Hyperbaric Medicine from its inception in 1999.to 2014. He is an executive member of the Australia and New Zealand College of Anaesthetists (ANZCA) special interest group in diving and hyperbaric medicine, chief examiner for the ANZCA Certificate in diving and hyperbaric medicine and Chair of the ANZCA Scholar Role Subcommittee. He is a past Vice-President of the UHMS and currently the Past President of SPUMS.

ERIC P. KINDWALL, MD MEMORIAL LECTURE

ABOUT DR. KINDWALL

Dr. Kindwall is known by so 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 has 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. Some of us have been blessed to have had a closer impact by Dr. Kindwall's life, but I think that I can easily say that each of us has been influenced in some way.

Optional Noon Plenary

“The Merit-Based Incentive Payment System, The National Hyperbaric Registry and the Future of the U.S. HBOT Reimbursement”

Caroline Fife, MD, Helen Gelly, MD, Marc Robins, DO

12:30 PM – 1:30 PM

ABOUT THE LECTURE:

This session is an explanation of the basics of the Merit Based Incentive Payment System (MIPS) which will determine the payment rate for advanced practitioners, beginning next year (2017). Attendees will learn how hyperbaric quality measures developed by the UHMS can be used to satisfy the quality reporting requirements under MIPS, and how the same hyperbaric quality data reported to CMS can automatically populate the UHMS hyperbaric registry, creating a data repository for future research. "Do what you have to-- get what we need." Additionally, attendees will be acquainted with recent changes in regulatory oversight that may impact future reimbursement.

SESSION D
DIVING AND DECOMPRESSION ILLNESS

Moderators: Neal Pollock, PhD & Annette Gwilliam, ACHRN

FRIDAY, JUNE 10

1:00 PM – 4:00 PM

D 46

ORAL PRESENTATION TIME: 1330 - 1342
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Effects of repetitive breath-hold diving on executive brain function in Japanese Ama divers evaluated using digitalized clock drawing test.

Wiley JM, Koshi K, Penney DL, Tamaki H, Davis R, Denoble PJ
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jenna_wiley@med.unc.edu

Introduction/Background: Traditional Japanese Ama divers have been reported to manifest acute neurological symptoms after a long series of breath-hold dives. Magnetic resonance imaging has revealed asymptomatic cerebral lesions with higher prevalence in divers than in the general population. We tested Ama divers for possible subclinical deficits in executive functioning.

Materials and Methods: Twelve Ama divers were tested before and after a workday of breath-hold dives using the Montreal Cognitive Assessment (MoCA) and a digitalized clock drawing test (dCDT). The dCDT includes drawing of a command and copy clock with a digital pen, which stores information for computer-assisted analysis. The software helps to detect subtle changes in drawing strokes and times. Pre- and post-diving dCDT results were assessed and compared to the MoCA results.

Results: Subjects were 12 males, mean age 54 (32-65) years. The median pre-dive MoCA score was 25 (20-28) and post-dive 26.5 (21-30). The score was lower in older divers. Both groups took longer to draw the command clock than the copy clock. Total number of strokes used to draw the clock did not differ between command and copy clock pre- or post-diving. The command clocks became smaller and the drawing speed slower on the post-test, both subtle changes that could not be picked up with the MoCA.

Summary/Conclusions: The cognitive changes we found on the dCDT reflect similar changes as seen in insidiously progressive neurocognitive disorders. When combined with low MoCA scores in older divers, this raises the possibility that commercial breath-hold divers may be at risk for long-term cognitive damage. The small sample size limits the significance of the findings but the consistency of changes indicates that the dCDT could be a useful tool to study this issue. We plan to expand the study and include a proper control group.

D 47

ORAL PRESENTATION TIME: 1342 - 1354
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Recompression treatment tables used for artisanal fishermen divers in the Yucatán Peninsula: understanding depths and duration.

Chin W, Huchim-Lara O, Popa D, Nguyen P, Ninokawa S
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Introduction/Background: Decompression illness (DCI) is endemic among artisanal fishermen divers in the Yucatán Peninsula, Mexico. Fishermen seek therapy when they experience one or more severe symptoms such as unmanageable pain, partial paralysis, vomiting, or vertigo. We sought to understand the characteristics of recompression therapy being rendered by a single hyperbaric program in Tizimín.

Methods: We retrospectively collected all treatment profiles conducted during the 2014-2015 fishing season. A digital pressure transducer, ReefNet ® ULTRA SENSUS dive recorder, with an accuracy of +/- 1 feet of seawater (FSW), was secured with a zip tie inside the hyperbaric chamber to measure the therapy depth. The transducer was set to record a data point every 10 seconds once activated at 3 FSW, and to stop recording data at the surface for longer than 20 minutes.

Results: A total of 107 therapies were recorded. Fifty-four percent of the fishermen divers were treated for type II DCI. The majority of these treatment tables (65%) were recorded as a U.S. Navy Treatment Table 5 (TT5). However, in 27 therapies the patient was taken deeper than 60 FSW. Most of the therapies were conducted on Wednesday, and 73% of all therapies between 8 and 9 A.M. A Spearman's rank correlation showed a strong, positive correlation between the number of times the patient was taken to the correct depth and the hour of the day ($r=0.5899$, $p<0.000$).

	Average	Standard Deviation	Median
Therapy Depth (FSW)	53	8.40	50
Therapy Length (Minutes)	108	35.15	97

Discussion: Fishermen who present to the hyperbaric center with DCI symptoms are being treated with nonstandard recompression tables. There is variability in the depth and duration of these treatments. None of the therapies given were true TT5 nor TT6. Staff shortage, educational gap, and limited chamber occupancy during peak treatment hours may contribute to suboptimal treatment.

D 48

ORAL PRESENTATION TIME: 1354 - 1406
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Possible central nervous system oxygen toxicity seizures among U.S. recreational air or enriched air nitrox open-circuit diving fatalities 2004-2013.

Buzzacott P[1,2], Denoble PJ[1]
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Introduction: The first diver certification program for recreational “enriched air nitrox” (EAN) diving was released in 1985. At that time concerns were expressed that many EAN divers might suffer central nervous system (CNS) oxygen toxicity seizures and drown. Since then EAN diving has increased in popularity and among dives recorded by Divers Alert Network (DAN) 21% were breathing EAN.

Methods: The DAN diving fatality database was searched for possible oxygen toxicity cases. US fatalities on open-circuit occurring between 2004-2013, where the breathing gas was either air or EAN, were identified. Causes of death and the preceding circumstances were examined by a medical examiner trained and experienced in diving autopsies. Case notes were searched for the words “seizure” or “toxicity” and identified cases were reviewed for witnessed seizures at elevated partial pressures of oxygen.

Results: The dataset comprised 344 air divers (86%) and 55 divers breathing EAN (14%). EAN divers’ fatal dives were deeper than air divers’, (28 msw vs. 18 msw, $p<0.0001$). Despite this, of the 249 cases where a cause of death was established, 218 (88%) breathing air and 31 (12%) breathing EAN, only three EAN divers were considered to have possibly died following CNS oxygen toxicity seizures at depth (ppO_2 132, 142 and 193 kPa), and only one of those was considered likely (ppO_2=193 kPa).

Conclusion: Despite wariness of EAN three decades ago, our analysis of recreational diving fatalities in the US over 10 years found just one death likely from CNS oxygen toxicity among EAN divers. A further two possible, though unlikely, cases were also found. Determining causes of death among divers often involves a degree of uncertainty and 150 cases in this study had no cause of death available. Even so, fears of commonplace CNS oxygen toxicity seizures while EAN diving have not apparently been realized.

D 49

ORAL PRESENTATION TIME: 1406 - 1418
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Is decision-making performance of submariners impacted by exposure to low-to-moderate ambient CO_2 levels?

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Introduction/Background: Submarines routinely operate with levels of carbon dioxide (CO_2) that can exceed 2500 ppm – significantly higher than the levels found in normal work environments. This is a concern for submarine operations, as personnel regularly make mission-critical decisions that affect the safety and efficiency of the vessel and its crew. Though significant cognitive impairments are often not reported below 15000 ppm CO_2, recent studies (Satish, et al., 2012; Allen, et al., 2015), found impairments in decision-making performance of university students and professional grade employees during acute CO_2 exposure at levels as low as 2500 ppm. The main objective of this study was to determine if submarine personnel's decision-making performance -is impacted by exposure to concentrations of CO_2 that may be present in the submarine atmosphere during sea patrols. Based on findings from Satish, et al., 2012, it is hypothesized that submariners' decision-making performance will be impaired by acute exposures to low-to-moderate CO_2 levels (2500 ppm – 15000 ppm).

Materials and Methods: 36 submarine-qualified officers and senior enlisted were assigned to one of three CO_2 exposure conditions – <600 ppm (control), 2500 ppm (replication of Satish, et al., 2012) and 15000 ppm – in a subject-blinded randomized-balance design (n=12 per condition). Subjects were exposed at sea level pressure in NSMRL's Genesis hyperbaric chamber, where they completed a single 90 min session of the Strategic Management Simulation (SMS) test.

Results: No statistically significant difference was seen between the three exposure conditions for any SMS test performance parameter.

Summary/Conclusions: Using the SMS test we were unable to detect any difference in decision-making performance among groups of submariners acutely exposed to low-to-moderate ambient CO_2 levels. However, our inability to replicate Satish, et al. may be due to differences in design (between-subjects vs. within) or study population (i.e., submariners).

Sponsor: Office of Naval Research

D 50

ORAL PRESENTATION TIME: 1418 - 1430
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Harvested species dictates severity of decompression illness among artisanal fishermen divers in the Yucatán Peninsula.

Chin W, Huchim-Lara O, Gonzalez A, Popa D, Nguyen T, Ninokawa S
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Introduction/Background: Fishermen divers in the Yucatán Peninsula of Mexico experience severe decompression illness (DCI) annually. Previously, we reported the Symptom Severity Scale (SSS)[1] that identified predictors of severe DCI among these fishermen divers. In the present study, we wanted to understand whether the harvested species, lobster versus sea cucumber, predicted symptom severity among fishermen divers treated for DCI over two fishing seasons.

Materials and Methods: A retrospective chart review of 272 fishermen divers treated for DCI during the lobster and sea cucumber fishing seasons from 2014 to 2015 was conducted. Fishermen stemmed from 4 fishing villages, and charts were obtained from the Hyperbaric Center in Tizimín, Yucatán. Using the SSS, each symptom present upon admission was scored using a two-point scale (0-1) and assigned an importance factor from 25% to 100%, with 0% indicating absence of symptom and 100% presence of a critical symptom, such as paralysis. Non parametric and parametric tests were used to assess distributions for normality and equality of variance.

Results: A Mann-Whitney *U* test indicated that the SSS score was greater among fishermen treated during the sea cucumber season (Mdn = 3.75) than among those treated during the lobster season (Mdn = 3.25), $z = -3.06$, $p < .0022$. Present DCI symptoms included upper and lower extremity pain (72%), thoracic-abdominal pain (32%), ecchymosis (10%), and inability to walk (13%). Minor symptoms included nausea (17%), vomiting (11%), vertigo (20%), and pruritis.

Summary/Conclusions: Fishing behavior is dictated by the type of species that is being harvested. Lobsters are agile, and fishermen can catch only a handful per dive, conducting a “yo-yo” dive pattern. Meanwhile, sea cucumbers are relatively non-mobile, and fishermen harvest up to 60 kg per dive. The resultant difference in nitrogen load among the two groups of fishermen may account for the difference in SSS scores among those fishermen treated for DCI.

D 51

ORAL PRESENTATION TIME: **MOVED to Saturday: 0936 - 0948**
POSTER PRESENTATION TIME: **MOVED to Saturday: 1100 - 1130**
RESIDENT/TRAINEE COMPETITION: No

Effect of immersion and rehydration timing on exercise endurance.

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E 81

ORAL PRESENTATION TIME: 1430 - 1442
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Mental health: to dive or not to dive?

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Background: Scuba diving requires psychological stability. Medical standards regarding mental fitness to dive exist, but studies are limited. As part of an ongoing study of health in UK sport divers, we aimed to gain insight into the mental well-being of divers.

Methods: An anonymous online survey was publicized through diving exhibitions and social media. Measures included diver and diving demographics, GAD-7 Anxiety and PHQ-9 Depression questionnaires, diagnosed current or past mental health (MH) conditions, medications, other medical conditions/treatments, perceived MH benefits of diving, and transparency concerning MH issues. Free text was also gathered.

Results: Data were provided by 729 divers (females 29% males 71%), age range 16-85 (median 48). Overall, 60/729 respondents had a physician diagnosed MH condition; depression was most commonly reported. Medication was prescribed to 45/60 respondents and of the 51 medications detailed, selective serotonin reuptake inhibitors were most common (35/51). Of those on medication, 21/45 did not declare this on self-certification forms. The majority of respondents taking medications 40/45 did not experience unwanted side effects whilst diving. Separate GAD-7 and PHQ-9 analysis suggested 35/729 respondents had moderate to severe anxiety and 57/729 moderate to severe depression respectively. The majority of those with MH issues (54/60) felt diving improved their condition; only 152/729 respondents were aware of diving and MH guidance.

Conclusion: Reported rates of MH issues in this study were similar to background populations. The majority taking medication for depression did so in accordance with UKDMC guidance. A small number of those diving would fall outside guidelines due to the type or number of medications taken. Further research into the effects of diving on MH and how medications act at depth is needed. Scuba training should include awareness of MH issues to dispel existing stigma, and encourage disclosure.

D 52

ORAL PRESENTATION TIME: 1442 - 1454
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Divers age as a risk factor and prognosis predictor of decompression sickness among artisanal fishermen.

Huchim-Lara O, Chin W, Salas S, Tec J, Baeza L, Popa D
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Introduction. Decompression sickness (DCS) incidence among recreational divers is low (0.019%) compared to the incidence among artisanal divers (8.8%). Diving behavior of artisanal divers has been related to the target species and, in the sea cucumber fishery, hundreds of divers are treated for DCS. The aim of this study was to analyze the association between age and the decompression sickness events treated at a hyperbaric program during the 2015 sea cucumber fishing season in Mexico.

Methods. We conducted a retrospective chart review for all cases treated at a single center multiplace hyperbaric chamber located in Tizimin, Mexico.

Results. A total of 157 hyperbaric oxygen (HBO_2) therapies were rendered to 98 divers from four different fishing villages, mean age was 38.8±9.46 years with a range between 20 and 59. Older divers needed more HBO2 therapies than younger divers (Kruskal-Wallis test: H:8.66; $p<0.05$) and had more DCS events than younger divers (Kruskal-Wallis test:4.16; $p<0.05$). Musculoskeletal pain was the most frequently reported symptom followed by neurological and gastrointestinal symptoms. Two divers suffered permanent hearing loss and spinal cord injury.

Conclusion. Diver's age is an important risk factor to have a DCS event but also as a predictor of prognosis after HBO_2 therapy. There is a need for increased DCS awareness and medical screening for diving skills among artisanal fishermen.

D 53

ORAL PRESENTATION TIME: 1454 - 1506
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Characteristics of neuromuscular fatigue caused by static contraction during a simulated heliox saturation dive to 31 ATA.

Iwakawa T, Ozawa K, Domoto H, Inoue K
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Background: Since sustained muscular contraction causes linear increase in integrated electromyogram (EMG) as well as linear decrease in mean power frequency of EMG, integrated EMG slope (IES) and mean power frequency slope (MPFS) have been used as non-invasive indices of neuromuscular fatigue in many studies. We therefore measured these indices during a simulated 31 ATA heliox saturation to evaluate neuromuscular fatigue under hyperbaric environment.

Method: Six male professional divers (age: 38.0 ± 3.2 yrs.) participated voluntarily in this study. They performed 10 kg and 15 kg sustained static handgrip contraction (SHG), then tried maximal voluntary handgrip contraction (MVC); measurements were done for 30 sec at the pre-dive phase (1 ATA normoxic air: N-condition) and the compression phase (21-26 ATA, heliox with 0.42 ATA oxygen: H-condition). Surface EMG was recorded from belly of flexor digitrum superficials with active bar electrodes and digitized at 1 kHz. IES and MPFS during SHG measurements were normalized the level of MVC at each condition.

Results: IES at H-condition was significantly lower than that of N-condition ($p<0.05$) during 10 kg SHG. In contrast, MPFS at H-condition during 15 kg SHG was tended to be higher than that of N-condition ($p=0.053$).

Discussion: Our results suggest that neuromuscular fatigue develops more slowly during 10 kg handgrip contraction and more rapidly during 15 kg handgrip contraction at H-condition. These differences in neuromuscular fatigue development between hyperbaric heliox and normoxic air may depend on contraction intensity.

D 54

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Immersion pulmonary during saturation diving: a case report and review of the literature.

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Introduction/Background: Immersion pulmonary edema is a relatively rare condition that can occur in divers, swimmers, and breath hold divers. The characteristic symptoms include dyspnea, cough, and frothy sputum. The underlying cause is multifactorial, with the end result of increased pulmonary capillary permeability and disruption of the integrity of the alveolar-capillary interface.

Materials/Methods: We present a case and literature review of an experienced saturation diver stored at 90 fsw with working excursions to the bottom (130 fsw). Following a bell run, he became short of breath and felt he couldn't breathe. He adjusted his equipment, but ultimately had to abort the dive and proceed into the bell. Within the bell, he was distressed and still felt as if he could not get enough air. He was treated on-site, and ultimately evacuated and treated at a hyperbaric chamber facility with follow up with a diving medical specialist.

Results: This diver was examined, evaluated, and diagnosed with probable immersion pulmonary edema.

Summary/Conclusions: The saturation diver lives and works in in an atmosphere of increased pressure. The environment is carefully controlled to maintain the appropriate gas mixture, at the correct pressure and flow rate to mitigate the effects. There is no reported increased occurrence of pulmonary edema in saturation diving. However, the diver is exposed to the same effects of immersion during working excursions from the saturation habitat. Immersion pulmonary edema has been reported in swimmers, SCUBA divers and breath hold divers. The mechanism of injury is described as multi factorial, related to changes in pulmonary vascular resistance and respiratory effects of increased inspiratory resistance.

D 55

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Severe immersion pulmonary edema in a diver requiring endotracheal intubation.

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Introduction: Immersion pulmonary edema (IPE) has been described since 1981. Despite extensive discussion, debate remains as to its exact pathophysiology and predisposing risk factors, which include exertion, cold water, excessive hydration, and pre-existing cardiopulmonary disease. While fatalities have occurred, most patients that survive have been managed successfully with medication and supplemental oxygen administration, or occasionally non-invasive positive pressure ventilation. We describe a case of IPE sufficiently severe to require intubation and mechanical ventilation.

Case Description: A 48-year-old female with diabetes and hypertension, not requiring medications, had 20 uneventful dives over 2 years. She was diving on open circuit air using a drysuit in 57°F water. She had a maximum depth of 75fsw with a total dive time of 22 minutes. At 35 fsw she developed dyspnea, and at 15fsw she was found to have altered mental status and was escorted to the surface. Frothy sputum was noted and rescue breathing was administered. She demonstrated respiratory distress and was intubated by paramedics.

In the emergency department, her chest radiograph revealed severe bilateral pulmonary edema. Arterial blood gas analysis on 100% oxygen while mechanically ventilated demonstrated pH 7.10, PCO_2 62, PO_2 81. Head computed tomography scan and electrocardiogram were normal but she had a lactate of 7.4 and peak troponin 0.31. She was treated with supportive care and diuretics and successfully extubated 6 hours after admission. Her neurologic exam was nonfocal, making arterial gas embolism unlikely. Echocardiogram demonstrated mild diastolic dysfunction. Laboratory values had normalized and she was discharged on hospital day 3.

Discussion: We report a patient with severe IPE to the point of requiring intubation with mechanical ventilation. This appears to be very rare in the published literature. She had no prior history of IPE and had no evidence of stress cardiomyopathy. Cases can range from mild to fatal but this case illustrates that intubation may be required.

D 56

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Secualae after HBO_2 therapy for DCS in three fishermen divers with diabetes and hypertension: how many more might be at risk?

Carrillo-Arceo L[1], Chi-Mendez GC[2], Mendez N[2], Chin W[3], Huchim-Lara O[1]
[1]Universidad Marista de Merida; [2]Cinvestav- IPN Merida, Departamento de Ecología Humana;
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lennyarceo@hotmail.com

Introduction/Background: Diabetes mellitus (DM) has been associated with hypertension (HTN), dyslipidemia, obesity, and polyneuropathic ischemic syndrome. Long term endothelial changes affecting microvascular beds lead to nephropathies, retinopathy, and auditory neuropathy. During the 2015 fishing season three fishermen divers treated for type two DCS were also diagnosed with DM and HTN, none were previously aware of their condition. Based on the findings, we aimed to identify fishermen at risk for diabetes and/or hypertension and thus, at higher risk for developing sequelae after DCS.

Materials and Methods: We conducted a cross sectional study of 105 fishermen divers. Blood pressure Riva Rocci method using a mercury manual sphygmomanometer and pre-prandial glucose was drawn from the fingertip using Bayer Contour 10 TS© Glucometer. Data was analyzed using Stata 12©.

Results: From the 105 participants, mean blood pressure was 118/75[median: 120/75]; 22 fishermen (20.95%) showed high blood pressure. Mean pre-prandial blood glucose was 103.6±31 [Median 105], 20 fishermen (19.0%) had elevated glucose. Six participants had high blood pressure and also hyperglycemia. From the 22 participants with high blood pressure, eight had been diagnosed previously and from the 20 hyperglycemic, six had been previously diagnosed (five with type 1 and one with type 2 diabetes).

Summary/Conclusion: Our preliminary findings indicate that Diabetes and Hypertension might be a prevalent health issue among fishermen divers, further studies are needed to rigorously identify the impact of these chronic illnesses among fishermen divers. There is a need to develop clinical and epidemiological interventions that aim to reduce the risks of developing sequelae among fishermen divers.

D 57

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Pulmonary function among fishermen divers in association with decompression events and years of diving: comparative lung function among commercial fishermen from the Yucatán Peninsula.

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Introduction/Background: Lung function (LF) can be affected by increased partial oxygen pressure (ppO_2) and venous gas microembolism that take place during activities such as diving. Decompression sickness (DCS) is endemic in this region. DCS facilitates inflammatory reactions and gas exchange abnormalities that could potentially impair lung function. We wanted to understand how LF, previous DCS hits, and the year of diving.

Materials and Methods: In this comparative study we evaluated the LF by measuring Peak Flow in millimeters using TruZone© flowmeter of 105 fishermen divers. We measured peak air flow (PF). We compared PF across previous DCS hits. We obtained descriptive statistics and mean comparison T test using Stata 12©.

Results: Fishermen with less than ten years diving had an average PF of 425mm hat tended to decrease over time, for those fishermen with over 30 years diving, the average PF was 320mm.
From the 105 participants, 30 had no records of previous DCS and 72 had at least one previous event. Mean age/height/weight for the non-decompression group was 40.6±11.7mm / 1.61±0.6mm / 82.3±12.7mm, and for the decompression group was 41.9±11.2mm / 1.61±0.1mm/ 82.3±13.2. Mean PF values for fishermen without previous decompression was 420 mm (CI 95% 304-536) and for divers with DCS antecedents 367 mm (CI 95% 254-480). The two group mean comparison T test showed that PF was significantly higher for those divers in the non-decompression group (t=2.16, p<0.05).

Summary/Conclusions: Our preliminary findings indicate that fishermen divers have a decrease in lung function over time as they continue diving as a fishing strategy.

D 58

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Nitrogen narcosis addiction in a recovering alcoholic: a case study.

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Introduction: Nitrogen narcosis is a condition that occurs in divers breathing compressed air. The increased partial pressure of nitrogen causes this effect when divers go below depths of approximately 100 ft. (30m) on compressed air and produces an altered mental state similar to alcohol intoxication.

Materials and Methods: A 51-year-old diver with a past medical history of alcoholism, who reported over 2000 logged recreational dives and multiple "hits" presented with generalized headache, photosensitivity, right-sided paresthesias, vertigo and emesis thirty minutes after reaching boat dock. He had completed multiple (10) repetitive fresh water dives over a 48-hour period. All dives were completed on compressed air with a maximum depth to 180 FFW. All decompression stops were completed with no uncontrolled rapid ascents. The patient was treated initially with a USN TT6 (with 2 extensions) and 2 USN TT5 trailing treatments.

Results: The patient had progressive improvement in his presenting symptoms. Photosensitivity, vertigo, and paresthesias completely resolved. A mild headache persisted and after 3 treatments, no further improvement in overall symptoms was noted. During the course of his treatments he admitted to diving with friends on compressed air to depths of > 100 FFW specifically for the narcotic effects. This is notable in the context of a recovering alcoholic. This put him at great risk and resulted in multiple DCS events including the one for which we treated him.

Summary/Conclusions: We present a case of a recreational diver who experienced secondary gain from provocative diving by purposefully seeking the narcotic effect of nitrogen resulting in development of inner ear decompression sickness. A complete psychosocial history in patients with provocative compressed air dives is warranted to illicit nitrogen narcosis abuse. Intervention assistance should be provided when this problem is identified.

D 59

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Literature review and case report: critical care hyperbaric oxygen treatment of an injured diver with severe neurological decompression sickness.

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Background: The treatment of neurological decompression sickness, at times, requires critical care hyperbaric expertise. We present a case of A 54-year-old healthy, experienced male scuba diver, who developed severe neurological decompression sickness while diving the USS Oriskany artificial reef. We review barriers to transport of care and the pertinent literature.

Material/Methods: The diver's profile included two dives: 144 fsw for :53 followed by a dive to 129 fsw for :53. The diver became unconscious approximately 10 seconds after surfacing from the second dive. The diver received a USN TT6. His GCS improved from 6 to 13, but deteriorated to a 9 following treatment. Approximately 28 hours after injury, the patient was transported via fixed wing critical care transport to a critical care hyperbaric facility. Upon arrival, he received a COMEX 30 on day one, and a USN TT6 on day two. At this time, he was intubated in the MICU and all critical care specialists considered his case grim and end of life discussion were had. His brain MRI showed diffuse cerebral and cerebellar infarcts and he had multisystem organ failure. He was responsive to stimuli on day four, and extubated on day five. He was given tailing treatments until clinical plateau.

Results: The patient was initially given a grim prognosis. However, he was discharged walking, jogging, engaging in extensive ADLs, with only minimal residual deficits of easy fatigability and some loss of fine LUE fine motor skills.

Conclusions: This case highlights the barriers to the critical care treatment of severely injured divers and reviews how severe neurological DCS may be remarkably responsive to aggressive critical care hyperbaric oxygen therapy.

D 60

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Hypertension screening in a commercial diver program.

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Introduction/Background: Hypertension is one of the most common chronic diseases in the world; in the US it affects one third of the adult population. Most cases are primary hypertension – with no identified cause – and significantly increase the risk for cardiovascular disease and stroke. NASA's Neutral Buoyancy Laboratory (NBL) employs a cadre of professional divers to provide support during diving operations centered around the training of astronauts for extravehicular activity (EVA, 'Spacewalks'). The NBL occupational health program requires regular physical exams, including weekly blood pressure checks.

Materials and Methods: Blood pressure and medication data from all personnel certified to dive in the facility in 2015 was collected from the medical records and analyzed. Variables included annual blood pressure in clinic, blood pressure from the work-site physicals, diagnoses of hypertension and pre-hypertension, and medication list.

Results: A total of 90 divers were identified, which consisted of 26 'guest' divers (divers who only dive for a specific project or event) and 64 NBL divers. 11 divers (12.2%) were identified with hypertension, 12 with pre-hypertension (13.3%). Comparisons between work-site and clinic blood pressures showed NBL measurements were in overall agreement with clinic values. Distribution of blood pressures identified 16 divers with consistently elevated blood pressures that were not diagnosed with hypertension and were not taking anti-hypertensives.

Summary/Conclusions: This study demonstrated that blood pressure measurements performed from an occupational health perspective (screening for hypertensive emergencies) was a practical and valid mechanism to identify divers at risk for hypertension. It also demonstrated that jobsite measurements correlate well with the more controlled clinic visit. This practice allows referral for early intervention and management of hypertension while maintaining operational capacity.

D 61

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

HBO_2 therapy in a lobster harvester from the Yucatán coast in Mexico: a case study.

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Introduction: Diving is the economic way to obtain living sustenance for fishermen from the Yucatán coast. High value species like sea cucumber and Caribbean lobster make the activity attractive especially when the labor alternatives are limited, that's could be the reason why fishermen start diving early nevertheless the risk of potential risk of diving accidents.

Methods: A review of a 23-year-old patient medical record was conducted at a hyperbaric facility in the city of Merida, Yucatán. Patient comes from the western coast of the Yucatán coast. After diving at 83fsw for 180 minutes suffered pain in knees, vomiting, vertigo and loss of muscle strength in legs (3/5 in Daniel's Scale). He referred consumption of alcohol and tobacco, and a previous DCS event.

Results: Diagnosis was DCS I and treated with HBO_2 using Table 5 with an extension at 60ft for 20 minutes. After exiting the chamber blood pressure increase slightly (100/60 to 120/80) but pain was relieve. Two days after therapy patient returns to hyperbaric facility because intense pain in knees and left groin. Table 6 was the therapy selected, however, pain remains and Table 5 was needed.

Conclusion: Fishermen at the Yucatán coast start diving at early age hence diving accidents was suffered at early age too. Treatment tables are not relieving DCS symptoms with only one therapy as it happens at other facilities who give therapy to the eastern coast fishermen, remains the possibility that modifications to treatment tables should be considered.

D 62

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Facial nerve paralysis in a diver.

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Introduction: Facial nerve palsy may occur from inflammatory, infectious, ischemic, neoplastic, traumatic, idiopathic, and dysbaric causes. Here we present a case of facial paralysis after diving.

Case Report: A 37-year-old healthy experienced female SCUBA diver completed 26 uneventful dives over 6 days from 25-88 feet of seawater (fsw) for 45 minutes, including safety stops at 15fsw for 3 minutes, all breathing 35% nitrox. She equalized pressures satisfactorily. Thirty-five hours after diving she flew commercial aircraft home and felt normal. The next day she noted mild, transient left-sided facial numbness. The following day she had difficulty closing her right eyelid, elevating her right lips and diminished taste/feeling along the right tongue. She denied viral prodrome. She was evaluated by Emergency Medicine thoroughly, including referral to Neurology, but without diagnosis (including stroke). Investigations showed normal cranial imaging (CT, MRI, MRA). She sought Hyperbaric consult by telephone, where we suspected idiopathic facial nerve paresis (Bell's Palsy). Her PCP agreed, she was treated with steroids and symptoms resolved in five days.

Differential diagnosis:

Condition	Argument for	Argument against	Decision
Bell's Palsy	Predominantly unilateral LMN symptoms. Response to steroids	Left-sided transient facial symptoms	Likely
Decompression illness	Neurologic involvement	Timeline. Only facial N involvement unlikely	Not likely
Facial Nerve Baroparesis	Mimics Bell's, transient Facial N neuropraxia could elicit lingering symptoms	No otic barotrauma during dive or flight	Less likely
Stroke	Acute central nervous signs	7th cranial nerve involvement only	Not likely

Conclusion: This case of Bell's Palsy highlights the importance of considering dysbaric and non-dysbaric diagnoses in SCUBA divers, while understanding disorders that can mimic decompression sickness. We cannot eliminate the possibility of dysbaric irritation to the 7th nerve, but believe the more likely cause was idiopathic.

D 63

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Comparison of the updated (2016) policies and procedures of the Association of Diving Contractors International (ADCI) medical diving standards with those of the International Marine Contractors Association (IMCA).

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Introduction: The ADCI was founded in 1968 to cultivate and promote commercial diving, establish uniform safety standards for commercial divers, and encourage industry-wide observance of these standards. The Physician's Diving Advisory Committee (PDAC) of the ADCI was formed in 2012, and tasked with revising the 2008 medical standards put forth in ADCI's International Consensus Standards for Commercial Diving.

Material and Methods: Changes to Section 2.0, Medical Personnel Diving and Training Requirement, of the 6th Edition to the ADCI's International Consensus Standards for Commercial Diving were summarized and compared to the IMCA standards.

Results: Significant ADCI revisions include that diving medical examinations occur annually and are performed by qualified physicians only. IMCA also has this standard, but require their submission annually, at a minimum. In addition, the ADCI changes regarding return to diving after injuries or illnesses require re-examination if the incident resulted in the need for treatment with prescription medications, surgery and/or hospitalization. The IMCA regulations are more pointed, focusing on cardiac, pulmonary, neurological, and otological disorders, inclusive of neurological DCI or any condition requiring the diver to be off work for more than 14 days. Further ACDI updates include: a list of disqualifying medications, changing chest radiograph requirements from annually to every three years (and from a single view to 2 views), and using the Framingham Cardiac Risk Score as a screen. These requirements are absent from IMCA regulations.

Summary: Important changes to the ADCI's International Consensus Standards for Commercial Diving will have an immediate impact on requirements for those who are required to have these examinations, as well as those who perform them.

D 64

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Alternative PO_2 sensor authentication for electronic closed-circuit rebreathers.

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Electronic closed circuit rebreathing apparatuses for diving, ECCR, have several advantages over conventional Open circuit SCUBA, mainly related to gas consumption and decompression time. Therefore, they are now widely used in the military, in the commercial and in the recreational dive market. However, there are known problems related to the complexity of such systems especially concerning the accuracy of the breathing gas composition over time. Specifically identified as a safety matter are the galvanic oxygen sensors and their failure modes. These are mainly related to non-linearity, current limitation, inaccurate calibration and invalid signal. In the current state of the art, three methods are used to increase the reliability of the oxygen measurement; 1) redundant electronics and sensors, 2) voting logic where disagreeing sensors are voted out and 3) sensor validation where sensor signals are validated with a known gas during the dive either automatically or manually. All these methods increase safety, however the first two methods are commonly criticized in that even redundant sensors share a common history and failures are therefore not independent events. A common objection for the validation method is that it is usually done with a gas with a partial pressure below the set point and thus would not test for non-linearity and current limitation in the high PO2 region.

During the Rebreather Forum 3 consensus, there was a call to improve oxygen measuring technologies as well as a consideration of beneficial emerging strategies. With this new suggested method we can address these demands and present an alternative to the current state of the art technology and challenge systems that have issues with non-linearity, current limitation, inaccurate calibration and invalid signal.

D 65

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME:
RESIDENT/TRAINEE COMPETITION:

A study on heuristic transportation routes of patients with acute dysbarism for the best prognosis.

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WITHDREW

D 66

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Who seeks therapy in Tizimin hyperbaric program: a 17-year review of all the subjects treated in a single hyperbaric program, grasping at incidence of DCI.

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Introduction/Background: Decompression illness (DCI) is endemic in the Yucatán Peninsula. Artisanal fishermen divers use gasoline engines and compressors to pump ambient air into volume tanks as a form of surface supplied diving. We wanted to understand how often the Tizimin Hyperbaric Program was used and for what indication.

Methods: We conducted a retrospective chart review of all the treatment logs that were recorded from January 1998 to October 2015. Data sets were extracted from paper logs into Microsoft Excel spreadsheet. Six parameters were captured that described demographics, date of service, hour of therapy, fishing village, age, and fishing season. Univariate and bivariate analysis of data sets, and parametric and non-parametric techniques were used to describe data.

Results: We captured 4,768 treatments from 612 unique subjects. Most of the subjects treated were from 12 villages. Most were treated on Wednesday and Friday between the hours of 8am and 9am. Most were treated in the months of August to November. Forty-two percent of the treatments rendered were for type I DCI. Sixty-six percent of the subjects were between the ages of 20 and 30.

Discussion: Type I DCI was prevalent among artisanal fishermen divers between the ages of 20 and 30 – peaking especially during the 4-month fishing season between August and November. Incidents derived mostly from 12 out of the 18 villages assessed. We plan to conduct on-site interviews of subjects in the community in an effort to validate incidence of DCI.

D 67

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Understanding dive behavior: bottom time as a function of days of the week.

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Diving activity among fishermen divers: Bottom times as a function of days of week.

Introduction Background: Artisanal fishermen divers in the Yucatán Peninsula dive for sustenance. Fishermen divers use compressed air via a hookah dive system to conduct multiple repetitive dives per day. We used a nested model to predict diver fishermen depths.

Methods: We retrospectively reviewed dive data sets from dives conducted by fishermen divers from 2011-2015. Digital pressure transducers, Reef Net ® ULTRA SENSUS dive recorder, with an accuracy of +/- 1 FSW, were set to capture depth and education of dive every 10 seconds and have an activation depth of 10 FSW. STATA version 14 was used to conduct a chi-square test to assess distribution of bottom time by day of week.

Results: A chi-square test of independence showed a significant difference in the distribution of bottom time among day of the week, X^2 (48, N= 2,702) = 79.87, p <.003.

Discussion: Distribution of bottom time in accordance with days of the week show that Mondays and Wednesdays are times of highest activity among artisanal fishermen divers. This increased activity may correlate with higher incidence of decompression illness (DCI). A decompression intervention could be established for days of the week where fishermen spend longer bottom times.

D 68

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Swimming-induced pulmonary edema in a tropical climate: case report.

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Introduction: Swimming-induced pulmonary edema (SIPE) occurs during strenuous physical exertion in cold water and has been reported in scuba divers, free-diving competitors, combat swimmers, and triathletes. We describe a case of SIPE in a combat swimmer in warm tropical waters.

Case Report: A 21-year-old Naval Diver trainee developed dyspnoea, chest discomfort and hemoptysis after performing a 2km timed sea swim in water temperatures of around 30°C. Over a 2-hour period, his O_2 saturations deteriorated to 90% on room air. He was started on O_2 supplementation and sent to the Emergency Department. Chest X-ray showed hazy air space opacities in the right lower lung and retrocardiac region. He was admitted to the general ward for observation and was given supportive treatment. His symptoms resolved over 2 days and O_2 saturations remained stable. Repeat chest X-ray was normal. After discharge, he was reviewed by the Diving Medical Officer and was certified fit to continue with naval diver training.

Discussion: Much of the literature on SIPE describes the development of symptoms after exposure to temperate waters as one of the main risk factors. This case highlights the risk of development of SIPE in warm tropical waters. With a low reported incidence of SIPE in warm waters, this condition is likely to be under diagnosed. There is therefore a need to increase the local awareness of SIPE in the medical community. A deliberate effort to collate data on SIPE in our local community will also help us to better understand the pathophysiology of SIPE in the context of a tropical climate.

Conclusion: Development of SIPE in tropical waters suggests that other risk factors may be predominant. There should be a high index of suspicion when any strenuous in-water activity is conducted so that timely treatment may be instituted.

D 69

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Self-reported physical activity and perceptions of the importance of structured exercise in certified divers.

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Introduction: It is crucial for divers to maintain fitness levels necessary to cope with unexpected demands, especially among older divers where additional health risks are more likely present. This study examined self-reported physical activity and perceptions of exercise importance among certified divers in two distinct age groups.

Methods: Questionnaires were distributed by hand at dive sites in three states, half to students from an academic program in scuba diving at a regional university. The 18-question survey included questions about health status, dive history, certification levels, structured exercise activity levels (including Godin-Shephard exercise scores) and perceived importance of regular exercise to their health, diving ability, and safety. 188 questionnaires were completed; 32 were ineligible due to being incomplete or not yet certified to dive, leaving 156 completed questionnaires for analysis. Data were imported into SAS 9.4 (Cary, NC) and significance was accepted at $p<0.05$.

Results: Anthropometry, diving experience and health factors are presented in Table 1.

Table 1: Anthropometry, diving experience and health factors by occupational status

	Students (n=73)	Non-Students (n=83)	Overall (n=156)	P-value
Mean age in years (SD)	21 (2)	44 (14)	33 (15)	<0.0001
% Male:Female	78:22	86:14	82:18	0.23
Mean body mass index in kg/m² (SD)	26 (5)	28 (6)	27 (5)	0.006
Open Water Diver only n (%) Beyond open water diver n (%)	33 (45) 40 (55)	11 (13) 71 (87)	44 (28) 111 (72)	<0.0001
Median logged dives n	10	146	30	<0.0001
Mean years certified to dive (SD)	2 (1)	12 (12)	7 (11)	<0.0001
Median dives per year (%)	7	25	11	<0.0001
Current structured exercise program? %	77	69	72	0.26
Health? 1=Excellent, 3= Good, 5=Poor	2.3 (0.8)	2.3 (0.9)	2.3 (0.9)	0.11
How often do you work up a sweat each week? Often n (%) Sometimes n (%)	 39 (53) 23 (32)	 34 (41) 36 (43)	 73 (47) 59 (38)	 0.22

Lastly, three questions examined perceived importance of regular exercise. There was no detectable difference between groups in perceived exercise importance to health ($p=0.69$), diving ability ($p=0.75$), or diving safety ($p=0.25$). Fitting age, sex, occupation and number of dives to a generalized linear model to predict Godin-Shephard scores, number of dives was removed first ($p=0.43$), followed by student status ($p=0.33$). Remaining predictors of Godin-Shephard exercise scores were age (-0.004 per year, $p<0.0001$) and sex (males= + 0.11, 95% CI 0.04, 0.17, $p=0.0012$).

Conclusion: Non-students were older than the students and had greater diving experience. Both groups reported similar structured exercise regularity, overall health and perceived importance of regular exercise for health, diving and safety. Despite acknowledging the importance of exercise, Godin-Shephard scores for physical activity decrease with age. This is similar to findings among non-divers.

D 70

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

ONR's Undersea Medicine Program efforts to mitigate decompression sickness and hyperbaric oxygen toxicity.

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The Office of Naval Research (ONR) Undersea Medicine (UM) program exists because humans were not made to operate under water. To address this, either human physiology has to be enhanced or technology solutions have to be provided. If not, operational limitations are set which can affect mission success. With the goal providing improved undersea capabilities, ONR has funded UM research from the early 1950s until the present day. Throughout, the program has enjoyed close ties to Navy divers, who face occupational safety and industrial hygiene challenges; special warfare operators, who perform high risk missions anytime and anywhere; and submariners, who operate in an unnatural space with diminished sensory input.

Since the 1990s, the program has remained a stable part of ONR's warfighter protection efforts. In 2001, a report by the Undersea and Hyperbaric Medical Society clearly articulated the need for sustained, stable research funding and the maintenance of a trained cadre of undersea medical researchers, arguing that without ONR funding the research capability in the US would decline precipitously. As a result, in 2006 Undersea Medicine was declared a "National Naval Responsibility (NNR)," one of only five within the Navy.

The Undersea Medicine program funds research in diver and submariner health and performance. A special emphasis is placed on understanding the pathology and etiology of decompression sickness and hyperbaric oxygen toxicity. This discussion will review the progression of research in these two areas over the last decade since the designation as an NNR, including highlighting the major findings. The most pressing and fruitful short-term and long-term research questions for each of the conditions will be offered in the context of planning future ONR investments.

D 71

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

ECG abnormalities detected in a commercial diver during eight- and twelve-hour immersions: a case report.

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Introduction: Minor arrhythmias have been reported in recreational divers during scuba dives of less than one hour. It is unknown if these changes persist or change during longer duration dives.

Materials and Methods: In this case report, we collected high resolution, 12-lead Holter ECG data from a commercial diver who performed one, 8-hour and two, 12-hour dives over a four day period. Data collection was incidental to equipment tests being performed by the diver. The diver was an experienced commercial diver (male, 40 years old, 26.5 BMI). All three dives were performed in thermoneutral conditions in a 20-foot dive well while wearing a dry suit and breathing air (scuba).

Results: During the 8-hour dive, the mean heart rate calculated each hour varied from 77-98 bpm. Supraventricular ectopic beats were infrequent in the first two hours (< 10/hr). The supraventricular beats increased in hour three (n=76) and peaked in hours five and six (n=170 and 106 respectively). There were 37 junctional/ventricular ectopic beats primarily occurring in hours 5-7. During the 12-hour dive (day 2), the Holter monitor recorded 853 supraventricular and 112 junctional/ventricular ectopic beats. A similar pattern was noted with supraventricular ectopic beats increasing in frequency before the junctional/ventricular ectopic beats. The second 12-hour dive (day 4) a similar pattern of supraventricular (1491) and junctional/ventricular (186) ectopic beats were recorded, increasing with dive time.

Conclusion: Supraventricular and junctional/ventricular ectopy increased in this commercial diver as a function of dive duration and on consecutive dive days. Additional studies should be conducted to determine both the mechanism and if all divers are at risk for arrhythmias during long duration dives.

D 72

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Dive profiles of sea urchin fishermen divers in California.

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Introduction/Background: California sea urchin divers use surface-supplied air to harvest sea urchins. The sea urchin market has grown with a popular demand for uni, the sea urchin's inner roe, in both domestic and international markets. To our knowledge, this is the first study conducted among these fishermen divers. We wanted to understand the dive behavior among these fishermen divers.

Methods: We prospectively collected dive patterns among five fishermen divers from January to March 2016. ReefNet ® ULTRA SENSUS dive recorders, with an accuracy of +/- 1 FSW, were set to capture dive parameters including bottom time, dive depth, and ascent rate. We utilized a user written subroutine in R Studio to analyze dive data. Univariate and bivariate analysis of data set with STATA 14 was used to describe data sets.

Results: The average number of dives per day per fisherman was 5.

Subject	Mean Depth (FSW)	Max Depth (FSW)	Bottom Time (minutes)	Mean Number of Ascents	Number of Deco Violations
1	50.42	62.51	558.79	5	5
2	35.24	44.44	48.56	3	0
3	43.00	54.42	66.05	2	2
4	37.63	45.52	38.07	2	0
5	39.11	49.63	28.95	2	0

Discussion: The dives captured in this season show that fishermen divers in the region are not violating the U.S. Navy No Decompression limit. Most of the dives were conducted to conservative depths and bottom times. We plan to further this study by gathering a more robust dataset and increasing the number of subjects across multiple regions of the world. Contrasting and comparing dive behavior across multiple groups of fishermen divers will allow us to further understand nitrogen loading by species and region.

D 73

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Difference in age among artisanal fishermen divers treated for decompression illness in the Yucatán Peninsula by fishing season.

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Introduction/Background: Artisanal fishermen divers use compressed air to dive in the Yucatán Peninsula of Mexico. Decompression illness (DCI) is endemic in this population. Since it emerged in 2013, the sea cucumber fishery has been opening annually for a short term. Fishermen's profits depend on the capture species and the length of the fishing season. We wanted to understand the incidence of DCI and the characteristics of fishermen treated for DCI by fishing season, in particular, the lobster and sea cucumber.

Methods: This study was reviewed and approved by the UCLA IRB#13-000532. We retrospectively collected treatment profiles from one hyperbaric center located in Tizimín, Yucatán. The parameters of age, DCI history, treatment table used, subsequent treatment table used, fishing season, and fishing village were assessed using parametric and nonparametric techniques.

Results: There were more treatments rendered during the lobster season (n=114) than during the sea cucumber season (n=107), even though the sea cucumber season spanned less than 2 months versus the lobster season, which covered 8 months. A Mann-Whitney *U* test indicated that age among fishermen treated during the sea cucumber season was greater (Mdn = 42) than during the lobster season (Mdn = 35), z = -5.39, $p<.001$. A chi-square test of independence showed a significant difference in the distribution of fishing villages for the fishermen treated for DCI during the two fishing seasons, X^2 (6, N=222) = 82.16, $p<.001$.

Discussion: The profitability of the sea cucumber fishery is attracting older, novice divers to this region. There were more treatments rendered to out-of-state fishermen during the sea cucumber season as compared to the lobster season. This influx of fishermen divers during the newly established sea cucumber season may strain already limited health resources in the region.

D 74

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Data mining on Divers Alert Network DSL database, Phase 1: Classification of Divers.

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Background: Dive Safety Laboratory project which has been conducted since 1994 by Divers Alert Network has leaded to creation of a database containing medical information of 3108 divers and details about 50151 dives including divers' daily condition, dive profiles, problems/symptoms and Doppler measurements. An in-depth epidemiological analysis focusing on habits and risks of the diving community and investigating additional risk factors correlated with the development of circulating bubbles and decompression sickness were the major aims of the project. This paper reports the results of the first phase of the study, consisting of diver clustering.

Materials and Methods: To eliminate time effect, divers with only one were included in the analysis (120 female and 754 male, aging from 12 to 70). TwoStep, Gower distances and K-means methods were performed to find the naturally associated clusters. Age and dive activity years were distributed in 3 categories. Conventional statistical analyses were performed to understand differences in clusters and between male and female divers.

Results: Divers were separated into 3 clusters and distinguishing variables of these clusters were revealed. The most distinct clusters were formed by TwoStep Clustering. The middle aged male divers with without any health problem are in Cluster 1. Male and female divers with health problems and high rate of cigarette smoking are in the Cluster 2 and older divers with many dive activity years are in the Cluster 3. The significant differences in dive-related variables on the TwoStep Clustering results and separating male and female divers were reported.

Conclusions: Missing and repetitive data and time effect on variables were the major problems. Only 28% of total divers were included in analyses and some important variables were eliminated. Still the discrimination of clusters is highly significant. In the second phase of the study, relationships between diver clusters with dive-related problems, specifically decompression sickness, will be investigated.

D 75

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Association between BMI, waist circumference and DCS events among artisanal fishermen.

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Introduction/Background: Artisanal fishermen divers from the western coast, Yucatán Mexico, use compressed air to dive for subsistence. Decompression Illness (DCI) is endemic to this population. Obesity has been linked as a possible predictor of DCI. Obesity is major health problem in Mexico, 71% adults nationwide are overweight or obese; In the Yucatán peninsula the prevalence is 80%.

Materials and Methods: In order to establish the association between BMI, waist circumference and DCS events we undertook a cross sectional study with 105 divers. After standardization of the research team, anthropometric data was collected using conventional techniques;the number of DCS events was collected from the hyperbaric chamber (HBC) clinic. Data was processed and analyzed using Stata12 software, overweight was defined when BMI=25-29.9 and obesity when BMI ≥30 using Quetelet´s index, while abdominal obesity was defined as ≥90cm

Results: From the 105 participants, mean BMI was31.6 ±5, mean height 1.61 ±0.06; 9.5% (n=10) were healthy weighted, 28.6% (n=30)were overweight and 42.8% (n=45) obese; abdominal obesity was found in 90 individuals (85.7%). The median number of DCS events was 2 (range 0-5) for healthy weighted, 3 for overweight (range 0-11) and 3 for obese fishermen (range 0-17). Depending on the time elapsed since they started diving.

Summary/Conclusions: Overweight and obese fishermen are more prone to DCS events when compared to their healthy weighted peers. DCS events are cumulative and have a temporal time distribution. Overweight and obesity rates are higher among fishermen divers with more DCI events. Overweight and obesity rate are dramatically high among the studied population, meaning that they in higher risk not only for DCS but also many other chronic diseases.

D 76

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

A decompression sickness case provoked by flying after diving.

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Introduction: Decompression sickness (DCS) originates from dissolved gases coming out of solution and forming bubbles inside the body. DCS may occur during the decompression or after surfacing. It may also be provoked by flying after diving. Herein, we present a case of decompression sickness precipitated by flying after diving.

Material and Methods: The record of a decompression case was evaluated retrospectively at the Department of Underwater and Hyperbaric, Istanbul Medical Faculty.

Results: A 41-year-old man who has been working as professional diver for 21 years made a dive to 8 meters with 80 minutes total dive time, in Caspian Sea. He made a flight after 6 hours 50 minutes surface time by a commercial airline. During the flight the patient fainted and cabin crew started administering oxygen by a mask. After the oxygen treatment for a while he became consciousness, but had dizziness, headache, nausea, and difficulty in walking. He was admitted to our department with the diagnosis of DCS and recompression treatment was started about 12 hours after the onset of symptoms. Initial physical examinations revealed paresthesia around his left thigh and shoulder, and difficulty in walking, which were disappeared after the completion of recompression treatment on US Navy Table 6.

Conclusion: It is well known that the risk for DCS is increased if divers fly after a dive, because of the decrease in environmental pressure. Flying after diving may provoke DCS even after a shallow dive which is otherwise accepted as safe for DCS. Therefore there should be surface interval enough before flying which should be determined in accordance with dive profile by using certain manuals. In our case the surface interval determined as 9 hours and 13 minutes according to recommendations issued by US Navy, but the diver’s interval was about 2,5 hours less than this period.

D 77

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

A case of cerebral decompression sickness with spontaneous pneumothorax caused by hidden lung cancer.

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Introduction: A health scuba diver presented with severe cerebral decompression sickness, spontaneous pneumothorax after diving.

Case Presentation: A 46-year-old man, previous healthy experienced diver and diving instructor, was transferred to our emergency department. Immediately after a controlled surfacing from 33 MSW, his mentation changed to stupor after complaint of a shortness of breath, rigid extremities. At other medical center, intubation was done. The brain CT scan showed no abnormal finding. And then he was transferred to our hospital. The chest CT scan revealed pneumothorax in the left side and the obstruction of left upper lobe bronchus with obstructive pneumonia.

Hyperbaric oxygen (HBO_2) therapy was given with U.S. Navy treatment table 6A after closed thoracostomy. Brain MR diffusion image taken after the HBO_2 showed acute infarction in both MCA and PCA territories. After transferring to intensive care unit, we started therapeutic hypothermia to prevent worsening of cerebral function; cooling to 33 ± 1℃ for 24 hours using Arctic Sun®, rewarming by 0.25℃ per hour, and then normothermia (37℃) for 72 hours under the ventilator care with sedatives, muscle relaxants. Finishing the therapeutic hypothermia, we repeated HBO_2 treatments with U.S. Navy treatment table 5 and rehabilitation therapy. He gained normal neurological and physical function.

Searching for the cause of the obstructing lesion seen on the chest CT scan, bronchoscopic biopsy was done. The result was squamous cell carcinoma. Because the cancer stage was far advanced (T4N1M0), adjuvant chemotherapy and radiotherapy were given before thoracic surgery. He is in recovering state with respiratory rehabilitation after left pneumonectomy.

Conclusion: This is the first case of cerebral decompression sickness with spontaneous pneumothorax caused by undiagnosed lung cancer. Therapeutic hypothermia may be helpful to salvage the penumbra in severe

Plenary Session:
"Access to Emergent Hyperbaric Therapy in the United States"
Jim Chimiak, MD and Walter Chin, RN

4:00 PM – 5:30 PM

ABOUT THE LECTURE:

"**Decreasing Emergency Hyperbaric Chamber Availability is a Growing Risk to Diver Health"**
Jim Chimiak, MD

This presentation will detail the alarming decrease in the availability of hyperbaric oxygen treatment (HBOT) for emergency use, especially after normal office hours. With over 70% of hyperbaric indications denied by clinical Hyperbaric Oxygen facilities, our specialty and more importantly our patients are at risk. Factors for this decline are discussed as well as solutions. This discussion will focus on emergent HBOT for decompression sickness and arterial gas embolism.

SATURDAY, JUNE 11

Plenary Session:
"New Pearls of Wisdom in the Diving and Hyperbaric Medicine Literature"
UHM Fellows:
Bradley Hickey, MD (LSU)
Peter Ceponis, MD (Duke/IMC)

8:00 AM – 9:00 AM

ABOUT THE LECTURE:

Title: New Pearls of Wisdom in the Diving Medicine Literature
Presenter: Bradley Hickey, MD, PhD

Dr. Hickey will briefly review four new articles within the diving medicine literature and elucidate key points from those contributions. The following topics will be highlighted: the theoretical mechanisms of action leading to decompression sickness, the theoretical benefit of exercise prior to experiencing decompressions stress, important nutritional considerations for saturation divers, and the many contributions of Professor Alf Brubakk.

Title: New Pearls of Wisdom in the Hyperbaric Medicine Literature
Presenter: Peter Ceponis, MD

Dr. Ceponis will discuss highlights from the recent Hyperbaric Medicine literature. Articles will include a mix of current clinical practice, concepts in hyperbaric physiology and thought-provoking basic science.

SESSION E
HBO_2 THERAPY, CHAMBERS, AND EQUIPMENT

Moderators: James Holm, MD & Janet Bello, ACHRN

SATURDAY, JUNE 11

9:00 AM – 11:30 AM

E 78

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME:
RESIDENT/TRAINEE COMPETITION: Yes

Short- and long-term effects of chronic hyperbaric oxygen therapy on nasal mucociliary clearance.

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WITHDREW

E 79

ORAL PRESENTATION TIME: 0912 - 0924
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Strengths and weaknesses among recompression facilities in the DAN Network.

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Introduction: Divers Alert Network (DAN) deals with recompression facilities all over the world following multiple industry standards and local regulations. In recent years, many facilities ceased to accept divers due to cost, logistical complexity and difficulty maintaining expertise with rare treatments. DAN strives to raise the level of care, enhance overall availability and improve treatment opportunities for divers. The Recompression Chamber Assistance Program (RCAP) is an International DAN initiative created over a decade ago to support underserved recompression chambers. We surveyed facilities known to treat divers to learn about their expertise and the challenges they face.

Methods: A survey was sent to 373 facilities DAN regularly deals with when treating DCI worldwide. Areas of interest ranged from placement, utilization, operational capacity type and level of training and safety issues. The survey was conducted in English.

Results: A total of 155 completed the survey sufficiently to analyze (42% response rate): 70 US, 27 European, and 58 from other regions. Around-the-clock availability was reported by 102/143 (71%); 53% reported service interruptions since they became operational, with two-thirds due to maintenance issues. 24 facilities report no appointed Safety Director; 18 of these facilities are in developing countries.

Discussion: Around-the-clock availability in this sample differs with the general trends in the US, potentially reflecting a bias in chambers voluntarily participating on the DAN network, or the ones responding to the survey. The main weakness on developing countries seems to be technical. Considering this survey was conducted in English, it is possible that facilities on the most vulnerable regions may be underrepresented. Additional work is required to evaluate the status of chambers. DAN is committed to continue to bridge this gap empowering facilities through educational opportunities.

E 80

ORAL PRESENTATION TIME: 0924 - 0936
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Patient preference of monoplace or multiplace hyperbaric chambers.

Koumandakis G[1,2], Churchill S[1,2], Cable R[1,2], Wilson G[1,2], Deru K[1,2], Weaver LK [1,2,3]
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Introduction: Some claim patients prefer multiplace chambers. Because patient satisfaction can influence reimbursement/referrals, we assessed our patients' chamber preference.

Methods: Chambers were assigned per medical/safety considerations, then by clinic schedule and patient preference. At the conclusion of their course of hyperbaric oxygen (HBO_2) (Fink DL8 multiplace or Sechrist 3200/3600 monoplace chambers), patients completed a written survey asking which chamber they preferred. They also were asked to rate confinement anxiety, staff attention, ear equalization, temperature, privacy, entertainment, and scheduling convenience by chamber type on a Likert scale (0=not a problem; 4=a big problem).

Results: Of 171 patients treated 10/2014-2/2016, 46 (27%) completed the survey. Of those not surveyed, 59 (35%) received HBO_2 only briefly (≤3 sessions); 11 (6%) were intubated; 54 (32%) were missed due to other clinical activities. All 46 survey responders received HBO_2 for approved indications (mean sessions 33±18 [±1 standard deviation]). Twenty-nine (63%) were male; mean age was 56±16 years.

Twenty-two (48%) were treated in both chamber types, 8 (17%) in monoplace, and 16 (35%) in multiplace. Four patients requested only monoplace sessions (privacy concerns, hospital location, scheduling convenience), and 7 requested the multiplace (confinement anxiety, hospital location). For patients treated in both chambers, 7 had no chamber preference, 8 preferred monoplace (privacy, temperature, easier equalization, positional comfort, hood intolerance), and 7 preferred the multiplace (entertainment, socialization, space, positional comfort).

On Likert rating, temperature was most often rated ≥2 (multiplace 9; monoplace 7). Six patients reported problems with ear equalization in the multiplace (monoplace 1), and 5 rated privacy a problem in the multiplace (monoplace 2). Chambers were similar for claustrophobia (4), entertainment (3), scheduling convenience (3), and staff attention (0).

Conclusions: Conclusions are limited by low response rate, but in this patient group, while some individuals had strong personal preferences for chamber type, neither was universally preferred.

E 81

ORAL PRESENTATION TIME: **MOVED to Friday: 1430 - 1442**
POSTER PRESENTATION TIME: **MOVED to Friday: 1530 - 1600**
RESIDENT/TRAINEE COMPETITION: No

Mental health: to dive or not to dive?

St Leger Dowse M, Conway RM, Whalley B, Waterman MK, Smerdon GR.
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D 51

ORAL PRESENTATION TIME: 0936 - 0948
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Effect of immersion and rehydration timing on exercise endurance.

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Introduction: Exercise on land is sometimes preceded by water immersion resulting in decreased plasma volume, and compromised cardiac output and exercise endurance. The present study tested the hypothesis that rehydration after (A) head out water immersion (HOWI) prior to an endurance run would preserve endurance more than no-hydration (N) or rehydration during HOWI (D).

Materials and Methods: Five subjects experienced thermoneutral HOWI for 4 hours. 90 min after HOWI, they ran to exhaustion at 70% of $\dot{V}_{O2}$ max with each hydration schedule.

Results: Prior to immersion, there were no differences among conditions. Temperature was unaffected by time or condition (36.9±0.4˚C) during HOWI. HR decreased as a function of time during HOWI similarly in all conditions (-0.03 b/m/m). Urine flow was 0.52±0.10L during the first 60 min of HOWI and remained elevated throughout. Hb decreased 8% during HOWI (p = 0.08) but Hct did not. Mass decreased in all groups (2.71 ± 0.98 kg) during the protocol. Post-HOWI exercise HR was significantly higher at 5 min of exercise in N (8%) when compared to D and A, and continued to increase similarly in all conditions to 170±3 bpm at exhaustion. The time to exhaustion was less with N (45±10 min) than with D (52±8 min) and A (54±13) (0.014).

Conclusion: Not rehydrating from a 4-hr immersion reduces endurance running time while rehydration during and after immersion increased it (20%). Rehydrating after immersion appears to be as good or better as during.

E 82

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION:

Implementing a nurse-driven protocol to manage diabetic patients in hyperbarics.

Stevens SL, Sorita A, Narr AJ, Claus PL, Tescher A, Millman MP, Shields RC, Buchta WG, Haddon R, Murad MH
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Introduction/Background: The Institute of Medicine (IOM) identified making health care both more effective and efficient as two of its six quality aims. The practice of hyperbaric (HBO_2) medicine has long recognized the potential for hypoglycemia in diabetic patients undergoing HBO_2 therapy; however, there is no standard approach to identify which patient should be monitored during HBO_2 therapy and how to provide such monitoring. Benchmarking identified a quality gap and inconsistent practices. A review of the literature offered no evidence-based approach for monitoring.

The goal for this project was twofold: 1) Reduce the frequency of blood glucose checks per treatment session while maintaining patient safety 2) Develop a nurse-driven protocol to standardize glucose checks for patients undergoing HBO_2 therapy.

Materials/Methods: Historical data were analyzed to identify the safest pre-treatment glucose cutoff. Following the Model for Improvement, a nurse-driven protocol was developed and implemented and tested prospectively. Three Plan-Do-Study-Act cycles over a four month period were done with multiple iterations and testing changes. The primary measure was the number of glucose checks per treatment session; the counterbalance measure was the incidence of hypoglycemic events (blood glucose < 70 mg/dl). Compliance to the protocol was the secondary measure.

Results: Compared to the pre-protocol baseline (N=332), glucose checks per session guided by the protocol decreased by 37.7% (2.84 vs. 1.77 per session, p<0.001). Compliance to the protocol improved from 84.2% to 97.3% (p<0.001). There were no cases of a symptomatic hypoglycemic event after the implementation of the protocol.

Summary/Conclusions: The *Hyperbaric Glycemic Monitoring Protocol* successfully improved the management of diabetic patients in the HBO_2 unit; while also maintaining quality and safety through rigorous application of quality improvement methodology. Formulating a nurse-driven protocol in practice is a safe and effective method of moving from current practice to best practice.

E 83

ORAL PRESENTATION TIME: 1012 - 1024
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

An assessment of the performance of the Baxter Elastomeric Large Volume (LV 10) Infusor Pump under hyperbaric conditions.

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Introduction: The effect of increased pressure on the flow rate of elastomeric infusion pumps in a clinical hyperbaric chamber is currently unknown.

Aim: This study evaluated the flow rate of the Baxter LV10 infusion pump under three hyperbaric dive depths of 101 kPa, 140 kPa, 180 kPa, and normobaric conditions.

Methods: Elastomeric pumps were secured to participants in the same manner as a typical patient with a container collecting the delivered antibiotic solution. Pumps and tubing were weighed before and after the test period. Flow rate was determined at three different commonly used hyperbaric treatment pressures and two different time periods. The nominal flow rate of the Baxter LV 10 infusion pump is 10 ml/hr.

Results: The mean flow rates in ml/hr (SD) were: 10.4 (0.5), 10.7 (0.4), 10.5 (0.5), 9.5 (0.4) from 0-2 hours and 12.2 (0.6), 9.4 (0.5), 10.4 (1.0), 10.5 (1.2) at 19-21 hours for the 101 kPa, 140 kPa, 180 kPa and normobaric conditions groups respectively. Two-factor analysis of variance revealed a statistically significant difference in flow rate among the four pressures ($F=3.96$, $p=0.016$), but not between the two time periods ($F=1.36$, $p=0.252$). A one-way analysis of variance measuring the effect of only pressure, not time period, confirmed a statistically significant difference in the flow rates at the four pressure settings ($F=3.93$, $p=0.016$). A post-hoc trial repeating the 101 kPa 19-21 hours pumps with a different antibiotic resulted in a flow rate of 10.4 (0.8). Analysis of variance incorporating those data found no significant associations between flow rate and pressure ($F=0.18$, $p=0.671$) or time period ($F=0.061$, $p=0.611$).

Conclusion: The flow rate of the Baxter LV10 elastomeric infusion device was not significantly affected by increases in ambient pressure however there appears to be a change in flow rate when the device is filled with different antibiotics. Baxter LV 10 elastomeric infusion pumps can safely be used in a hyperbaric chamber. Further research should be performed to investigate the effect drug choice and dose/concentration may have on flow rate.

E 84

ORAL PRESENTATION TIME: 1024 - 1036
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Allocation concealment in a blinded, randomized trial of hyperbaric oxygen for post-concussive symptoms.

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Introduction: In randomized clinical trials, allocation concealment, or blinding, can minimize bias. We report concealment results in a randomized, double-blind clinical trial of hyperbaric oxygen (HBO_2) for persistent post-concussive symptoms (HOPPS).

Methods: HOPPS randomized 72 military service members at 4 sites to 13 weeks of local care (LC) or forty 60-minute sessions of HBO_2 (1.5 ATA, oxygen) or sham (1.2 ATA, air) chamber sessions. Participants receiving chamber sessions were blind to pressure and breathing gas. Following study participation, these participants were given a 2-question written survey asking whether they thought they received the 40 HBO_2 sessions and why.

Results: Of 49 participants randomized to chamber interventions (HBO_2 n=24, sham n=25), 35 returned the survey (HBO_2 n=18 (75%), sham n=16 (64%)). In the HBO_2 group, 10 (56%) thought they received HBO_2 and 8 (44%) sham, while in the sham group, 8 (50%) thought they had received HBO_2 and 8 (50%) sham. One participant circled both interventions. The blind was protected (p=1.00).

Of 12 participants who gave reason for believing they received HBO_2, 10 (5 in each group) cited symptom improvement, while 6 (3 in each group) believed they received sham due to lack of symptom improvement. Five participants who believed they received sham (3 HBO_2, 2 sham) listed taste, smell, gas flow, and lack of neurological symptoms inside the chamber. One HBO_2 participant believed he received HBO_2 based on colder than expected gas temperature in the hood. No participant reported that they based their conclusions on interactions with chamber or study personnel.

Conclusions: Sham pressurization effectively protected the blind in this randomized trial. Participants based their assumptions about allocation on outcome and could not discern intervention arm based on pressure, smell, taste, or gas flow.

E 85

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Altmetric scores and cited times of publications in *Undersea and Hyperbaric Medicine.*

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Background: Almetrics measured metrics of article sharing in social media including Twitter, Facebook, blogs, Wikipedia, etc. The correlation between Almetric scores and cited times of publications in *Undersea and Hyperbaric Medicine* (UHM) had not been studied.

Materials and Methods: All of the publications in UHM between 2006 and 2015were collected from SciVerse Scopus database and Almetric scores were obtained from Almetric.com. A computerized literature search was conducted and data on publications including publication year, document type, cited times, and Almetric scores were recorded. The distribution of cited times and Almetric scores were analyzed by descriptive statistics. The correlation between cited times and Almetric scores were analyzed by Spearman's correlation analysis.

Results: A total of 579 publications were enrolled. The overall cited times and Almetric scores were 1871 and 274. Fifty-seven percent of publications had been cited and 18% had Almetric scores. The highest, median, mode, mean± SD of cited times and Almetric scores were 60, 1, 0, 3.231±6.037, and 21, 0, 0, 0.473±1.667. The 10 publications with highest cited times were all published before 2009. Six of the 10 publications with highest Almetric scores were published after 2013. Three (4.6%) of the publications in 2015 had been cited and 12 (18.5%) had Almetric scores. The total cited times of publication between 2013 and 2015 accounted for 9.2% of total cited times and the number was 40.5% for Almetric scores. The correlations between cited times and Altmetric score was weakly positive ($r_s = 0.22$, $p < 0.001$).

Conclusions: Almetric scores measured different aspect of influence of publications in UHM and recognized the influence of recent publications earlier than cited times. The share numbers on social media were less than cited times. The editorial boards should take actions to enhance knowledge transfer and spread via social media.

E 86

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: WITHDREW
RESIDENT/TRAINEE COMPETITION: Yes

Unexpected decompression sickness in a hyperbaric inside attendant.

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WITHDREW

E 87

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Stroke due to hyperbaric oxygen-induced seizure.

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Oxygen toxicity seizures are a well-known complication of hyperbaric oxygen (HBO_2) therapy. Until now there have not been any reported cases of acute stroke as the result of an HBO_2 induced oxygen toxicity seizure. Herein we report such an event, raising the question regarding risk for HBO_2 therapy in patients at risk for cerebrovascular accident.

An 80-year-old male with a past medical history of cerebrovascular accident and peripheral vascular disease was undergoing HBO_2 for an arterial insufficiency ulcer. On ascent from his second hyperbaric treatment (2.4 ATA with air breaks) he developed expressive aphasia, left paresis and rhythmic lip smacking movements. He then had a tonic-clonic seizure lasting 90 seconds.

The patient's head CT was negative for acute issues. He returned to his baseline function and mental status and was admitted to the hospital for further work-up of this incident. MRI which showed acute to sub-acute infarcts of his right putamen and right frontoparietal cortex. It was believed that he suffered a seizure as a result of CNS oxygen toxicity, a known complication of HBO_2 therapy. This seizure was thought to have provoked his stroke. The location of the stroke would not have produced the symptoms with which the patient presented. It was felt that demand ischemia from the oxygen induced seizure in the setting of vascular insufficiency caused his stroke. Further HBO_2 therapy was deemed to be more risk than benefit to the patient and his treatment was discontinued.

Patients being treated with HBO_2 for diabetic foot wounds and other arterial insufficiencies often have co-morbidities which may put them at increased risk for complications during therapy. The potential for stroke or other brain damage secondary to stroke should be taken into consideration when choosing a treatment protocol and discussed with the patient as part of informed consent.

E 89

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Rapid deterioration of visual acuity with hyperbaric oxygen treatment for failing flap after radiation for *Mycosis fungoides.*

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Introduction and Background: It is well known that hyperbaric oxygen (HBO_2) treatment may lead to deterioration in visual acuity (DVA) after many treatments. A case is described in which a patient rapidly developed DVA requiring cessation of HBO_2.

Materials and Methods: A 48-year-old male received radiation to his left palm for Stage 1A mycoses fungoides resulting in severe contracture between the thumb and index finger. A reverse radial forearm flap was performed by the plastic surgeon and subsequently a flap hematoma required evacuation. The patient was referred for urgent HBO_2 for developing flap failure. Right eye DVA was noticed by the patient after only 4-5 monoplace treatments at 45 fsw, sufficient to cause difficulty reading road signs. Some discomfort and a halo effect was noticed around lights with his better, right eye. He had to rely upon his previously worse left eye that had undergone strabismus repair when younger. Urgent ophthalmology consultation found normal pressures and retina and no signs of cataract or acute glaucoma.

Results: The compromised flap rapidly improved and for this reason, and the marked DVA, HBO_2 was discontinued after 9 treatments. When last seen the patient remained near-sighted in his previously better right eye.

Summary/Conclusions: Marked DVA may occur within 4-5 HBO_2 treatments and affect one eye more than the other. Some reports suggest DVA may be more frequent with monoplace hyperbaric chambers compressed on oxygen or with multiplace head tent compared to use of a BIBS mask in a multiplace chamber. Direct exposure of the eye to hyperoxia is a possible etiology. This is the first case to be described where visual acuity deteriorated within 5 hyperbaric treatments. When rapid DVA occurs alternate diagnoses should be considered and HBO_2 in a multiplace chamber using a BIBS mask may be preferred if treatment is essential.

E 90

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Prospective study of mucosal atomizer device use on myringotomy patency.

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Introduction/Background: Otic barotrauma from Eustachian tube dysfunction is the most common complication related to hyperbaric treatments. Tympanostomy tubes have long been placed in patients who are unable to equalize the middle ear while undergoing hyperbaric treatments. This requires evaluation by an otolaryngologist, which can delay hyperbaric treatments. Myringotomies performed by the HBO_2 provider are an alternative option. A concern with this procedure is premature myringotomy site closure requiring repeat myringotomies or tympanostomy tube placement resulting in further patient discomfort and possible complications. A possible solution is to use a mucosal atomizer device to gently infuse the myringotomy site with air to maintain patency, which has become standard of care at HCMC. However, the effectiveness of this method to maintain myringotomy patency has not previously been studied

Materials and Methods: Patients who are undergoing bilateral myringotomies will be randomly assigned to use a mucosal atomizer device in a randomly assigned ear. This will allow for a self-control scenario with the contralateral ear acting as the control. Randomization will occur using a random number generator with continuous enrollment. Patients will use a mucosal atomizer device prior to each hyperbaric oxygen treatment. Patients will be evaluated routinely for myringotomy patency with planned examination 15, 30, 45, 60 and 90 days after the myringotomies were performed to evaluate patency.

Results: Study Parameters to be Measured:
- Primary outcome: Myringotomy patency
- Need to repeat myringotomy
- The number of hyperbaric treatments in which the patient has ear pain or requires any stops during compression.
- Any demonstrable otic barotrauma on exam (with TEED score).

E 91

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Knowledge, attitude and practice of hyperbaric O_2 therapy in the treatment of chronic non-healing wounds among physicians in the Saudi Armed Forces Hospitals.

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Background: Hyperbaric oxygen (HBO_2) therapy is used as an adjunctive treatment for chronic non-healing wounds especially wounds of the diabetic foot. However, very little is known about the factors that influenced Physicians use of this mode of therapy in their practice.

Objectives: 1st: To assess physicians knowledge, attitude and practice of HBO_2 therapy in the treatment of chronic non-healing wounds among physicians, whose practice included wound care in the Saudi Armed Forces Hospitals during the year 2008.

2nd: To identify the factors associated with their knowledge, attitude and practice of HBO_2 therapy.

Materials and Methods: 110 physicians participated in a Cross-sectional study with an analytical component. Data collection tool was a 21-item questionnaire, which was pre-designed and validated.

Results: The practice of HBO_2 therapy was adopted by only a minority (7.3%; 95% C. I. = 3.7 – 13.7) of physicians. This was despite that the majority of physicians had a high knowledge (76%; 95% C.I= 76.4–83.5) and agreed (61.9%; 95% C.I.=52.4–70.6) with the use of HBO_2 therapy.

Physician knowledge was significantly associated with the dependence on various sources of information to stay informed about the evidence of wound care treatment. Physicians Attitude was significantly associated with knowledge of physicians ($P < 0.05$). Physician practice of HBO_2 therapy was significantly associated with Patients voluntary request of HBO_2 therapy ($P = 0.006$), Symposia as a source of information to stay informed about the evidence of wound care treatments ($P = 0.007$).

Conclusions: The low level of Physicians Practice, in contrast to their high Knowledge of and Attitude towards, HBO_2 therapy in the treatment of chronic non-healing wounds was mainly due to the inaccessibility of the therapy despite the availability of HBO_2 chambers in the various armed forces hospitals.

Recommendation: It is suggested that Policy procedures and protocols for use of (or referral for) HBO_2 therapy to be implemented. Also educating both patients and physicians and focusing on cost-effectiveness most probably will encourage future use of HBO_2 therapy.

E 92

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Hyperbaric oxygen (HBO_2) treatment schedule changes to reduce effects on visual acuity.

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Introduction and Background: HBO_2 may lead to deterioration in visual acuity (DVA) after multiple treatments. A case is described in which DVA necessitated changes to HBO_2 therapy scheduling.

Materials and Methods: A 60-year-old male courier driver required HBO_2 for hemorrhagic proctitis and non-healing painful anal fissure following 39 radiation treatments for prostate cancer. Medical history included polycystic kidneys, successful cardiac ablation for WPW syndrome and a parathyroid adenoma that was surgically removed during the course of HBO_2. Medications included iron, candesartan for renal protection and omeprazole. Marked DVA was noticed after 33 monoplace treatments at 45 fsw. HBO_2 was stopped as difficulty reading road signs interfered with his work.

Results: Ophthalmologist consultation excluded acute glaucoma, cataract and retinal disease and attributed DVA to HBO_2 therapy. The patient was reassessed periodically at the hyperbaric unit. DVA recovered sufficiently after 3 weeks and HBO_2 resumed. However, marked DVA recurred after 11 further treatments and HBO_2 was interrupted after 46 HBO_2 treatments. After 4 weeks vision was improved but not as quickly as previously. HBO_2 was restarted after 8 weeks due to recurrence of bleeding when the DVA had largely resolved. Subsequent measures adopted to reduce visual effects included alternate day, alternate week and longer HBO_2 interruptions. HBO_2 at lower pressures was considered but not implemented and the multiplace chamber was out of service. The patient received a total of 58 HBO_2 sessions with cessation of bleeding and resolution other symptoms.

Summary/Conclusions: Reports suggest visual acuity changes may be more frequent with monoplace hyperbaric chambers compressed on oxygen or with head tent use in multiplace chambers compared to multiplace chambers using a BIBS mask. Direct exposure of the eye to hyperoxia is a possible etiology. When marked DVA occurs, alternate diagnoses and ophthalmology consultation should be considered. HBO_2 in a multiplace chamber using a BIBS mask may be preferred.

E 93

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Go / No-Go Survey: finding common ground and developing a reference guide.

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Introduction/Background: The purpose of the survey was to collect data on practice patterns for items allowed inside hyperbaric chambers. We also want to develop a reference guide from this data that could be used as a resource for hyperbaric facilities

Materials and Methods: *Part One* consisted of a short survey that was sent to Class A, Class B pressurized with 100 percent Oxygen, and Class B pressurized with 21 percent Oxygen. Respondents were asked which items were typically allowed at their facilities as well as questionable items considered by the author. The surveys were sent to roughly 120 facilities including all facilities in the Undersea and Hyperbaric Medical Society directory.

Part Two asked participants to send a copy of their current Approved/Not Approved list of items to help provide a resource for other hyperbaric facilities.

Results: *Part One*: 33 facilities responded (12 for class A, 21 for Class B with 100% oxygen, zero for class B with 21% oxygen) with varying results.

Part Two: Six facilities responded with a copy of their current Approved/Not approved list as a resource for other facilities.

Summary/Conclusion: *Part One:* While most facilities had similar results, some made exceptions when presented with extraneous situations. There are different interpretations of items considered safe or hazardous inside hyperbaric chambers. However, with this data our field could strive for consistency.

Part Two: Only a small sample of facilities responded back with their current Approved/Not approved list for Items Inside of the Hyperbaric Chamber. Further research is needed for a more complete comprehensive list.

E 94

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

Blood glucose fluctuation in a non-diabetic patient during hyperbaric oxygenation.

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Introduction: Hyperbaric oxygen (HBO_2) therapy is associated with decreased blood glucose (BG) measurements in diabetic patients. The effect of HBO_2 on BG measurements in non-diabetic patients has not been well documented. We present a non-diabetic patient with baseline relative hypoglycemia, who experienced fluctuations in BG during HBO_2.

Case Report: A 57-year-old non-diabetic male with a history of a recent gastrectomy, presented to a hospital in septic shock and was found to have a mottled right foot with decreased pedal pulses. Compartment syndrome was diagnosed, and he underwent an emergent four-compartment fasciotomy, followed by serial debridements and adjunctive HBO_2 treatments. Due to the patient's reported poor oral intake and the presence of baseline relative hypoglycemia (average BG 70s-80s mg/dL), pre and post HBO_2 BGs were ordered. A pre-HBO_2 BG threshold of 100 mg/dL was established. The patient's BG decreased by an average of 22 mg/dL (range 9-29 mg/dL) during HBO_2 treatment. No symptomatic hypoglycemic events were observed. The patient received 8 HBO_2 treatments before he was discharged to a rehabilitation facility.

Discussion: Diabetic patients undergoing HBO_2 have been reported to experience decreases in BG of up to 60 mg/dL. The mechanism of action of this is unclear, but may relate to increased systemic glucose utilization under hyperbaric conditions. The patient described above reported a disdain for hospital food and admitted to having poor oral intake. In addition, he likely experienced changes in satiety and nutrient absorption related to his recent gastrectomy, which may also have predisposed him to having a relative baseline hypoglycemia as well as fluctuations in BG measurements.

Conclusion: Non-diabetic patients, especially those who are inpatients and/or who have altered dietary intake patterns, may be at increased risk for HBO_2-induced hypoglycemia. Further research is needed to determine which non-diabetic patient populations may require BG monitoring during HBO_2.

E 95

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1100 - 1130
RESIDENT/TRAINEE COMPETITION: No

A systematic quality improvement program for improving patient care and satisfaction.

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Introduction/Background: Quality improvement involves continuously measuring, assessing and initiating changes to improve outcomes. Continuous quality improvement is essential for sustaining a high quality hyperbaric program. The following describes specific measurements taken at a high volume multi-place hyperbaric center.

Materials/Methods: The Division of Hyperbaric Medicine at Hennepin County Medical Center is a high volume multiplace hyperbaric chamber with around 4500 hyperbaric treatments a year that is also open at all times for emergency treatments. A systematic program was developed for collecting and documenting data for quality improvement. Measurements that are tracked include unexpected events, which are recorded daily, outcomes for all patients, and patient satisfaction scores, which are collected by survey. In additional certain parameters on our emergency patients are tracked including time to treatment for all of the patents with carbon monoxide poisoning, decompression sickness, central retinal artery occlusion, or arterial gas embolism. All information is then compiled and reviewed quarterly.

Results: Having a systematic quality improvement program in place has resulted in improvements to the care of patients. Changes have been made to improve time to hyperbaric treatment, decrease unexpected events, and improve patient satisfaction.

Summary/Conclusions: A comprehensive quality improvement program to monitor different hyperbaric processes and outcomes is essential to continually improve and provide safe quality care to our patients.

Plenary Session
"Guidelines for Prehospital Management of Diving Injuries"
Simon Mitchell, MD

11:00 AM – 12:30 PM

ABOUT THE LECTURE:

SESSION F
CLINICAL AND DIVING-RELATED HBO_2 THERAPY

Moderators: Mike Bennett, MD & Connie Hutson, RN

SATURDAY, JUNE 11

1:30 PM – 4:00 PM

F 96

ORAL PRESENTATION TIME: 1330 - 1342
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Misdiagnosed cases as neurologic decompression illness: the importance of neurologic examination in diving medicine.

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Introduction: The protean features of decompression illness (DCI) make diagnosis difficult in some cases. The main reason is no standard criteria in diagnosis of DCI, made on the basis of physicians' experience including diving profiles and clinical conditions of divers. We report three cases of patients who were misdiagnosed as neurologic DCI from their conditions and were transported for the treatment of recompression therapy. In the field of diving medicine, emergency physicians should examine neurologic findings of divers in diagnosis of DCI.

Cases: An experienced 45-year-old female diver suffered conscious disturbance after 20 meters of SCUBA diving and she was transferred to our division as cerebral arterial gas embolism (AGE). However, her clinical diagnosis at our division was subarachnoid hemorrhage and was confirmed by computed tomography (CT) scan. Second case was a 49-year-old fisherman who complained right hemiparesis and partial motor aphasia during third SCUBA diving in a day, was transported as cerebral AGE to our institute. His clinical diagnosis was cerebral stroke on the basis of his neurologic findings, and CT scan showed cerebral hemorrhage. Third case was a 54-year-old fisherman who complained sensory numbness in upper and lower extremities and urinary incontinence after half an hour of 20-25 meters SCUBA diving, was transferred as spinal cord DCI. His neurological examination suggested another spinal event, and magnetic resonance imaging (MRI) showed acute spinal epidural hematoma.

Discussion: These patients were typical cases that their neurologic symptoms and signs were misdiagnosed as DCI, while neurologic events are much more frequent causes of spinal and cerebrovascular lesions. The misdiagnosis of DCI has been an issue in diving medicine because of a variety of their clinical and neurologic symptoms. Emergency physicians should examine neurologic events based on DCI or other disorders.

F 97

ORAL PRESENTATION TIME: 1342 - 1354
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Efficacy of hyperbaric oxygen therapy in ischemic stroke early rehabilitation and evaluation of health economics.

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Objective: Compare hyperbaric oxygen (HBO_2) therapy with conventional therapy in the efficacy and health economics of early rehabilitation from ischemic stroke.

Methods: This study included 60 patients who suffered acute ischemic stroke within 7 days prior to HBO_2 therapy. We used randomized system to divide patients into control group (30 patients received conventional treatment), and HBO_2 group (30 patients received conventional treatment, and HBO_2 for more than 10 times during the first month). General data were compared between the two groups. One, three, six and twelve months after the onset of ischemic stroke, patients were assessed with NIHSS, BI, mRS and a comparison was made between the two groups. Health economics evaluation included calculation of cost-effectiveness and the incremental cost-effectiveness ratios. Reoccurrence and disability rate were recorded and compared between the two groups using chi-squared test.

Results: The two groups made a significant improvement of the patient's condition evaluated by the scores of NIHSS, BI and mRS, and showed reduced reoccurrence and disability rate. The expenditure in the HBO_2 group was lower than that in the control group, while NIHSS being 1-point decrease, BI being 5-point increase, and mRS being 1-point decrease.

Conclusions: Conventional treatment and HBO_2 for patients with acute ischemic stroke could significantly improve neural function. The addition of HBO_2 to conventional therapy in the early stage of acute ischemic stroke reduced the medical expenses while reaching the same effect.

F 98

ORAL PRESENTATION TIME: 1354 - 1406
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Indocyanin green angiography results pre- and post-hyperbaric oxygen exposure.

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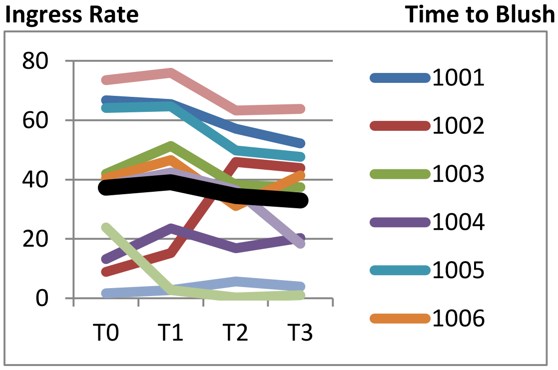
Introduction: Indocyanin green angiography (ICGA) is being adopted by wound care and hyperbaric centers for the evaluation of microvascular perfusion of wounds and extremities, but there are still unknown confounders to obtaining consistent and reliable results. Hyperbaric oxygen (HBO_2) exposure is known to cause vasoconstriction, so ICGA theoretically would show falsely lower measurements if testing takes place after HBO_2 treatments. We undertook this systematic analysis of the effects of a single HBO_2 exposure on ICGA metrics in order to determine whether ICGA testing should take place before or after HBO_2 exposure.
Methods: Patients currently receiving a course of HBO_2 were enrolled in this IRB-approved pilot study. Treatments were at a pressure of 2.4 ATA and were for 90-minutes with two 5-minute air breaks. A patient could be enrolled multiple times provided that there was a 2-week interval between enrollments. Each subject was imaged at four time intervals on the study date: T_0 was a baseline measurement, T_1 was 30 minutes after T_0 and prior to undergoing HBO_2 exposure, T_2 was within 5 minutes of completing the HBO_2 exposure, and T_3 was 30 minutes after T_2. Vital signs were obtained with each ICGA study. ICG was injected over a 1-2 second fast IV push. Recording was initiated upon ICG injection and lasted for 2.5 minutes.
Results: Six patients were enrolled in the study. Four patients were enrolled twice according to the protocol. Four of the 6 patients were diabetic. The ICGA metrics most closely associated with perfusion are the ingress rate and time-to-blush. Unpaired *t*-test was used to analyze Baseline (T_0), Pre-HBO_2 (T_1) and Post-HBO_2 (T_2) measurements. Although the only statistically significant change was in mean arterial pressure Pre- vs. Post-HBO_2, we did see a clear trend in variability between time intervals.

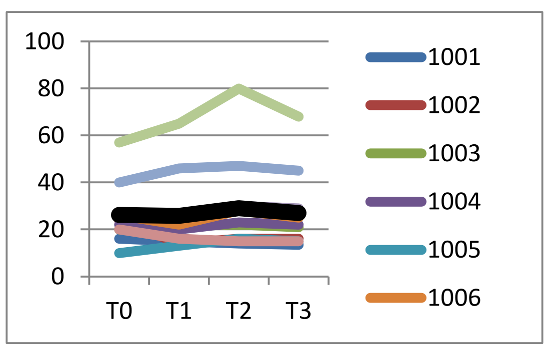
ICGA measurements

Metric	Baseline (T_0)	Pre-HBO_2 (T_1)	Post-HBO_2 (T_2)	T_0 vs. T_1 p-value	T_1 vs. T_2 p-value	Vasoconstriction suggested by…
Ingress Rate	27.27	39.06	34.47	0.88	0.68	Lower number
Time to Blush	26.2	25.8	29.1	0.95	0.70	Higher number

Ingress Rate



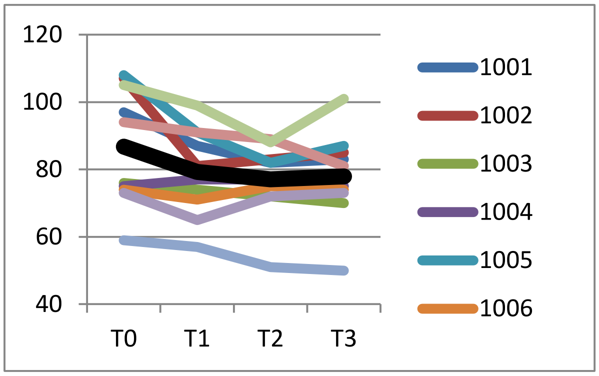
Time to Blush



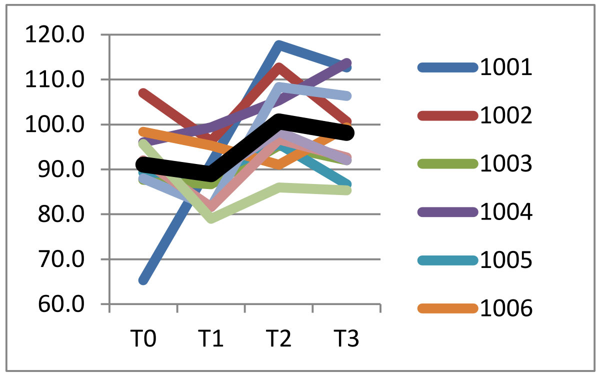
Physiological measurements

Metric	Baseline (T_0)	Pre-HBO_2 (T_1)	Post-HBO_2 (T_2)	T_0 vs. T_1 p-value	T_1 vs. T_2 p-value
Heart rate	87	79	77	0.29	0.69
Mean arterial pressure	91.1	88.9	100.7	0.59	*0.006*

Heart rate



Mean arterial pressure



Discussion: There are still many unknown confounders that affect the interpretation of ICGA, and clinicians need to exercise caution in interpreting the results. While we did not show any statistically significant change in the Ingress Rate or Time To Blush, Mean Arterial Pressure increases significantly following HBO_2. This mechanism is consistent with reduced perfusion to the extremity, which is suggested by the data. Some of our results may have been affected by variability in our testing protocols. Further research using larger sample sizes and more stringent testing protocols are necessary to confirm this effect. In the meantime, we suggest that evaluation with ICGA in relation to HBO_2 exposure should be standardized to pre-HBO_2 testing to avoid the possibility that HBO_2 can falsely lower ICGA results.

F 101

ORAL PRESENTATION TIME: 1406 - 1418
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Vascular studies do not correlate with indocyanin green angiography results pre- and post-hyperbaric oxygen exposure.

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Introduction: Indocyanin Green Angiography (ICGA) is being adopted by wound care and hyperbaric centers for the evaluation of microvascular perfusion of wounds and extremities, but there are still unknown confounders to obtaining consistent and reliable results. Previous research suggests that hyperbaric oxygen (HBO_2) exposure may have a vasoconstrictive effect on ICGA testing, but that data did not reach statistical significance. It is unclear whether peripheral arterial disease (PAD) status may have had an impact on whether ICGA was influenced by HBO_2 exposure.

Methods: Patients currently receiving a course of HBO_2 were enrolled in this IRB-approved pilot study. Treatments were at a pressure of 2.4 ATA and were for 90-minutes with two 5-minute air breaks. A patient could be enrolled multiple times provided that there was a 2-week interval between enrollments. Each subject was imaged at four time intervals on the study date: T_0 was a baseline measurement, T_1 was 30 minutes after T_0 and prior to undergoing HBO_2 exposure, T_2 was within 5 minutes of completing the HBO_2 exposure, and T_3 was 30 minutes after T_2. ICG was injected over a 1-2 second fast IV push. Recording was initiated upon ICG injection and lasted for 2.5 minutes. Transcutaneous Oxygen Measurement (TCOM), Skin Perfusion Pressure (SPP), and Ankle-Brachial Index (ABI) were recorded at least once for each patient. Two patients had multiple measurements. PAD was defined as TCOM < 40 mmHg, SPP < 30 mmHg, or ABI < 0.8.

Results: Six patients were enrolled in the study. Four patients were enrolled twice according to the protocol and are identified below. The ICGA metrics most closely associated with perfusion are the ingress rate and time-to-blush. Ingress rate decreased in 8 of the 10 studies and Time-to-Blush increased in 7 studies, both suggesting vasoconstriction.

Subject	HBO_2 Tx #	Diabetic	Ingress Rate T_2 / T_1		Time to Blush T_2 / T_1		TCOM	SPP	ABI DP	ABI PT
1001[a]	17	Yes	87%	V	93%	–	7	50	0.97	0.96
1002[b]	23	Yes	302%	–	114%	V	63	53	1.15	1.06
1003[a]	31	Yes	74%	V	100%	–	29	56	CNO	0.51
1004[b]	39	Yes	72%	V	115%	V	60	100	0.84	1.00
1005[c]	27	No	77%	V	123%	V	10	83	1.1	1.10
1006[d]	15	Yes	67%	V	127%	V	50	74	1	CNO
1007	24	No	207%	–	102%	V	25	47	CNO	1.71
1008[c]	39	No	83%	V	94%	–	N/A	N/A	N/A	N/A
1009	10	Yes	11%	V	123%	V	3	20	0.45	0.45
1010[d]	22	Yes	86%	V	120%	V	N/A	N/A	N/A	N/A

Superscripted letters indicate the same patient, V = Vasoconstriction, CNO = Could Not Occlude, N/A = Not Available, Underlined Text = PAD criteria

Discussion: There was no correlation between subjects that showed evidence of vasoconstriction and their baseline vascular studies. Patients with evidence of PAD were no more likely to have vasoconstriction than patients without PAD. Results were also inconsistent for patients that had been enrolled twice per the study protocol. Future studies with more subjects and stricter testing protocols will provide more clarity and limit variability.

F 99

ORAL PRESENTATION TIME: 1418 - 1430
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Use of in-chamber TCOM to determine optimal treatment pressure.

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Introduction/Background: Hyperbaric oxygen (HBO_2) therapy is used to promote healing in select problem wounds. Transcutaneous oxygen measurement (TCOM) can be used to predict response of these wounds to HBO_2 therapy with in-chamber TCOM values of 200-299mmHg and higher having significantly reduced failure rates. In-chamber TCOM values may also be used to determine appropriate treatment pressure while minimizing risk.

Materials and Methods: We performed a retrospective review of patients undergoing HBO_2 for a lower extremity wound with in-chamber TCOM. Data collected included TCOM values, treatment profile, and patient outcome.

Results: We identified 142 patients with 59% healed, 11.3% with minor amputations and 16.2% with major amputations. TCOM measurements were available at 2 ATA for 140 patients and 2.4 ATA for 127 patients. With a TCOM cut-off value of 250mmHg, at 2 ATA 79.3% and at 2.4 ATA 86.6% of patients had TCOM values >=250mmHg. Among those with TCOM <250mmHg at 2 ATA 12 of 29 (41%) attained TCOM >250mmHg at 2.4 ATA. There were 126 patients subsequently treated at 2 ATA and 16 treated at 2.4 ATA. There were TCOM <250mmHg in 13.5% treated at 2 ATA and 43.8% treated at 2.4 ATA. Among those treated at 2 ATA the healing rate was 11.8% if TCOM <250mmHg and 70.6% if TCOM >250mmHg ($p<0.001$). Among those treated at 2.4 ATA the healing rate was 14.3% if TCOM <250mmHg and 33.3% if TCOM >250mmHg (NS).

Summary/Conclusions: Determining appropriate therapeutic pressure for patients undergoing HBO_2 therapy is important to maximize benefit and minimize risk. This study indicates that in-chamber TCOM can be used as an appropriate measure for making this determination in patients undergoing HBO_2 for lower extremity wounds. Nearly 80% of our patients had values >250mmHg at 2 ATA. Meanwhile 41% of those patients not therapeutic at 2 ATA reached therapeutic levels at 2.4 ATA.

F 100

ORAL PRESENTATION TIME: 1430 - 1442
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Long-term follow-up (LTFU) after hyperbaric oxygen or sham chamber sessions in military post-concussive syndrome.

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Introduction: Completed United States Department of Defense clinical trials of hyperbaric oxygen (HBO_2) for persistent post-concussive symptoms (PCS) lack LTFU. We report challenges encountered during LTFU data collection in a cross-section of this study population and the limited results.

Methods: In this observational cohort study, investigators contacted participants from two randomized, controlled trials of HBO_2 for PCS: the Defense Advanced Research Projects Agency/Virginia Commonwealth University HBO_2 (DARPA/VCU) study and US Army HBO_2 for Persistent PCS After Mild Traumatic Brain Injury (HOPPS) study. Participants completed an electronic survey assessing PCS (Rivermead Post-Concussive Symptom Questionnaire), post-traumatic stress disorder (PTSD), anxiety, depression, quality of life, current therapies, and interim trauma. Data are presented as the mean ±1 standard deviation.

Results: Of 132 randomized DARPA/VCU (n=60) and HOPPS (n=72) participants, 40 (30%) completed the survey (42 could not be contacted; 50 declined/were lost to follow-up). Survey participants were male, age 28.1±6.6 years. Most (88%) sustained multiple baseline head injuries. Time from original study randomization to LTFU was 39.2±6.1 months (range 28-51). At LTFU, participants reported continued symptoms of PTSD, depression, anxiety, and reduced quality of life.

Among DARPA/VCU participants, total PCS scores worsened from baseline to LTFU in the 1.5 atmospheres absolute (ATA) equivalent HBO_2 group (mean change 7.4±15.8) and improved in the sham (-8.0±7.7) and 2.0 ATA equivalent HBO_2 group (-3.3±7.4). Individual changes varied widely, range -23 to +28 points. In HOPPS participants, total PCS scores worsened in all groups: local care (mean change 10.5±8.7), sham (7.9±11.9), and 1.5 ATA HBO_2 (1.0±19.4).

Conclusions: In this limited, cross-sectional sample, PCS and PTSD symptoms did not appear to improve over time according to descriptive analyses. Low participation rates and potential response bias limit our ability to perform statistical hypothesis testing and to draw conclusions from these data. Future studies should consider prospective planning of longitudinal follow-up and regular engagement with participants to minimize attrition.

F 102

ORAL PRESENTATION TIME: 1442 - 1454
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Echocardiographic evaluation of intracardiac venous gas emboli following in-water recompression.

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Introduction: Decompression sickness (DCS) is a potentially fatal illness. Optimal treatment is dry recompression with hyperbaric oxygen. In-water recompression (IWR) offers expedited treatment, but has insufficient evidence to recommend it as a treatment option. This trial compares IWR to standard surface oxygen treatment using 2D echocardiography as the semi-quantitative measurement for inert gas loading.

Methods: Divers were randomly assigned to either IWR or normobaric oxygen (NBO_2). A provocative dive profile to 33.5 meters for 25 minutes was used to stimulate bubble formation. After 60 minutes on the surface, bubble scoring was obtained using 2D echocardiography. Divers underwent either the IWR or NBO2 treatment for 82 minutes. Echocardiography was then repeated.

Results/Summary: Pre-treatment mean bubble counts were 28.1bpf (bubbles per echo frame), [+/-13.2 to 43.0 95% CI] for IWR, and 18.3 bpf [+/-0.0 to 39.6 95% CI] for NBO2. After treatment, mean bubble score dropped to 0.1 bpf [+/-0.0 to 0.2 95% CI] (p<0.01) and 1.8 bpf [0.0 to 3.8 95% CI] (p=0.103) respectively. IWR vs. NBO2 reduction of bubble counts was 99.7% vs. 90.1%; however, this was not found to be statistically significant. IWR reduced the central VGE load compared to NBO_2, suggesting that IWR is a viable emergency treatment when a recompression chamber is unavailable.

F 103

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Adjuvant use of hyperbaric oxygen (HBO_2): treatment of complications following orthotopic liver transplantation (OLT) in human: report of 29 cases.

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Introduction/Background: To date, in OLT clinical practice, HBO_2 therapy has been used mostly in cases of hepatic artery thrombosis (HAT), a devastating complication that consists of a complete interruption of arterial blood flow to the graft and almost always causes irreversible damage. HAT is one of the most important causes of graft loss and of post-OLT mortality; its incidence in literature varies (1.6%÷8.9%) and it is more frequent in series, including pediatric recipients and OLT with partial livers (split-liver, living-donor liver-transplantation, reduced-size).

Materials and Methods: At Liver Transplantation Center in Turin, Italy, we have performed 2808 OLTs (1990-March2016), registering HAT, as a post-OLT complication [but also hepatic artery stenosis (HAS) or substenosis], in approximately 4.1% of all cases; only 41% of them eligible to undergo surgical correction, 49% needed retransplantation.
29 patients (26 adults/03 pediatrics) were post-OLT HBO_2-treated (at the HAT, HAS or substenosis stage), as neither could undergo retransplantation nor other conventional therapies could achieve the complete recovery.
Excluded concomitant contraindications to HBO_2, the majority of treated patients exposed to 20 dives, lasting 90 minutes/each, @FiO_2=1, 1Tx/day, @2.5 ATA.

Results: Both hepatic CTscan and/or ultrasonography were applied before, during, after HBO_2 treatment: they have clearly shown HBO_2 efficacy both in prompt recovery of intrahepatic blood flow and in resolution of intraparenchymal abscesses as well.

Pros: There is no need for retransplantation.

Contras/side effects: We have registered one case of mild O_2-mediated neurologic toxicity, easily managed thanks to adequate benzodiazepine administration.

Summary/Conclusions: This adjuvant treatment showed to be safe, well-tolerated and efficient. Also in our experience when associated with other more conventional treatments HBO_2 seems to be the proper choice when the clinical presentation suggests a conservative management in controlling/reducing the severity of HAT, HAS or substenosis after OLT. Moreover, from the direct experience on the ground, it appears that the earlier HBO_2 is delivered in such cases the more effective it shows itself to be.

F 104

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

The use of indocyanine green fluorescence angiography to assess perfusion of chronic wounds undergoing hyperbaric oxygen therapy.

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Objective: Traditional non-invasive methods such as ankle-brachial index or transcutaneous oximetry offer adequate perfusion assessments but are not without limitations. The purpose of this study is to determine the utility of using indocyanine green fluorescence angiography (IGFA) in assessing perfusion of chronic wounds after hyperbaric oxygen (HBO_2) therapy.

Method: From August to November 2015, patients underwent both HBO_2 therapy and IGFA. Near-infrared laser emitting charge-coupled device camera measured the flow of intravenous indocyanine green into the wound. IGFA was done pre-HBO_2 and after ≥ 10 HBO_2 sessions. Ingress and ingress rate pre- and post-HBO_2 were determined using built-in analytical tools. These values were then compared using descriptive statistical methods. The final study will include larger sample size and inferential statistics.

Results: Total of 6 chronic wounds (4 diabetic foot ulcers, 1 failed flap, and 1 crush injury) were identified. Baseline median ingress and rate were 35 units (IQR: 3 to 52) and 2.35 units/sec (IQR: 0.2 to 3.4) respectively. Median ingress and rate after HBO_2 were 123 units (IQR: 19 to 148) and 13.6 units/sec (IQR: 1.7 to 17.3) respectively. Median increase in ingress and rate from before to after HBO_2 were 57.5 units (IQR: 16 to 112) and 7.1 units/sec (IQR: 0.8 to 15) respectively.

Conclusion: This preliminary study shows capability of IGFA to detect change in angiosomal flow characteristics to wounds following HBO_2. Clinicians were able to directly visualize perfusion and obtain quantifiable data. This information may aid in assessing wound healing and in surgical planning to improve outcomes. Results support the use of IGFA to evaluate the effectiveness of HBO_2 in enhancing perfusion to chronic wounds. The final study (of larger sample size) will further clarify the benefit of IGFA to predict potential for wound healing.

F 105

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

The use of hyperbaric oxygen therapy in the treatment of a traumatic thumb amputation and a review of the literature.

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Introduction: Traumatic thumb amputations have profound consequences. The thumb enables both a power grip and a precision grip, allowing the performance of fine dexterous tasks. Current therapies for traumatic thumb amputations include heparin, dependent positioning, stellate ganglion blocks and leech therapy. Timely replantation survival rates of 80% - 90% have been reported. We present a case of the use of adjunctive HBO_2 therapy for these injuries and discuss the relevant literature.

Methods: We utilized HBO_2 therapy, along with reimplantation and wound care, to treat a 25 y/o man who was attacked with a machete. He presented to a Level One Trauma Center, but had to be flown 350 miles for surgical reimplantation. Following surgery, he was lost to care for a month, and represented with a necrotic, dying thumb. He was immediately given state of the art wound care and adjunctive HBO_2 therapy.

Results: At initial follow up, the entire thumb was greatly compromised, with edema, black necrotic tissue and sloughing. After wound care and 30 HBO_2 treatments, the patient thumb was fully salvaged and amenable to a skin graft. The patient can now grasp a cup, and engage in significant ADLs. He is undergoing physical therapy to sharpen his fine motor skills.

Conclusions: The case illustrates the challenges in finding those who will provide emergency replantation, the consequences in the delay to follow up care, and the benefits of state of the art wound care and adjunctive HBO_2 therapy. We find HBO_2 to be a beneficial post-op option for those with compromised digits post replantation, and advocate for further research in this area.

F 106

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Photographic tissue characterization applied to relative quantification related to hyperbaric oxygenation of diabetic foot ulcer: case report.

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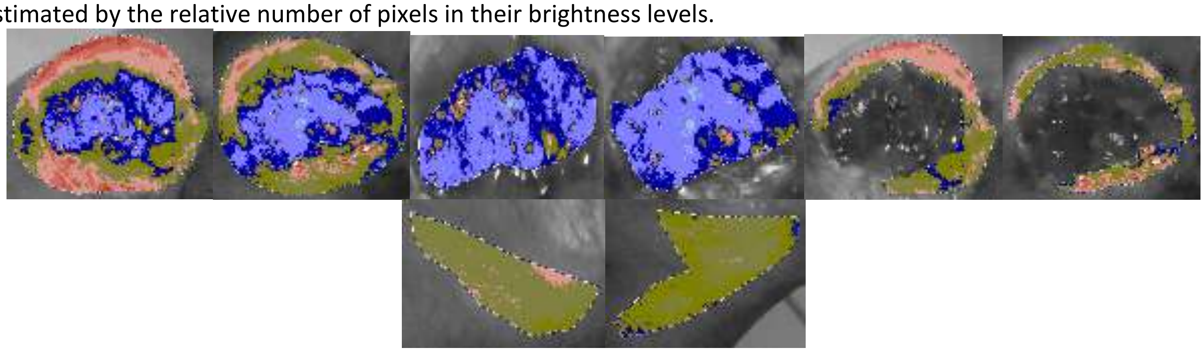
Introduction: Hyperbaric oxygenation (HBO_2) has been a successful treatment method of ulcerated feet of diabetic patients. HBO_2 effects are commonly documented with photography. Characterization of tissue by ultrasonography (CATUS) or by photographic imaging (pCATIM) has been applied to carotid atheromas, kidneys, venous thrombosis and arterial or venous ulcers. pCATIM feasibility to quantitate HBO_2 effects in a foot ulcer of a diabetic patient was investigated.
Methods: Pre and post HBO_2 treatment photographies were analyzed quantitatively based on pixel brightnesses of gray-scale imaging versions. Photographies were re-scaled based on "black and white" references posted at the side of the ulcer. Gray Scale Medians (GSM) were calculated for the entire ulcer, the inner ulcerated core, the ulcer border and the adjacent skin. Percentages of pixels in 14 ranges from 0 to 256 brightness levels were compared.
Results: Entire ulcer GSM brightness decreased from 92 to 77 despite apparently similar pre and post GSMs for the inner core, 60 vs 56, ulcer border, 105 vs 101, and adjacent skin, 105 vs 90. Post-HBO_2 pixel percentages were lower in the 112-153 intervals, 11% vs 29% (p=.0013 by Chi-square) and higher in the 41-111 brightness range, 87% vs 68% (p=.0008).
Conclusion: A case report demonstrated quantifiable relative changes detected by pCATIM post-HBO_2 treatment of a diabetic foot ulcer. Further investigation may determine and quantify brightness variabilities and/or specific GSM data for individual ulcer inner core, border and adjacent skin. Eventually the sizes of each region may be estimated by the relative number of pixels in their brightness levels.



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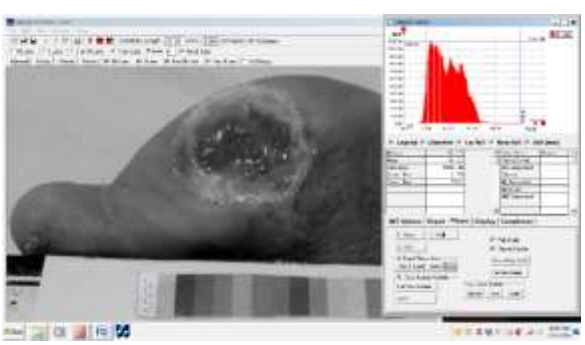

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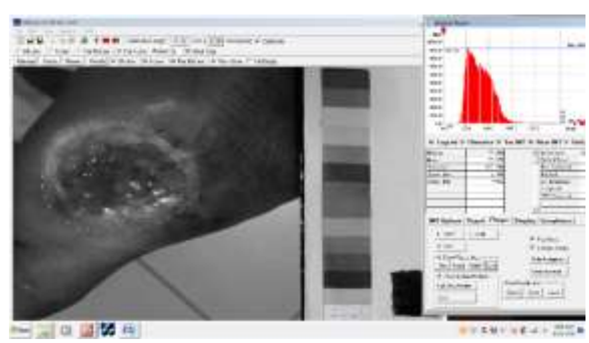

F 107

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Patient outcomes and factors associated with healing in calciphylaxis patients undergoing adjunctive hyperbaric oxygen therapy.

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Introduction/Background: Calcific uremic arteriolopathy, also known as calciphylaxis is a rare syndrome of small vessel calcification of unknown etiology causing painful, violaceous skin lesions that progress to form chronic non-healing ulcers and gangrene. Hyperbaric oxygen HBO_2 therapy can be used as adjunctive therapy in the treatment of these ulcers. However, due to paucity of cases, there is limited data on the clinical benefit of HBO_2 and identifying factors associated with healing. The purpose of this study was to determine patient outcomes and factors associated with healing in patients with calciphylaxis undergoing HBO_2 therapy.

Materials and Methods: A retrospective chart review was completed on 8 patients who were diagnosed with calciphylaxis between May 2012 and January 2016. Clinical outcomes, demographics, risk factors, laboratory values, wound distribution, and HBO_2 treatment profiles, were collected and analyzed.

Results: Out of 8 patients consulted for calciphylaxis, five were consented and underwent HBO_2 (2 males and 3 females). All had coexisting ESRD and diabetes. All males were able to tolerate being in the chamber and received therapeutic treatments (at least 20 HBO_2 sessions) with complete resolution of ulcers. HBO_2 was discontinued in one female due to an inconsistent biopsy report and two others due to death secondary to septic shock or respiratory arrest and severe uremia.

Summary/Conclusion: Calciphylaxis is a devastating disease with a high mortality rate. Our results demonstrated a positive response to HBO_2 especially when receiving at least 20 treatments. A majority of calciphylaxis cases are females and indeed female gender has been cited as a risk factor for this disease. However, current literature has not conferred a relationship between gender nor the number of HBO_2 received and outcomes. Our results showed that males had a more favorable outcome provided they received at least 20 HBO_2 treatments. Further prospective studies are needed to elucidate these outcomes.

F 108

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Mystery gas embolism: a case report.

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Introduction: True "idiopathic" gas embolism is rare. We present a case of significant gas embolism of mysterious etiology.

Case: An 87-year-old man abruptly experienced severe pain on the apex of his head, nearly knocking him off his feet. He called this an "explosion in his head." Upon EMS arrival his symptoms had resolved. Nonetheless, he was taken for further Emergency Department evaluation. A head CT, demonstrating extensive pneumocephalus. Further CT evaluation showed also pneumomediastinum and pneumopericardium.

He denied any numbness, weakness, loss of consciousness, or trauma. He was awake, alert, with a normal neurological examination. The only event different in routine that could be elicited was a dental visit 4 days previous.

Discussion: Gas emboli have been described from numerous iatrogenic causes. A less well-known cause is from pneumatic dental drills. Since Rickles 1963 demonstrated possible air embolism from a root canal as a cause of death, dental procedures have been known to cause gas embolism. These infrequently, but at times, can be fatal as in the case series by Davies 1990, where 3 patients died from cardiac arrest suspected secondary to gas embolism after dental implant surgery.

For the rare case of fatal or obvious clinical gas embolism, there are likely many cases of subclinical gas embolism, particularly venous gas embolism. Gas bubbles have been known to persist for several days. If the dental drill produced an air embolus, it would likely be the longest reported timeframe where subclinical iatrogenic gas later produced a significant clinical response. We discuss the likelihood of this as a source of gas embolism and a literature review of embolism from dental procedures. Factors for and against hyperbaric treatment in such a patient are reviewed. Emergency Department evaluation should consider dental procedures, even several days in the past, as possible sources of gas embolism.

F 109

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Arterial gas embolism after bone marrow biopsy successfully treated with hyperbaric oxygen therapy: a case study.

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Introduction: Gas embolism is entry of gas into the vascular system from either arteries, veins, or both. It is a potentially life-threatening event, which can result in high morbidity and mortality. Venous gas embolism occurs when gas enters the venous circulatory system usually from iatrogenic causes, invasive procedures or other surgical procedures.

Materials and Methods: We report on a 64-year-old male who had sustained a right humeral fracture after a mechanical fall. During his hospitalization a bone marrow biopsy was performed as part of a heme/onc work-up for thrombocytopenia and anemia. 24 hours later he developed atrial fibrillation with tachycardia and hypotension. A TEE performed showing severe RV strain and pulmonary hypertension suggestive of pulmonary embolism. Non-contrast CT showed extensive intravascular air within the arterial and venous structures as well as air within both the right atrium and ventricle, pulmonary artery, ascending thoracic aorta, and left brachiocephalic vein. The patient was transferred from an outside facility for emergent hyperbaric oxygen therapy in setting of gas embolism.

Results: The patient underwent 2 hyperbaric oxygen treatments with a 7-hour break in between treatments. There was no decompensation during decompression with either treatment. Repeat CT Chest performed after HBO_2 therapy #1 revealed resolution of intravascular air in the aorta, pulmonary artery, and right and left ventricles.

Summary/Conclusion: Air and fat emboli have been known to occur following arthroscopic and other open orthopedic procedures. However, it has never been reported in the setting of bone marrow biopsy to date. Our patient developed hemodynamic instability 24 hours after undergoing bone marrow biopsy with evidence of air within vascular tree who was successfully treated for arterial gas embolism.

F 110

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Use of indocyanine green fluorescent angiography in a hyperbaric patient with soft tissue radiation necrosis.

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Introduction: Indocyanine green fluorescent angiography (ICFA) is emerging as a useful adjunct for hyperbaric oxygen (HBO_2) therapy patients. ICFA is commonly used to assess vascularity in patients with non-healing lower extremity wounds. We describe the use of ICFA to measure vascularity and to create an appropriate HBO_2 regimen in a patient with soft tissue radiation necrosis (STRN) of the breast.

Case Report: A 67-year-old female with a history of right breast cancer treated two years previously with lumpectomy and radiation therapy, developed open wounds in the right breast area. Oncologic evaluation revealed no evidence of recurrent malignancy. A diagnosis of STRN was established, and the patient completed twenty HBO_2 treatments followed by surgical excision and closure. Intraoperative ICFA demonstrated a focal area of hypovascularity at the medial margin of the incision. Due to a concern of suboptimal vascularity, the patient returned for additional HBO_2 treatments. ICFA was performed after eight postoperative HBO_2 treatments, and showed improved vascularity in the previously identified area of concern. Uncomplicated wound closure was achieved in the right breast wound, and the patient healed fully using this combined approach.

Discussion: The hypovascularity noted intraoperatively in this case may have occurred secondary to surgically induced mechanical vascular damage or radiation soft tissue injury. Studies of patients previously irradiated for head and neck cancer suggest that HBO_2-induced vascularity is apparent after approximately eight HBO_2 treatments and peaks around twenty treatments. The results from this case substantiate this, but indicate that the doses of HBO_2 needed for adequate neovascularization in patients with STRN may be variable.

Conclusion: The use of ICFA may provide additional insight regarding the degree and timing of HBO_2-induced angiogenesis. Further studies are required to establish the correct number of HBO_2 treatments required for adequate angiogenesis in previously irradiated patients with STRN.

F 111

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Use of hyperbaric oxygen therapy for vasopressor-induced ischemic necrosis.

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Introduction: Ischemic necrosis of digits can occur after the administration of high dose vasopressor agents. We describe the use of hyperbaric oxygen (HBO_2) therapy as a limb salvage adjunct in a patient with bilateral hand and foot ischemic necrosis after vasopressor use.

Case Report: A 61-year-old male with a history of GERD and BPH, developed prostatitis and septic shock after a transrectal prostate biopsy. Due to multisystem organ failure, treatment with high dose vasopressor agents was initiated which resulted in purple discoloration of his digits. The patient was initially treated with nitroglycerin infusion and paste; thrombocytopenia precluded the use of heparin infusion. After he stabilized medically, he was noted to have gangrene of the plantar aspect of his feet bilaterally, as well as all fingers and toes. Finger amputations were performed, and bilateral below knee amputations were considered. In an attempt to preserve his lower extremities as much as possible through optimized tissue oxygenation and vascularity, daily therapy treatments to 2.5 ATA were administered in conjunction with serial debridements of his feet. The patient eventually underwent bilateral transmetatarsal amputations, and it was determined that enough residual tissue was present to allow for future salvage of both feet using microsurgical free flaps.

Discussion: Traditionally, ischemic gangrene has been managed conservatively, with observation for demarcation followed by eventual amputation. The use of an aggressive and multidisciplinary limb salvage approach, including HBO_2, can reduce the degree of tissue loss, improving functional outcomes and avoiding proximal amputations in patients who have vasopressor-induced ischemic necrosis.

Conclusion: Vasopressor-induced ischemic necrosis can lead to significant tissue destruction and functional impairment. An intensive combination of surgical care and therapy can optimize tissue preservation and should be considered for patients with this condition.

F 112

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME:
RESIDENT/TRAINEE COMPETITION:

The impact of hyperbaric oxygen therapy on the vegetative state patients with different ages and duration of disease.

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WITHDREW

F 113

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Successful treatment of cutaneous nocardiosis with hyperbaric oxygen therapy.

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Introduction: Nocardia are gram-positive, aerobic bacteria of the order *Actinomycetales* that are commonly found in soil. Norcardia infections are rarely encountered in clinical hyperbaric practice, but may be easily misdiagnosed due to their nonspecific clinical presentations. Cutaneous Norcardia infections may benefit from treatment with hyperbaric oxygen (HBO_2) therapy. We describe the successful use of HBO_2 in the management of a traumatic wound complicated by nocardiosis.

Case Report: A 66-year-old non-diabetic male with a history of bilateral total knee replacements, sustained a laceration to his right knee while hiking in Colorado. The wound was irrigated and sutured in a local Emergency Department within hours of the injury. When the patient presented for suture removal two weeks later, gravel was noted within the wound. The patient underwent urgent operative debridement; deep wound cultures grew Nocardia cyriacigeorgica. He underwent serial debridements, received topical wound care, and took oral doxycycline based on an infectious disease consultant's recommendations, but the wound failed to heal for two months. Due to concern for potential infection of his prosthetic knee joint, the patient was referred for adjunctive HBO_2 to facilitate improved healing of the wound. Daily HBO_2 treatments to 2.5 ATA were administered. The wound healed completely after administration of 16 HBO_2 treatments, and the artificial knee remained stable and uninfected.

Discussion: Norcardia species exhibit resistance to the bactericidal effect of neutrophils; this may be secondary to increased catalase and superoxide dismutase activity. HBO_2 administration results in increased superoxide concentrations which may decrease the activity of these enzymes, leading to restoration of neutrophil-induced phagocytosis and elimination of Nocardia.

Conclusion: HBO_2 represents an effective adjunctive treatment modality for cutaneous Nocardia infections, especially those that are resistant to standard wound care techniques.

F 114

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Serious concerns with Toronto hyperbaric oxygen (HBO_2) treatment for diabetic foot ulcer (DFU) study: use and abuse by health institutions and authorities.

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Introduction and Background: Many health jurisdictions have health technology assessment agencies (HTAA) with a stated goal of ensuring appropriate cost-effective technology use. In Ontario, these include the Program for Assessment of Technology in Healthcare (PATH, McMaster University, Hamilton) and Ontario Health Technology Assessment Committee (OHTAC, part of Health Quality Ontario (HQO), a provincial Government agency). The study by Fedorko, et al.[1] at University Health Network (UHN, University of Toronto) was funded by OHTAC, overseen by PATH and claims no benefit of HBO_2 for DFU. Concerns exist about the study and potential Institutional Conflicts of Interest (ICOI) as defined by Tri-Council Policy Statement (TCPS2).

Materials and Methods: The actions of health authorities related to the study were reviewed.

Results: In 2011, a PATH report to OHTAC of early trial data was made available to the General Hospital in an attempt to end HBO_2 in Hamilton. Another, 2012, confidential report to OHTAC claimed no benefit. In March 2013 PATH published a meta-analysis that recommended against HBO_2 for DFU, without awaiting final trial data. During 2014 summer holidays, 18 months before the Fedorko publication[1], OHTAC released recommendations against funding HBO_2 for DFU based upon two meta-analysis papers (one by PATH) and preliminary study results. Public representations led to withdrawal. In 2015 OHTAC commissioned an "external" review of the 2 meta-analysis papers by another OHTAC member, a committee that included the PATH trial principal investigator (also first author of the PATH meta-analysis). It supported the PATH position. Public complaints led HQO to establish an "independent" review in December 2015, tasked with considering publications until January 31, 2016. Prior knowledge of the 2016 Fedorko publication could only come from cooperation with the authors.

Summary/Conclusions: These events risk undermining confidence in the impartiality of HTAA/OHTAC and raises concerns of possible ICOI, particularly considering the absence of any relationship between criteria and actual amputations.

F 115

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Serious concerns with Toronto hyperbaric oxygen (HBO_2) treatment for diabetic foot ulcer (DFU) study: science and ethics.

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Introduction/Background: Concerns about a recent publication by Fedorko, et al. in Diabetes Care[1], claiming to demonstrate no benefit from HBO_2 for DFU, prompted detailed scrutiny.

Materials and Methods: The manuscript and references cited, along with other study-related documents were reviewed. Amputation data was analyzed using the Fisher Exact test.

Results: The methods in the Fedorko paper[1] did not match the previously published protocol[2], clinical trial registration[3], or REB-approved protocol, all of which mention physical examination of patients for determining the primary outcome (PO), freedom from having or meeting criteria for amputation (CA). Instead, only digital photos (DP) were assessed. The CA included pain, weight-bearing and risk of infection, none of which may be assessed from DP. Neither the CA nor the use of DP for determining CA have been validated. The references[4,5] cited by Fedorko did not assess amputation or support use of DP for this purpose, finding less reliability for diabetic leg wounds and overdiagnosis of cellulitis, infection and erythema. A single surgeon assessed DP and inter- and intra- observer variation were not studied. Fedorko did not disclose cross-over after 12 weeks to open label hyperbaric treatment or the reduction from 18 to 12 weeks for PO assessment after study start, reducing the opportunity to find a difference between groups. No relationship was demonstrated between CA -51 patients, intention-to-treat; 37 per-protocol and real amputation (RA) (1 patient); and Fisher Exact test demonstrated $p<0.0001$ for both. The CA rates therefore exceeded RA by a factor of 51 and 37 respectively. The power analysis relied upon studies of RA up to one year, not CA at 12 weeks. The major "amputation" rate of about 23% greatly exceeds all previous studies.

Summary/Conclusions: This review strongly suggests that the scientific methods, power analysis and REB approval for the Fedorko study were invalid.

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F 116

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Implantable cardioverter-defibrillator placement complicated by cerebral arterial gas embolism.

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Introduction/Background: Cerebral arterial gas embolism (CAGE) is an extremely rare complication of implantable cardioverter-defibrillator (ICD) implantation. We present a case of CAGE following ICD implantation leading to focal neurologic deficits and requiring hyperbaric oxygen (HBO_2) therapy.

Case: A 55-year-old male with a past medical history significant for coronary artery disease and left ventricular dysfunction presented for primary prevention ICD implantation. During placement of the axillary sheath and while under mild sedation, the patient was noted to take several deep inspirations. Shortly thereafter, there was a hemodynamically stable decrease in oxygen saturation, which resolved with an increase in oxygen flows via face mask.

After one hour in the post anesthesia care unit, the patient complained of fluctuating right upper extremity paresthesias and demonstrated mild ataxia. A computed tomography (CT) of the head demonstrated no intracranial pathology. However, the patient's symptoms subsequently worsened, including progression of the right upper extremity numbness and development of a tremor in the right hand. CT angiogram (CTA) of the head and chest showed a curvilinear density consistent with gas within two parietal branches of the left middle cerebral artery (MCA) and a similar density in the left cardiac ventricle. The patient was emergently treated with HBO_2 via a United States Navy Treatment Table 6. By the second oxygen period, the patient's symptoms had resolved completely. He was subsequently discharged with no neurological deficits.

Discussion: CAGE is a rare, but potentially devastating complication, of many intravascular procedures. Although there is a case report of CAGE following ICD lead extraction, to our knowledge, this is the first report of CAGE secondary to ICD implantation.[1] Risk factors for air embolism during ICD implantation include coughing/deep breathing, advanced age, preoperative sedation, and large caliber sheath.[2] Prudent suspicion for this complication and swift treatment are vital for optimal outcomes.

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ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Hyperbaric oxygen use in cancer treatment.

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Introduction/Background: Cancer encompasses multiple specific diagnoses depending on the primary organ system involved; therefore, the physiological approach to treatment likewise will vary. In addition to physiology differences based on the primary site, even more variation in treatment approach is based on stage, interventions tried or planned, and the co-morbidities of the individual patient.

Materials and Methods: A literature review was done by residents and staff focusing on finding articles relevant to the use of hyperbaric oxygen (HBO_2) in the realm of cancer treatment. Online search for articles was done in collaboration with the Franzello Aeromedical Library at the U.S. Air Force School of Aerospace Medicine, 711th Human Performance Wing, Wright-Patterson Air Force Base, Ohio.

Results: Residents and staff found many instances where HBO_2 has been used in the treatment of cancer patients. In some cases, it was used to treat complications secondary to other treatment such as a non-healing wound. In other cases, it was used as an adjunctive treatment to surgery, chemotherapy, or radiation therapy. Benefits of its use in carefully selected patients included improved quality of life, and in some patients, it may have contributed to prolongation of quality life as well as perhaps to survival until death due to a different cause.

Summary/Conclusions: In carefully selected patients, HBO_2 may be a useful option in the treatment of patients with cancer. It has been shown to be useful in the treatment of complications such as a non-healing wound. In addition, it has been used as an adjunct with other treatment methods such as surgery, chemotherapy, and radiation therapy. Research may show additional ways that HBO_2 may be of benefit to cancer patients.

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ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Hyperbaric oxygen therapy: role in skin grafting.

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Introduction: Hyperbaric oxygen therapy (HBO_2) promotes healing of compromised myocutaneous tissue flaps. Positive reports of improved skin graft survival after HBO_2 preconditioning and HBO_2 treatment of newly grafted skin flaps is noted.

Qi et al reported HBO_2 preconditioning in rats increased the size of flap tissue survival with a reduction in inflammatory markers, IL-1Beta, TNF-alpha, and IL-6 and improved microcirculation compared to controls. (1) Liu et al reported HBO_2 preconditioning promoted neovascularization by increasing SDF-1 and CXCR4 in transplanted skin flaps in rats. (2) Xiao et al reported HBO_2 preconditioning inhibited skin flap apoptosis in a rat ischemia-reperfusion model as indicated by increased expression of Bcl-2 and inhibited pASK-1 and Bax expression. Caspase-3 activity and Bax/Bcl2 ratio declined in the HBO_2 treated rats. (3) Kang et al reported that HBO_2 preconditioning attenuated HMGB1 and NF-kB inflammatory proteins during ischemia-reperfusion injury. (4) These rats had pedicle vessel flaps created after HBO_2 pretreatment at 2.0-2.5 ATA for 1-2 hours 1-2 times a day for 2-5 consecutive days.

Rech et al reported less tissue necrosis and increased collagen in rat skin flaps treated with HBO_2 2.4 ATA for 2 hours for 7 consecutive days after undergoing skin flap grafting. (5)

Methods: This patient, photos below, experienced necrotizing fasciitis of his right upper extremity and torso. He underwent surgical debridement of necrotic tissue followed by 1 pre-graft and 14 post-graft HBO_2 treatments, 2.4 transitioning to 2.0 ATA, 85-90 minutes each.

Results: The patient achieved significant surgical wound coverage healing via autologous skin grafting and limited tissue flap reconstruction after surgical debridement, facilitated by HBO_2 therapy.

Summary/Conclusions: HBO_2 provided as preconditioning and post grafting likely promotes skin grafting success.

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F 119

ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Hyperbaric oxygen therapy for osteomyelitis.

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Introduction: Presently, various antibiotics have been developed, but antibiotics alone are insufficient to kill the osteomyelitis bacteria as osteomyelitis is an infection of the bones and joints. We carried out Hyperbaric oxygen (HBO_2) therapy with antibiotics in many patients since 1981. This report shows the results of treatment for the last thirty-five years.

Method: The following research was carried out from June 1981 to December 2015 at Kawashima Orthopaedic Hospital. We carried out HBO_2 in all 773 cases. In addition to HBO_2, almost all of these cases were treated with antibiotics and/or surgical intervention. HBO_2 was carried out under the condition of 2 ATA 60 minutes per day. “Closed-irrigation-suction-therapy” was only carried out if the case was unchanged or became worse.

Recently we use "ozone (O3) nano-bubble water” (NBW3) in the “closed-irrigation-suction-therapy” resulting very favorably. The main feature of the "ozone nano-bubble" is that it has excellent antiseptic capabilities against bacteria.

Result: "Good" here means symptoms were eliminated, while "Fair" means symptoms clearly improved and "Poor" means symptoms showed little improvement. The results of HBO_2 – 418 cases of 773 cases (54.1%) were in the “Good” outcome, while 63 cases (8.2%) were in the “Fair” outcome and 292 cases (37.7%) were in the “Poor” outcome. “Closed-irrigation-suction-therapy” was only carried out in 265 cases. The results of “Closed-irrigation-suction-therapy” group, 209 cases (78.9%) were in the “Good”, while 42 cases (15.8%) were in the “Fair” and 14 cases (5.3%) were in the “Poor”. The results of all 627 osteomyelitis cases (81.1%) in the “Good” outcome, while 105 cases (13.6%) in the “Fair” outcome and 41 cases (5.3%) in the “Poor” outcome.

Conclusion: HBO_2 was thought to be an effective treatment, but HBO_2 alone was insufficient. However, good results were obtained by using a combination therapy of HBO_2 and "closed-irrigation-suction-therapy" plus NBW3.

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ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Fluorescence microangiography to guide management of non-healing wounds.

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Introduction/Background: Treatment of non-healing wounds is often complicated by poor perfusion. Tissues need a constant supply of blood and oxygen to ensure adequate wound healing. Currently, the most reliable method for assessing these wounds is clinical gestalt. TCPO2 is often used to measure tissue perfusion, though this modality has multiple drawbacks. Fluorescence microangiography is increasingly being recognized as a useful tool by providing real-time visual and quantitative assessments of perfusion to guide treatment decisions in patients with complicated wounds. We discuss two patients whose management changed based on the results of their microangiography studies.

Materials and Methods: Two patients with non-healing wounds underwent evaluation with the LUNA fluorescence microangiography device. After consent and time out, a peripheral IV is started on the patient for the injection of 2.5mL indocyanine green (ICG) dye. A still photo of the target is taken for future reference. We then inject the ICG dye followed by a saline flush. Images are obtained at 7.5 frames per second and capture the ingress and egress of ICG dye to the target area.

Results: The first patient is an 87-year-old woman with ischemic changes to the 4th and 5th digits of her right foot. Initial plan was to perform a transmetatarsal amputation. After evaluation with fluorescence microangiography she underwent a 4th and 5th digit amputation and went on to heal without complication.
The second patient is a 63-year-old man with a history of PAD and a non-healing post-surgical wound from a great toe amputation. Based on his fluorescence microangiography evaluation his initial hyperbaric course of 20 treatments was extended to 30 treatments and he ended up healing well.

Summary/Conclusions: Fluorescence microangiography is a promising tool in the evaluation of complex wounds.

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ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Endoscopic bubble trouble: hyperbaric oxygen therapy for cerebral gas embolism during upper endoscopy- case reports and literature review.

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Gas embolism is a rare but potentially devastating complication of endoscopic procedures. We describe three cases of gas embolism which were associated with endoscopic procedures (esophagogastroduodenoscopy (EGD) and endoscopic retrograde cholangiopancreatography (ERCP). We treated these at our hyperbaric medicine center with three different outcomes: complete resolution, death and disability. We review the literature regarding this unusual complication of endoscopy and discuss the need for prompt identification and referral for hyperbaric oxygen therapy (HBO_2). Prevention, mitigation, mechanisms, diagnosis and additional adjunctive therapies are also discussed.

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ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Early treatment of frostbite with hyperbaric oxygen.

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Introduction/Background: Hyperbaric oxygen (HBO_2) therapy is often considered appropriate treatment for frostbite[1-7]. Supportive evidence is limited although there is a plausible mechanism of action for tissue salvage. Damage to human tissue in clinical frostbite results from increased viscosity and thrombus formation leading to endothelial inflammatory cascade with further congestion, stasis, circulatory collapse and plasma leakage. HBO_2 decreases edema, improves oxygenation to compromised ischemic tissues while sustaining cellular metabolic needs acutely, and inhibiting ischemic-reperfusion injury[9].

Treatment goals: maintain normal tissue oxygenation, support marginally perfused tissue with enhanced oxygenation to reduce edema, optimize the preservation of neuro-muscular function, and mitigate effects of ischemic-reperfusion injury thereby minimizing tissue loss and reducing risk for loss of limb or function.

Methods/Results: Patient #1: 18 y.o. male, hiking mountain trail on a sunny winter day wearing cotton socks and tennis shoes. Hiked 4 of 7 miles in knee deep snow, losing the left shoe in the snow. Moderate frostbite diagnosed on plantar surface of left foot and all toes bilateral. Pentoxifylline[8,10,11] and HBO_2 therapy was initiated within 3 hours of rewarming. Thirteen total treatments were given BID over 6 days with full resolution and no loss of tissue.
Patient #2: 19 y.o. male attending wilderness behavioral camp. Walked in snowy conditions for 24 hours in boot shell only – felt liners removed. Presented to clinic 24 hours after rewarming with moderate frostbite of all toes. Received 13 HBO_2 treatments over 10 days (BID x 4, QD x 6). Minor dermal loss to distal digit tips only.
Patient #3: 41 y.o. male construction worker in subzero weather developed severe frostbite of bilateral middle fingers. HBO_2 initiated within 24 hours post rewarming. (16 BID treatments over 9 days). Minimal tissue loss over distal pads only.

Summary/Conclusion: Early adjunctive use of HBO_2 treatments may improve tissue/limb salvage following Frostbite injury.

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ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: No

Early institution of hyperbaric oxygen therapy for decreasing complication of air embolism.

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Introduction: Early identification and treatment of air embolism can prevent life threatening and functionally debilitating outcomes.

Case Report: A 64-year-old male arrived at Wound Healing Center for evaluation and immediate HBO_2 treatment of air embolism in Left Ventricle apex. Complications arose during atrial fibrillation ablation procedure that was conducted a few hours earlier. During the procedure. Patients became hypotensive and a 12-lead ECG detected ST elevations in the inferior leads indicating acute MI or possible air embolism down the coronary artery. The patient was stabilized but coronary angiography, Flouroscopy Images and TEE showed evidence of air embolism to Left Ventricle apex that was suspected to have occurred during trans-septal access. Aspirations were attempted to remove air embolism but flouroscopic images continued to show residual air pockets. Sheaths in left common femoral artery and right common femoral artery were left in place post-surgery and patient was sent to ICU for stabilization before reporting for emergent HBO_2 treatment to dissipate residual air. Patient was alert and oriented with no neurological symptoms present upon arrival to hyperbaric center. We used TcPO2 monitoring via chest lead placement on left 3rd intercostal space to evaluate effectiveness of air-breaks and predict patient stability. Patient received one HBO_2 treatment using U.S. Navy Treatment Table 6. Post treatment, a CT Angio report revealed the absence of air embolism in the left ventricle and remainder of the heart. Patient was observed for 24 hrs and then discharged with no complications.

Discussion: In patients with air embolism who already develop neurological sequele or other complications. Blanc P, et al. found, Patients treated with HBO_2 sooner than 6 hours had a better outcome than those treated later. In our case, patient has not embolized air from the heart. Air pocket in the heart was diagnosed early as a cause of patient's hypotension and EKG's changes. Immediate treatment with HBO_2 therapy caused complete resolution of air pocket in the heart in follow-up images. Authors of this abstract recommend education for early diagnosis of air embolism and treatment within 6 hrs to prevent further complications and sequele of air embolism

Conclusions: We stress the beneficial effect of an early HBO_2 treatment in air embolism. Hyperbaric oxygen therapy could be safely used in a monoplace setting to prevent complications from air embolisms. Authors stress the beneficial effect of an early HBO_2 in air embolism even before embolism and neurological sequele occur. Authors also recommend increased awareness and education of physician so that early diagnosis and treatment with hyperbaric oxygen therapy can be instituted.

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ORAL PRESENTATION TIME:
POSTER PRESENTATION TIME: 1530 - 1600
RESIDENT/TRAINEE COMPETITION: Yes

Carbon Monoxide Poisoning Rates and Median Household Income in Philadelphia.

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Background:

- Socioeconomic status (SES) is a known risk factor for both burn incidence and burn severity and can be measured using several epidemiological markers including GDP, median household income (MHI), property values, and housing quality.
- The relation of socioeconomic status to the incidence of carbon monoxide (CO) poisoning in the city of Philadelphia is unknown.
- The objective of this study is to perform an analysis of the relationship between the incidence of patients requiring hyperbaric oxygen therapy (HBOT) for CO poisoning and socioeconomic status using median household income (MHI) as a surrogate.

Study Design:

- Retrospective patient information was collected from 2009 to 2015 on all patients receiving hyperbaric oxygen treatment at the Hospital of the University of Pennsylvania (HUP) for carbon monoxide poisoning. Patients were excluded from final analysis if they did not possess a postal code from Philadelphia or if postal codes were not obtainable from patients charts. The subject's postal code was linked to median house hold income obtained via US census data. Mantel-Haenzel chi-squared test was used to evaluate significance of the results.

Results:

- 212 patients were included in the study. No statistically significant correlation between MHI and the incidence of CO poisoning. Patients from higher MHI postal codes more likely to be admitted. Suicide attempts not excluded from this study. Initial serum COHB values on presentation to HUP ED unreliable as many patients transferred from outside hospital and many diagnoses made based on CO-oximetry.

Discussion/Conclusions:

- Median household income is not a reliable indicator of predicting CO poisoning incidence in Philadelphia, however other markers of SES are not ruled out.
- One limitation of this study is that of retrospective review, where missing or inconsistently recorded data in some variables can limit the interpretation of results. Only well recorded variables were used in the analysis.
- Deaths from CO poisoning are a preventable public health problem. High risk populations should be identified and targeted with preventive measures such as CO detector distribution and education about indoor combustion device safety.

Plenary Session
"International Perspectives on Hyperbaric Oxygen Therapy"
PANEL
4:00 PM – 5:00 PM

ABOUT THE LECTURE:

Jacek Kot, MD, PhD
Assoc. Professor National Centre for Hyperbaric Medicine, Gdynia, Poland; ECHM General Secretary
email: jkot@gumed.edu.pl
Lecture Titles: ***Preliminary report on the ECHM Consensus Conference 2016 conclusions on Clinical Indications for HBOT***
Dr. Jacek Kot will introduce *the new European consensus conference guidelines.*

Gerardo Bosco MD PhD
Assistant Professor, Dept. of Biomedical Sciences, Master II level in Hyperbaric Medicine, University of Padova, Via Marzolo 3, 35131 Padova, Italy
email: gerardo.bosco@unipd.it
Lecture Title: ***Femoral Head Necrosis and HBO_2***
Dr Gerardo Bosco (VP candidate#1) will give detailed information on the newly accepted and upgraded indication Femoral Head Necrosis.

Nicklas Oscarsson, MD
Hyperbaric Unit, Sahlgrenska University Hospital/Östra, 414 76 Göteborg, Sweden
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Lecture Title: ***The Nordic HBO_2 Registry - From Idea to Reality***
Dr Nicklas Oscarsson (VP candidate #2) will describe an important research tool The Nordic HBO2 Registry -From idea to reality.

Lind Folke MD, PhD, FUHM
Assistant Professor, Karolinska Institutet, Stockholm Sweden.
email: Folke.lind@gmail.com
Brain Abscesses and HBO_2
Dr Lind will describe a clinical publication on Spontaneous Brain Abscesses.

AUTHOR LISTING


Undersea & Hyperbaric Medical Society's
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